

# Agriculture Based Recommender System using IoT – A Research

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**Abstract**—In today's world, IoT (Internet of Things) plays an important role in human life simply by allowing objects to be sensed or remotely controlled through other existing networks. Traditional farming methods with some recommendations will save time and effort. In this paper, we have planned to use technologies such as IoT, Machine Learning and Cloud computing to recommend to farmers the type of crop to be grown on the basis of available resources, climate, rainfall, temperature, market prices, area of land, past crop yield and other parameters, thereby reducing the effort and time required for different agricultural processes. In considering the above parameters, it is recommended that farmers grow and the type of pesticides and water supply be used from time to time. The system can help farmers produce suitable crops. As a result, they can improve their lifestyles and help society more. In this paper, we present an attempt to predict the yield and price of crops that a farmer can obtain from his land by analyzing past data patterns. It gives them an overview of the recommendation to grow the plant until the crop is sold. Therefore, provide a comprehensive guide to help farmers in their agricultural work.

**Keywords:** Agriculture, Recommender system, Machine Learning, IoT.

## I. INTRODUCTION

The days are gone when the planet relies heavily on agriculture and agriculture currently depends on the planet. Agriculture is something people have started to dazzle about, forgetting that it is what keeps America alive. However, some tireless, choleric farmers still live on farming. However, there is also corruption, which is growing considerably today. The main motive of the Department of Agricultural Promotion & Agricultural Business is to honestly have a good value for the United Nations farming community agency behind this competitive promotion situation, and the mission of achieving fair value is to create the current act and rules that are robust and more practical by implementing new technologies and techniques aimed at achieving fair value. The main purpose of establishing a regulated market is to eliminate unhealthy trade follow - up, to reduce market expenditure and to provide farmers with honest costs. Many initiatives are taken to promote agriculture so that rural

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economic development is promoted and maintained [1].

A recommendation system can be defined as a software

class that helps users to obtain the most appropriate products based on their preferences, needs or tastes [2]. It applies knowledge discovery techniques to the problem of personalized information, products or services recommendations during a live interaction between e-commerce, social media, and content-based websites. It can also be used effectively in the agricultural sectors with its immense power [2].

Today, we are in a world of smart devices and we use a network called the Internet of Things (IoT) to connect these devices. In today's world, IoT is evolving to a greater extent so that around 50 billion objects will be connected to the

Internet in 2020 [3]. IoT can be seen from speakers to home automation to smart doors and smart TV 's in various places. Each device can be connected, interacted and connected using other technologies such as wireless sensor networks, cloud computing, radio frequency identification or any other means [3]. In order to benefit agriculture from new opportunities for global market access, the country's internal agricultural marketing system must also be integrated and strengthened. In particular, the market system must be revitalized to [1]:

- provide incentives for farmers to produce more;
- transmit to producers the changing needs of buyers to enable production planning;
- promote true competition between market players and
- increase farmers' share of the ultimate price of their agricultural products.

Agriculture is our country's backbone. Although industry and other sectors have made India a diverse country, the majority of the population is still dependent on farm products. Many authors have presented their work with IoT in the area of intelligent agriculture work.

## II. RELATED WORKS

Kanaga Subha Raja et al., [1] proposed a recommendation system based on rainfall, temperature, and other area parameters and suggesting the right crops. Based on crop yield and current market price, it is recommended that farmers obtain high yields and profits. Mokkaram and Arefin [2] has used an algorithm called Upazila Selection and uses the current seasonal detection for the harvest recommendation. It calculates on the basis of agro-climatic data and an agro-cultural background to recommend correct

harvests at the right season.

Pudumalar et al., [3] used the data set comprising the attributes of the soil and other test results for consideration and used precision farming techniques to increase productivity and profitability. Shampa and Aseem [4] have made recommendations based on the available weather data and climate conditions. They used the Hidden Markov model to represent the weather and predict advice. Their weather analysis demonstrates a much-improved recommendation system.

Navya Sri [5] have used scalable graph-based collaborative filtering recommendation algorithm, unlike central recommender system which depicts the correct representation using the graph and another picture format. This enhances the accuracy and coverage area. Takashi Okayasu et al., [6] described their use of algorithm and devices for affordable field environmental monitoring and plant growth measurement system for smart agriculture. The sensors are used to measure plant height, leaf color, and other characteristics.

Zhao and Bai [7] have used IoT technology in conjunction with the remote monitoring system, the main objective of which is to collect and alert the agricultural production environment in real time through SMS. This paper gave the farmers a better understanding of how to sow and take care of the products. Lai and Zeng [8] used technologies such as Big Data, IoT and cloud computing to improve the yield of crops. This model analyzes the sequence of crops, the next crop to be grown, fertilizer requirements, etc. This model facilitates the estimation of total production and fertilizer requirements

per crop, as well as the control of the costs of agricultural products.

Ren and Lu [9] submitted a paper using a recommendation system based on humidity and humidity control that collects the data sets required from the geographical area to be grown and the type of fertilizer to be used. Increase the productivity of the crop. Mekala and palanisamy [10] used an algorithm to predict the growth rate of crops based on the resources provided, recommending the requirements to be supplied during the growth on the basis of the type of crop.

Vin Gia Nhi et al., [11] aims to include all the important factors for the successful production of crops. It comprises all major sensors and implements IoT technology for seed recognition with image processing. PI for raspberry is used. The sensor data, which was easily accessed by the Android app and the experiment, was a success. Feng et al., [12] presented recommendations on the application and improvement of the intelligence of agricultural information and the IoT prior algorithm for the use of sensors to collect information and process data and make recommendations based on them.

### III. COMPARISON OF DIFFERENT RECOMMENDER SYSTEM FOR AGRICULTURE USING IoT & RESULTS

Table 1 gives us a picturesque idea of the methods used by various smart agriculture researchers with IoT. It also gives the list of recommendations that we thought might in future have been implemented in the system.

**Table 1. Comparison of different recommender System for agriculture by using IoT**

Ref. No	Objective	Concept Used	Results/ Outcome	Advantage	Disadvantage	Recommendation
#1	In this paper based on climate yield and to the farmer about rainfall and temperature.	IoT	By applying this technique, the farmers will be benefited and improvement in yielding of crops.	It increases the crop rate by 3%.	More sensors can be used in order to have a complete summary of the crop health, produce and the soil conditions as well. Battery energy consumption can be more as for every node, the sensors need the batteries.	Solid ph. can be implemented here.
#2	In this users location and different agro-ecological and agro climatic is taken and calculated using the Pearson correlation similarity technique.	IoT	In this paper based on the algorithm and data sets collected recommendation of crops are made at upazil level.	It increases the production rate by 7%	The use of an expert system and IoT is an excellent way to improve the crop rate.	The use of advanced technologies like physiographic mechanism can be used here.

#3	Precision agriculture which is the modern farming techniques the approach used here.	K nearest Neighbors and naïve random tree technique	In this technique, it was more productive and more profit and it helped many to plant the right crop at the right time.	The use of an expert system and IoT is an excellent way to improve the crop rate.	The expert system does tell about the herbicide and pesticide recommendation depending on the disease but the use of a camera or an image capturing device is used in their paper. Also, battery consumption can be high.	Use of the technologies like the camera, ph. rate, solar we can optimize the crop rate.
#4	Recommendation based on weather data of the location and the interest of people to such conditions from past	IoT, hidden Markov model	It shows that weather context greatly enhances the recommended system.	It increases the accuracy of the weather data	Li-Fi being quite advanced takes time to be set up in developing countries but once done, it can be a boon for the sector and this idea can be implemented. Moreover, cattle sensors used are risky when the animals may fidget with it and the sensors can get damaged. It is not even cost effective as each animal needs a separate sensor.	We can use lifi technology to improve the accuracy of the problem.
#5	Recommendation based on trust enhanced factor and graphic analysis	IoT	The inclusion of trust into the RS increases both accuracy and coverage.	It increases IOT network accuracy.	The main disadvantage is that in case of large fields, the playhouses cannot be used as it increases the cost. The drip irrigation setup cost may also increase when we consider a large area.	IOT networking should be increased.
#6	Recommendation based on trust and regulation model and security	IoT	It aims at providing protection against IOT attackers to tackle security challenges	It improves security.	Security challenges can be faced.	Security should be increased.
#7	This paper is based on a recommended system for the agriculture information personalization based on user clustering	IoT, data mining, data warehousing	The framework drastically increases the system for the Agriculture information personalization	It improved the service quality of the website	The distance of transmission is less and it can cause problems if the connectivity is low.	It has been improved by adding an efficient and optimized code
#8	Calculation on energy state was similarity baring capacity.	IoT, dynamic tag, precision	From user similarity and service resource value the following theory was validated	It improves the precession	The ubimote sensor board used can result in failures and this, in turn, may stop the entire system from working as this is the one which gathers and sends the information to the farmers.	We can use improved services.

#9	This paper is based on the design of fertilization recommendation knowledge base and applications	IoT, c++	The data sensed by the sensors as easily accessed through the Android application and the experiment was a success.	It increases the fertilization efficiency.	N/A	The camera of better quality can be used, the concept of master node as specified in paper 2, can be used. Battery efficiency can be increased by tuning the microcontroller to sleep when the system is not in use and by that time, the batteries can be charged using solar.
#10	Cognitive approach for recommended system	IoT, the cognitive system sensors	The framework is engine observe the things like sensors by considering a used item	It increases stability in the system	It has security issues.	N/A
#11	This paper is based on a recommendation system for brown planthopper control	IoT, multiscaling,	It decreases the bph rate in the problem.	It decreases the growth rate of the bph	Battery consumption will be more and more sensors can be used for the way of farmers.	We can increase the measures to decrease the bph rate.
#12	This paper is based on the application and improvement of intelligence recommendation of agriculture information	IoT, the prior algorithm	The sensors and Raspberry PI were interfaced and wireless communication was established using IoT.	It increased the improvement in information for agriculture	The power supply is a disadvantage. As the entire system fails without power supply, it can be a disadvantage. Images captured during the day may be affected due to excess sunlight and images cannot be clicked clearly at night.	N/A

**IV. CONCLUSION**

Everywhere we talk about making India Smart from our homes to cities in our states, but in all this, we forget about our country’s backbone i.e. Our Indian Agriculture. India ranks second in the farm output worldwide. The agricultural sector, in fact, is the most important sector in the country. As per the statistics of 2013, India accounted for 13.7% of the gross domestic product, but over time, the results are declining. There are several ideas which are executed and a few are yet to be implemented. By reading different papers on Smart Agriculture, we came to the conclusion that our Indian agriculture needs to be changed and made smart by using different technologies such as IoT, Artificial Intelligence, Cloud Computing and Big Data combined together. IoT can be used to automate the equipment, thereby minimizing the human effort. It also can be used to analyze the data collected by the sensors present in the field. Drones used to monitor the entire field easily and capture the images of plants regularly at a certain time makes use of Artificial Intelligence. The data gets recorded every single second by the sensors and Big Data helps us to collect this huge amount of data. We can also retrieve past data from it and analyze for the present and also the future. Since the data amount is huge, its storage problem can be solved using cloud computing. There are a few

problems even in the existing implementation. Our plan is to introduce a system which will not only solve those existing problems but will prove to be a unique feature to tackle other new problems as well. Adding to the future scope of the paper, we are integrating our idea with Machine Learning to predict the demand and supply problem which predicts the market rate at the time of harvesting. The model predicts the price and crop to be grown which provides profit to the farmers. Overall, by combining all these technologies we can make our Indian Agriculture as Smart Agriculture.

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