A Study On Agriculture Commodities Price Prediction and Forecasting

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***Abstract*— Recent days interaction between computer and human is gaining more popularity or momentum, especially in the area of speech recognition. There are many speech recognition systems or applications got developed such as, Amazon Alexa, Cortana, Siri etc. To provide the human like responses, Natural Language Processing techniques such as Natural Language Toolkit [6] for Python can be used for analyzing speech, and responses. In our country, INDIA, agriculture is backbone of economy and major contributor for GDP. However, farmers often, do not get sufficient support or required information in the regional languages. Prediction analysis for farmers in agriculture is not only for crop growing but is essential to develop Crop recommendation system based on price forecasting for agricultural commodities in addition to providing useful advisories for the farmers of any state. Currently, to protect the farmers from price crash or control the inflation, the governments (Central and State) predicting the price for agricultural commodities using short-term arrivals and historical data. However, these methods are not giving enough recommendations for the farmers to decide the storage/sales options with evidence-based explanations. The goal of this study is to identify the research already done in this area and find out the pros and cons of different models and future scope for improvement**

Keywords*— *Gross Domestic Product (GDP), agricultural commodity, price forecasting, price prediction.

I. INTRODUCTION

Along with oxygen and water food is essential to survive on this planet. So agriculture is backbone or important sector in many countries. Without agriculture and farmers it is difficult to think about live. In India agriculture is one of the important sector. It is important to increase the per capita income and consumption. Along with increase in population, faster growth of agriculture sector is important. For overall economic progress the development of agriculture is very essential. In Indian about two third of population directly or indirectly dependent on agriculture. This sector generates about 28 percent of its GDP [1] and over 15 percent of exports.

One of the major problems with Indian agriculture sector is, getting the help or required information in local language is difficult. So what is the solution? on January 21,2004 "Kisan Call Centers (KCCs)" launched by the government of India. The goal of the project is to answer farmers queries on a telephone call. The replies are given in 22 local languages [2].

The major problems faced by the farmers with KCCs are farmer always get Network busy (94.44%), There will be a problem to connect to the network while calling to KCC (83.33%), KCC officials not able to communicate properly with illiterate farmers (82.22%), difficulties in getting complete information on the topic (77.77%), farmers are facing the difficulties to get the latest information on agricultural technologies[3]. Another major issue is with the expertise and availability of the Farm Tele Advisor (FTAs). Sometime waiting time is high because of busy network or FTAs are simply not responding. According to [3] other issues are there is no clarity with the information provided and also information provided are not in the local dialect of the region. There will be a lack of Credibility in the information provided by KCC level one officials. The KCC officials delivering the details in high speed and farmers are facing difficulty in understanding.

Revolution of telecommunication helped a lot in rural India. Now telephone or smart phones with good internet facilities are commonly available. Using the communication technologies and take the advantage of Artificial Intelligence we can come up with the question answer system or voice bot to answer the farmers queries. In case of human's speech is one of the powerful communication media. The signal we get from speech is very sophisticated. It is required to process the same at different level like, articulatory, semantic, acoustic and linguistic [4].

Recognition of speech is widely accepted and it is the future of interaction with machines like computer and mobile. It will eliminate use of traditional devices like keyboard, mouse etc. This is extremely useful for the users who don't have the knowledge of these devices [5]. The speech recognition also very helpful for disabled people like, blind, handicap etc.

Using speech recognition technology many web based and mobile based applications got developed. One of such application is "FarmChat: A Conversational Agent to Answer Farmer Queries" [6].To address the need of farmers in rural India the authors designed, FarmChat ,a conversational agent. This application provides both audio-only and audio+text facility.

Similar to above application many speech recognition [7][8] and question answering systems[9][10][11][12][13] developed. These applications really helped farmers to get the answers for their queries.

978-1-7281-7213-2/20/$31.00 ©2020 IEEE

However main requirement of the farmers is get the adequate return. We need to ensure they reap adequate returns for sustainable food security. Modern technology, in addition to quality seeds, irrigation, fertilizers etc., can be looked at to further enhance the return. The goal of this study is to find the availability of the models or frameworks to predict and recommend the price for farmers produce.

II. RELATED WORK

N. Hemageetha et al "Radial Basis Function Model for Vegetable Price Prediction"[14].In this paper the authors state that developing countries like India more support is required for agriculture sector. The price prediction not only helps farmers, it will help governments decision making. In this model for predicting the vegetable price the authors used datamining classification techniques like Back-propagation neural network (BPNN) and Radial basis function neural network (RBF). They used tomato price data from January 2009 to March 2012 (3 years) and it is weekly price collected from www.tnau.ac.in. The results of this study shows that the efficiency of RBF is more and accurate than Back-propagation. To increase the accuracy of price prediction authors suggested that it is good to use genetic algorithm based neural network.

Yung-Hsing Peng et al "An Investigation of Spacial Approaches for Crop Price Forecasting in Different Taiwan Markets"[15].In the agri-business the demand and supply indicated by the market price. So the price crop price furcating is important to increase the profit. In this research paper the authors talked about the Nearest Neighbor algorithm, the Inverse Distance Weighting technique, the Kriging method, and Artificial Neural Network. According to the authors the Kriging method gives better efficiency and low error in the forecasting. For the future enhancement consider other factors like climate condition, planting area, historical price. Also it is good to look for other algorithms like ant colony system [31] or the particle swarm optimization [32].

Zhenong Jin et al "Crop model- and satellite imagery-based recommendation tool for variable rate N fertilizer application for the US Corn system"[16].One of the important factor behind the better yield of the crop is the good fertilizer used. It is important to recommend that how much nitrogen content required. In this paper authors talked about nitrogen (N) management for corn. To simulate range of soil N processes they used Agricultural Production Systems sIMulator. Also they got the required weather data from National Climate Data Centre. For the further development of prediction of crop yield this tool can be used as a basic foundation.

S.Pudumalar et al "Crop Recommendation System for Precision Agriculture"[17].In agriculture to analyze biotic and abiotic factors the data mining techniques can be used. The Indian farmers has common problem.The farmers not choosing the right crop based on their soil requirements and this affects the productivity. In this paper the authors tried to address this problem through precision agriculture. The precision agriculture technique uses attributes such as soil types, yield data etc. Later based on site specific characters the model suggests the right crop. In this paper authors used an ensemble model. They used majority voting technique with Random tree, CHAID, K-Nearest Neighbor and Naive Bayes . Using improved data set with a greater number of attributes or parameters this model can be further enhanced. Also, it is required to predict the yield of a crop.

Rohit Kumar Rajak et al "Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique"[18].In India the farmers not choosing the right crop based on their soil. This is the reason behind the less yield or productivity. Here authors tried to solve the problem using machine learning techniques. They used Support Vector Machine algorithm and Artificial Neural Network for crop recommendation. These techniques provide high accuracy and efficiency. The data set contains soil specific attributes. To improve the model further, it is required to use other factors such as whether condition or climate condition along with soil attributes.

Ashwini Darekar et al "Cotton price forecasting in major producing states"[19]. India is one of the largest cotton producing and exporting country. In case of cotton it is important to forecast the price, which will benefit not only farmers, it will help purchaser and millers too. The goal of this study is, considering the major cotton producing states and forecast the price of cotton. For this study historical data of 10 years, monthly price of cotton, data collected from AGMARKNET. The parameters for the model were estimated using R programming software. Usually the crops prices are varies depending on global supply and demand along with the domestic demand and supply. So for the further improvement it is required to consider the global demand and supply and also export/import prices.

Zeel Doshi et al "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms"[20].The majority of the farmers in India decides which crop to grow or sow based on their previous experience and intuition in a particular season. This may affect the yield as well as prices in the market. To solve this issue authors proposed a model based on Big Data Analytics and Machine Learning algorithms. In this paper they presented the system called AgroConsultant. The proposed system assists the farmers to make decision about which crop to grow based on geographical location, environmental factors and soil characteristics. The model presented in this paper can be improved by considering the crop rotations. That is which crop to grow in the current season based on the crop was harvested in the previous cycle or season.

Lakshmi. N et al "Crop Recommendation System for Precision Agriculture"[21].Big Data is one of the useful technology for developing agriculture, medicines and retails recommendation system.While developing the new model Big Data,Data mining and IOT plays an important role. In the current research paper the authors proposed a model which predict the types of soil and crop that is suitable to be grown in that soil. They used flume to download the data from agricultural website and saved them on Hadoop file system. The data processed by Map Reduce. The proposed model

helps farmers to sow the right seed based on the soil and whether condition. This model can be further improved with the data set containing more number of attributes in yield prediction.

Chenhao Wang et al "High and Low Prices Prediction of Soybean Futures with LSTM Neural Network"[22].The prediction of future prices is a challenging task. Most of the research done previously concentrated on predicting the closing price. But it is important to predict low and high prices too. Here the authors came up with a model for predicting the high and low prices of soybean. They used LSTM for developing the proposed model. They have used the dataset from the Dalian Commodity Exchange. Later they used mean absolute error (MAE) and trend accuracy to evaluate the performance of the model. With this study they claimed that LSTM performance is better. In trend estimation it gave more than 80% of the accuracy. The authors used only the trading price or values considered. As a further improving the it is required to use other related attributes like weather, social conditions etc.

Yongli Zhang et al "A Novel Agricultural Commodity Price Forecasting Model Based on Fuzzy Information Granulation and MEA-SVM Model"[23].In the agriculture few important things are reduce the market risk. Also, it is required to increasing the agricultural income. Sometime government regulation influences the price of commodities. Considering all these it is important to predict the agricultural commodities price. With this paper the authors came up with a forecasting model for agriculture commodities price. To build the proposed model the fuzzy information granulation, MEA algorithm and support vector machine are used. In this study the authors claimed that the MEA-SVM model was effective and with this we can get higher accuracy during prediction. Also calculation speed during the forecasting is high in case of MEA-SVM model. There is scope for improving the proposed model by reducing the long-term prediction error.

A. Amarender Reddy, "Price Forecasting of Tomatoes"[24].The price fluctuations of commodities based on supply and demand. Tomato is one of the perishable commodity and it is important to forecast harvest period tomato prices. So that farmers can take informed production decisions. In other models seasonal variations are not considered. This model is based on seasonal variations of tomato prices from January 2006 to December 2016. For forecasting the prices Seasonal Autoregressive Integrated Moving Average (SARIMA) model was used. This study shows that there were differences in tomato prices across different regions due to lack of cold storage and refrigerated transport facility.

Tao Xiong et al "Seasonal forecasting of agricultural commodity price using a hybrid STL and ELM method: Evidence from the vegetable market in China"[25]. Previously the limited attention paid for the research. Here authors studied and proposed a hybrid method. They combined trend decomposition methods. This model is proposed based on STL and Extreme Learning Machines. Using this model authors tried to forecast vegetable prices for short, medium and long term. The authors mentioned that SARIMA is very popular forecasting technique. In case of SARIMA the performance may be poor, if we assume time series with high nonlinearity. Further this can be improved by interval forecasting of vegetable prices.

Koki Yamamoto et al "Predicting System of Harvest Time And Yield of Tomato"[26].Even farmers produce thousands of tonnes of tomato, many time farmers have to sell the same for lower price. This is demand and supply issue. On this research the authors proposed a new system. Based on the temperature this proposed model calculate harvest days and yield. With this system farmers can take decision on how to produce to get better profit. The limitations of this system is , only the temperature attribute is used for forecasting and it is good to consider other parameters too for getting better performance or accuracy.

Gerasimos Rigatos et al "Forecasting of commodities prices using a multi-factor PDE model and Kalman filtering"[27].In this study the authors proposed a method for forecasting commodities prices. For this purpose, they used Schwartz partial differential equation and Kalman filtering. The PDE model is a popular model used for representing the price variations of agriculture commodities. This is model is very useful especially in case of long-term contracts. As an enhancement, to get more accurate prediction of commodities price we can design Kalman filter as a m-step ahead predictor.

Yuchen Weng et al "Forecasting Horticultural Products Price Using ARIMA Model and Neural Network Based on a Large-Scale Data Set Collected by Web Crawler"[28]. Aagricultural products are an important component of the supply chain. The prices of commodities affected by many factors such as government policies,climate condition, supply and demand etc. The forecasting the price of horticulture products are important because we can't store them for long time. In this paper the authors came up with a model to forecast the prices for agriculture products using AutoRegressive Integrated Moving Average model, Back Propagation network, and Recurrent Neural Network method. In the future this model can be improved by considering the social factors (policies, holidays),weather condition, market condition. For the generalization it is good to consider the price data of different regions. Also parallel learning is the another option can be considered to train the computation system.

Asma Hasifa Nurcahyono et al "Price Prediction of Chili in Bandung Regency Using Support Vector Machine (SVM) Optimized with an Adaptive Neuro-Fuzzy Inference System (ANFIS)"[29].Indonesia is one of the largest chili producing country. In this country the farmers facing the problem of price fluctuations. One of the main reason is weather, because chili plants are sensitive and damaged if exposed to too much water. In this paper authors done a research to predict the chili price. They used SVM algorithm, long with Adaptive Neuro-Fuzzy Inference System. The authors claimed that with Support Vector Machine algorithm optimized with Adaptive Neuro-Fuzzy Inference System we can get better performance and accuracy compared to Support Vector Machine algorithm

alone. As a further improvement it is good to consider other conditions like soil, rain, temperature etc.

Dabin Zhang et al "Forecasting Agricultural Commodity Prices Using Model Selection Framework With Time Series Features and Forecast Horizons"[30].The fluctuations of agricultural products has great impact on both farmers and general public. So it is essential to have a system to forecast the commodity process which helps to take decisions. In this research paper the authors discussed about a forecasting model developed using Artificial Neural Network, Support Vector Regression and Extreme Learning Machine techniques. To measure or to learn the performance of the proposed model Random Forest and Support Vector Machine techniques are applied. Maximum Relevance Approach is used to improve the forecast accuracy. The experimental result shows that proposal model has better performance when the optimal candidate model and simple model average are used. This model can be further improved by using some powerful classifiers like Bayesian networks and AdaBoost.

The Table I below shows the comparison of the existing models and their pros and cons. Also scope for future work is listed.

TABLE I. COMPARISON OF EXISTING SYSTEM

Sl.No	Author	Title	Year	Methodology/Framework	Application	Limitations/Future scope
1	N.Hemageetha et al.	Reference [14]	2013	Back-propagation neural networks and Radial basis function neural networks.	Prediction of tomato price.	To increase the prediction accuracy genetic algorithm based neural network will be good choice. Only 3 years historical price considered
2	Yung-Hsing Peng et al.	Reference [15]	2015	Nearest Neighbour. The inverse distance weighting. The Kriging method, and the Artificial Neural Network.	Crop price forecasting	Data set with large number of attributes to be considered, like climate, region etc. Implement yield prediction.
3	Zhenong Jin et al.	Reference [16]	2016	N supply, losses and demand. Built on the Amazon Elastic Compute Cloud.	Precision N management for corn.	For the further research or development this model can be used as foundation.
4	S.Pudumalar et al.	Reference [17]	2016	Random tree, CHAID, K-Nearest Neighbour and Naive Bayes are used.	Based on the site specific parameters, recommend the crop.	Dataset to be improved. Only soil type is considered.
5	Rohit Kumar et al.	Reference [18]	2017	Majority voting technique using Support Vector Machine and Artificial Neural Network.	Crop recommendation based on site specific parameters.	Only Soil specific attributes used.
6	Ashwini Darekar et al.	Reference [19]	2017	ARIMA	Future prices prediction of cotton.	The proposed technique does not guarantee perfect forecasts.
7	Zeel Doshi et al.	Reference [20]	2018	Linear Regression, Decision Tree, K-NN, Random Forest and Neural Network frameworks used.	Which crop to grow based on soil. Rain fall predictor.	Consider crop rotations. Consider other aspects like demand supply, harvest prices and retail prices.
8	Lakshmi. N et al.	Reference [21]	2018	Big Data is used. Flume is used for download information.	Predict the types of soil and the crops that are suitable to be grown in that soil.	Data set with a greater number of attributes like weather, geographical features, water utility to be considered in yield prediction.
9	Chenhao Wang et al.	Reference [22]	2018	LSTM neural network, Mean Absolute Error (MAE).	Instead of only closing price, this model predicts high and low prices	Only trading price or values considered.
10	Yongli Zhang et al.	Reference [23]	2018	Information granulation by Fuzzy system, MEA, and SVM are used.	Agricultural commodity price forecasting.	This model has larger error for the long-term prediction. The current model can be further improved by optimizing penalty parameter c and kernel parameter g of SVM model.
11	A. Amarender Reddy	Reference [24]	2018	SARIMA	Price forecasting of Tomato.	Social factors not considered.
12	Tao Xiong et al.	Reference [25]	2018	Loess (STL) Extreme learning machine (ELM)	Price forecasting for vegetables.	The limitation of this model is attention given only to point

				Hybrid STL-ELM method		forecasting. The interval forecasting of prices is required.
13	Koki Yamamoto et al.	Reference [26]	2018	Temperature sensors and RNN	This model calculates harvest days and yield of tomatoes. Also predict the harvest time.	Only Temperature is considered.
14	Gerasimos Rigatos et al.	Reference [27]	2018	Schwartz PDE and Kalman filtering.	Forecasting commodities prices	To get the more accuracy in estimation, redesigning the Kalman filter as a m-step ahead predictor is required.
15	Yuchen Weng et al.	Reference [28]	2019	ARIMA, Back Propagation network method, and RNN. Data collection - web crawler technology	Price forecasting	By considering the social factors like, holidays, festivals, polices etc. it is possible to improve RNN model. While training the computation system, parallel learning can be applied.
16	Asma Hasifa Nurcahyono et al.	Reference [29]	2019	Support Vector Machine, Optimized Adaptive Neuro-Fuzzy Inference System.	Price Prediction of Chili	Only 3 years weather data used.
17	Dabin Zhang et al.	Reference [30]	2020	Artificial neural network, Support vector regression and Extreme Learning Machine. Minimum Redundancy and Maximum Relevance approach was used.	Forecasting agricultural commodity prices	To improve the classification capability, AdaBoost and Bayesian networks could be used.

III. CONCLUSION

In our country, India, majority of the people employed with agriculture. It is very important to give more importance for development in agriculture sector. In India still farmers are sowing based on the intuition or previous experience. Later some time they will not get the proper yield or some time they will not get the proper price for the commodities they grown. So, the immediate requirement is to help formers go get the profit for the commodities they grown. In this paper we have done the survey to get the details about the research already done and the frameworks developed to predict and recommend the yield as well as price. But most of the cases only specific attributes are used either like, soil, temperature, historical price etc. with these attributes it is important to consider other social factors like government policies, festivals, holidays etc. The artificial intelligence and machine learning techniques are promising to develop the required framework.

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