JOURNAL OF CRITICAL REVIEWS
ISSN- 2394-5125 VOL 9, ISSUE 04, 2022

# EFFECTIVE CROP YIELD PREDICTION USING RNN, FEED FORWARD AND LSTM NEURAL NETWORK

**Mr. N Srinu,[1]**
[1]Associate Professor, Department of Computer Science and Engineering
Qis College of Engineering and Technology

**L Sai Susmitha[2], K Surendra Kumar[3], T Sai Teja[4]**
Student, Department of Computer Science and Engineering
Qis College of Engineering and Technology

## Abstract

India's economic and social well-being depends heavily on the country's agricultural sector. It is critical for a nation that has 58 percent of its people engaged in farming that traditional and non-scientific techniques be used to choose the optimal crop for the soil. Soil conditions, planting season, and geographic location may all affect a farmer's decision to plant a certain crop. This leads to suicide, the abandonment of farming, and a move to metropolitan regions in search of work. An approach that takes into account a wide range of variables, such as planting season, soil type, and geographic location, has been developed to help farmers solve this problem. Furthermore, contemporary agricultural technology is being used to establish precision agriculture, which is increasing in developing nations and focusing on site-specific crop management. Precision agriculture.

**Keywords**— ***Agriculture, Crop Recommendation,Machine Learning.***

## I. INTRODUCTION

About 58 percent of our nation's population relies on agriculture as a primary source of income [14] [15]. Farmer suicides and the use of agricultural land for non-agricultural purposes are on the rise in 17 states, according to an economic study conducted in 2016-17.Since 48 percent of farmers do not want their next generation to take care of their agricultural, they choose to settle down in metropolitan regions. One of the reasons for this is that farmers often make incorrect crop selection decisions [9], such as choosing a crop that won't produce much on a certain soil or planting in the wrong season, etc. The farmer may have acquired the property from someone else, therefore the choice may have been made without prior expertise. If you choose the wrong crops, you'll always get a lower yield. It is quite difficult for a family to live if this money is their only source of income.Developing nation case studies are hindered by a lack of accurate and up-to-date information available to researchers.For this challenge, a method has been suggested that uses machine learning models trained to incorporate important environmental and economic

characteristics to provide predictive insights and suggestions on crop sustainability.The suggested system takes into account environmental factors like rainfall, temperature, and state, as well as soil properties like soil type, pH, and nutrient content, in order to suggest an appropriate crop to the user. Furthermore, if the farmer chooses the correct crop, he or she will get a yield projection as well. Develop an accurate and reliable model for crop sustainability in every given state based on the specific soil type and climate conditions. Offer advice on the best crops to plant in the region to help farmers avoid losses. Based on last year's harvest statistics, provide a profit analysis for each crop type.Machine learning is used to create the suggested system, which is an application of Artificial Intelligence that enables systems to learn and adapt automatically without being explicitly coded by a developer. Followed by that, the accuracy of the software will be increased without \shuman involvement. Many scientists are working in this area to aid farmers in the choices stated below, in which many aspects such as physical, environmental, and economic considerations were taken into account.

## II. RELATEDWORKS

Before cultivation, crops were graded using Decision Tree Learning-ID3 (Iterative Dichotomiser 3) and KNearest Neighbors Regression techniques [9], with the use of an Artificial Neural Network (ANN). The random forest technique and BigML [10] were used to analyse crop characteristics. A set of decision criteria for predicting a plant's status was developed using machine learning algorithms to mitigate the negative effects of water stress [11].

Smart technologies and machine learning approaches were used to provide predictions about crop costs in real time [5]. In this article [8], a survey \shas been done on numerous uses of machine \slearning algorithms in agricultural production \ssystems. In addition, crop management advice were provided by AI-enabled technologies. Crop cultivation may benefit from the use of deep learning methods [12] [19]. An effective yield forecasting technique is designed in this study [2] based on real-time monthly weather. The above-mentioned forecasting mechanism was implemented using a non-parametric statistical model and non-parametric regression techniques.

Machine learning and data mining approaches are being used to help farmers pick crops based on soil qualities, specific geographic location, sowing season, and environmental conditions [3]. The soil dataset is analysed using the regression approach [4]. Five distinct algorithms were used in this work [6] to recommend crops for the underlying soil data. Support Vector Machine, Bagged Tree, Adaboost, Naive Bayes, and Artificial Neural Network are the five methods. For even more precise findings, the ensemble approach is also used. When it comes to identifying pests in coconut trees using a drone, precision agriculture is applied [7]. CHAID, K-Nearest Neighbor, Naive Bayes, and Random tree were employed as learners in an ensemble model using a majority voting approach.

## III. PROPOSED SYSTEM ARCHITECTURE

Environmental and soil parameters are carefully considered in our proposed research. That's because some soil types support crops better than others, and when the weather doesn't cooperate, the yield suffers as a result. Figure 1 depicts the proposed system's overall operation. Attempts are being made to discover whether there are any correlations between the dataset's different properties.

Acquisition of the Training Data Set:

The algorithm is given data from a variety of sources, including the government website [16] and Kaggle [17]. Datasets \sincludeIn kg per hectare, this information includes the yield of 16 key crops farmed in every state. 0 indicates that the crop is not grown in the state where it is being grown. There are two datasets: ii) Cost of Cultivation and iii) Crop Cost of Cultivation Over the course of two months, this information provides the average market price of various crops. This dataset provides the current market price in rupees per hectare for the crops included in Table iv. State, Nitrogen content, Phosphorous content, Potassium content and average ph are the properties in this dataset's five columns. Crops, maximum and minimum rainfall, maximum and minimum temperature, maximum and minimum rainfall, and ph values are included in this dataset.

The cost of cultivation, the market price, the standard price, and the yield dataset are used to calculate profit. Crop prediction may benefit from knowing how much profit is driving this experiment.

State-specific profit is computed for each crop cultivated in the state and is deducted from the total profit for states that produce zero or no crop. This stage comprises replacing the null and 0 yield values with -1 so that the total forecast is not affected. For the neural network to perform properly, the data-set has to have been encoded before it can be fed into it. In order to make the data appropriate for use in machine learning algorithms, preprocessing is essential. Outliers and incorrect data are removed and missing values are handled during preparation. The dataset's values are stored as strings. In order to feed the neural network with this data, it has to be transformed to integers. Additional data reduction is achieved by filtering crops based on their nutritional requirements and the nutrients in their soil. The amount of time it takes to train a crop is greatly lowered if the nutrient content of the soil falls below the level needed by the crops. Prior to training machine learning models such as neural networks and linear regressions, the data-set undergoes a pre-processing stage.

LINEAR INCREASE

Each crop's y-pred value is determined via a linear regression that connects rainfall, temperature, pH, and yield.

A linear regression model's yorvalue is used to rank the crops using rapid sort, putting the crop with the highest yorvalue at the top.

Networks of neurons

The Keras module makes it easier for us to build the neural network. To determine the long-term viability of 15 different crops, a sequential model is used with three input levels and 15 output layers.

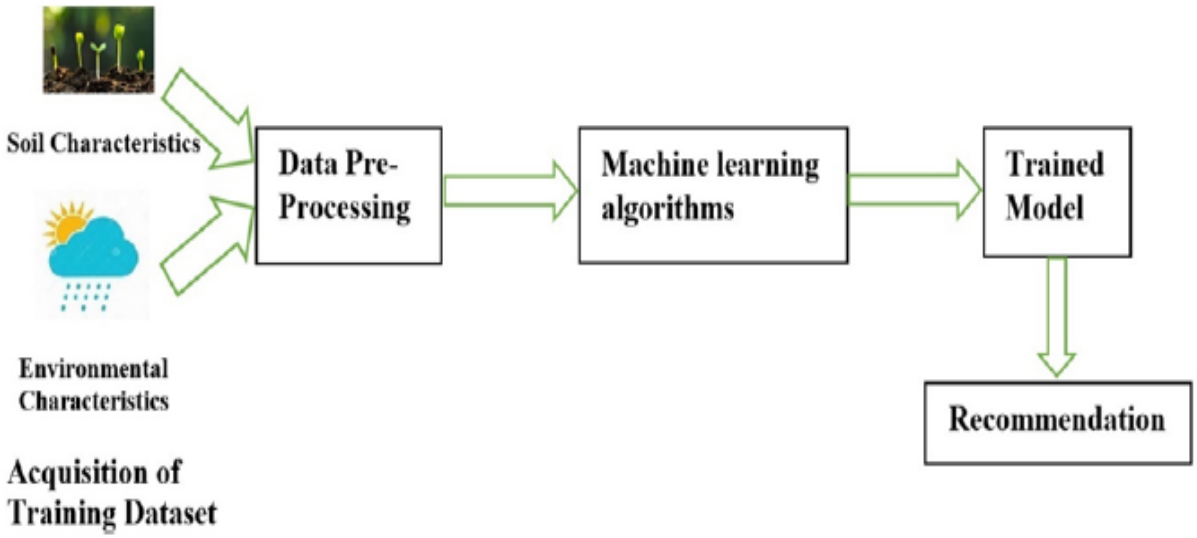


Fig 1: Crop Recommendation System

## IV. RESULTS AND DISCUSSION

Two techniques, linear regression and neural networks, are used to create the proposed system, which is written in Python utilising the Pandas, Numpy, Tensorflow, Keras, and Sickitlearn libraries and tools. However, both systems use supervised learning as a basis. Using K Nearest Neighbour, K Nearest Neighbour with K Nearest Neighbour cross validation, Decision Tree, Naive Bayes, and Support Vector Machine [13], the results are analysed and compared for accuracy to other crop recommendation methods.
There are three main parts to the system:
I Crop recommendation ii) Crop sustainability prediction iii) Profit analysis

Analysis of Profits

After the study, we get the profit data for each state's crop, as seen in Fig. 2.

This gives a clear picture of the crop to choose. RECOMMENDED B CROP

As shown in Figure 4, the crop recommendation model shows the crops in descending order of production, starting with the most productive and working down the list. Fig. 3 and Fig. 5 show the regression model output and input to the predictor, respectively.

Predictor of crop sustainability (C)

Given these three factors, the sustainability prediction value for each crop has been determined. As a result, one can see in Fig. 6 which crop will provide the best yield based on these numbers. As shown in Fig. 7, a comparison of the proposed system and several machine learning methods in terms of crop forecasting accuracy is provided in table 1.

```
In [15]: profit_data
```

Out[15]:

| | state | crop | profit |
|---|---|---|---|
| 0 | Andhra Pradesh | Rice | 6.385184e+04 |
| 1 | Andhra Pradesh | Jowar | 1.097407e+04 |
| 2 | Andhra Pradesh | Bajra | 7.414478e+03 |
| 3 | Andhra Pradesh | Maize | 3.136984e+04 |
| 4 | Andhra Pradesh | Ragi | 5.636376e+03 |
| 5 | Andhra Pradesh | Wheat | 1.000000e+00 |
| 6 | Andhra Pradesh | Barley | -1.000000e+00 |
| 7 | Andhra Pradesh | Gram | 5.058972e+03 |
| 8 | Andhra Pradesh | Tur | 1.000000e+00 |
| 9 | Andhra Pradesh | Groundnut | 1.017747e+04 |
| 10 | Andhra Pradesh | Mustard | 1.000000e+00 |
| 11 | Andhra Pradesh | Soyabean | 7.632153e+03 |
| 12 | Andhra Pradesh | Sunflower | 9.739718e+03 |
| 13 | Andhra Pradesh | Cotton | 1.000000e+00 |
| 14 | Andhra Pradesh | Jute | -1.000000e+00 |
| 15 | Andhra Pradesh | Mesta | 1.609931e+03 |
| 16 | Andhra Pradesh | Sugarcane | 8.931305e+05 |
| 17 | Arunachal Pradesh | Rice | 9.995866e+02 |
| 18 | Arunachal Pradesh | Jowar | -1.000000e+00 |

Fig. 2: Profit on crops per state

```
[7.01187226]
['Barley', 'Bottle Gourd']
[-13.77759935]
[-0.81033561]
[-5.14828826]
[-2.21432874]
[-4.81342706]
[-59.60942137]
[-2.84073175]
[-75.81061724]
[0.69908353]
['Barley', 'Bottle Gourd', 'Groundnut']
[0.70479237]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar']
[0.61912891]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar', 'Khesari']
[-9.91352688]
[-0.28529204]
[-1.7600131]
[4.11882972]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar', 'Khesari', 'Orange']
[-262.25858254]
[8.45690409]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar', 'Khesari', 'Orange', 'Potato']
[2.20757848]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar', 'Khesari', 'Orange', 'Potato', 'Raddish']
[-4.04423303]
[0.71076754]
['Barley', 'Bottle Gourd', 'Groundnut', 'Jowar', 'Khesari', 'Orange', 'Potato', 'Raddish', 'Sannhamp']
[-0.77569453]
[-54.22040544]
[-17.77020347]
[-24.76243297]
ACCURACY SCORE:- 88.26342114086883 %
```

Fig.3: Regression model output

```
In [55]: print ('Recommended crop for the month of '+NumtoMonth[month]+' in '+state+' is/are: \n'+final_crop)

         Recommended crop for the month of May in Bihar is/are:
         Potato,Bottle Gourd,Orange,Barley,Raddish,Sannhamp,Jowar,Groundnut,Khesari

In [ ]:
```

Fig. 4: Crop recommendation

```
172  0.546313  0.285233  0.149073  0.074952  0.029913  0.093333  0.008033
173  0.536654  0.242637  0.167341  0.201528  0.163237  0.181734  0.068485
174  0.428104  0.075437  0.008961  0.209194  0.432152  0.157399  0.039976
175  0.523158  0.221789  0.238394  0.327195  0.251305  0.164559  0.104569
176  0.482467  0.185739  0.208894  0.164559  0.030575  0.024127  0.002197

In [62]: Soil=input()
         Month=input()
         State=input()

         Alluvial
         March
         Punjab

In [63]: # df

In [64]: # df[df['State']==State]['State_code']
```

Fig.5: Input for the predictor

```
In [68]: pred = model.predict_proba(Choices)
         df2 = pd.DataFrame(pred, columns=["Rice","Wheat","Cotton","Sugarcane","Tea","Coffee","Cashew","Rubber","Coconut","O
         print(df2)
         df2.shape

              Rice    Wheat    Cotton  Sugarcane       Tea    Coffee    Cashew  \
         0  0.495499  0.2027  0.236318   0.184892  0.043014  0.035415  0.004605

              Rubber   Coconut  Oilseed      Ragi    Maize  Groundnut    Millet  \
         0  0.002973  0.005234  0.06702  0.087935  0.13789   0.075435  0.125787

              Barley
         0  0.043136

Out[68]: (1, 15)
```

Fig.6: Crop Sustainability prediction values

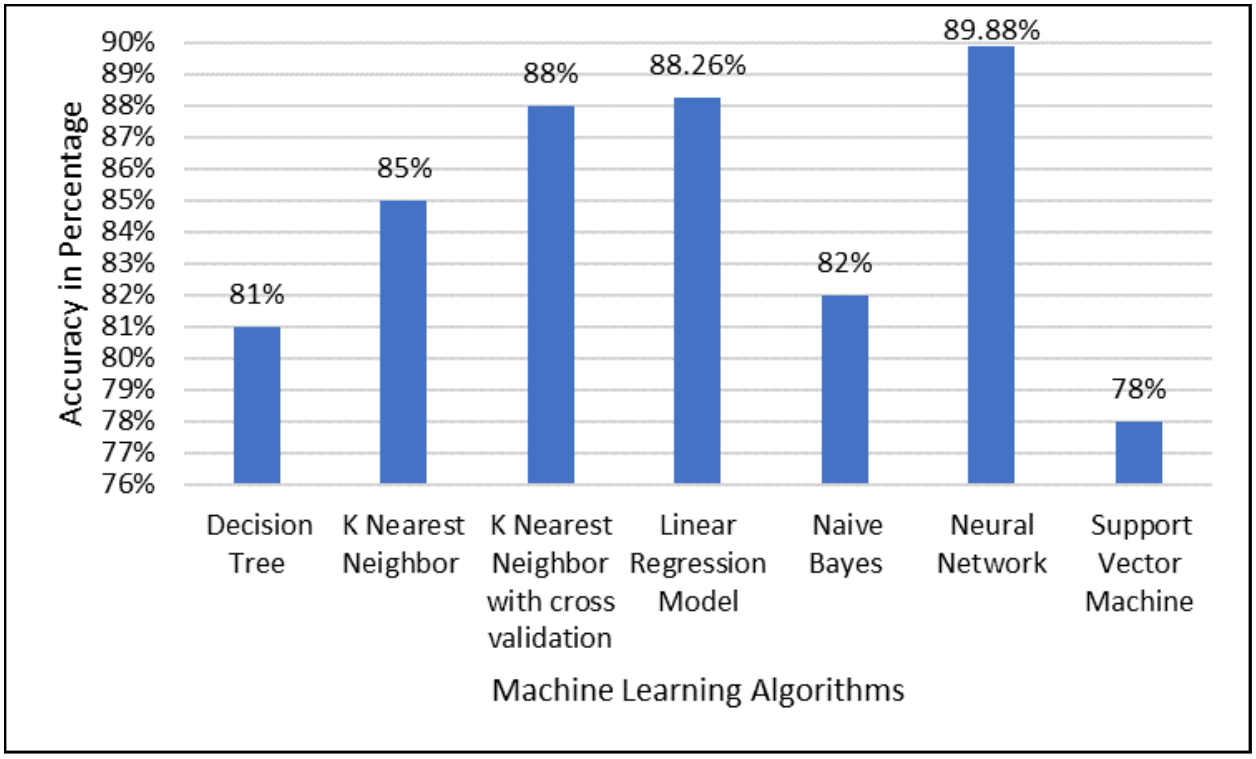


Fig. 7: Comparison of proposed system with other machine learning algorithms

TABLE 1: CROP RECOMMENDATION ACCURACY

| S.No | Algorithms | Accuracy |
|---|---|---|
| 1 | Decision Tree | 81% |
| 2 | K Nearest Neighbour | 85% |
| 3 | K Nearest Neighbour with cross validation | 88% |
| 4 | Linear Regression Model | 88.26% |
| 5 | Naive Bayes | 82% |
| 6 | Neural Network | 89.88% |
| 7 | Support Vector Machine | 78% |

## V. FUTURE SCOPE AND CONCLUSION

As a result, crop failure is reduced, and productivity is increased, thanks to the suggested system's insights that regular farmers do not have access to. As a result, they don't suffer any financial setbacks. Web and smartphone apps have been proposed as ways of providing farmers around the nation with advice on how to grow crops more efficiently and effectively.

## REFERENCES

[1] R. Kumar, M. P. Singh, P. Kumar, and J. P. Singh, "CropSelect ion Method to maximize crop yield rate using machinelearning technique", 2015 International Conference on SmartTechnologies and Management for Computing, Communicat ion,Controls, Energy, and Materials (ICSTM), Chennai, 2015, pp.138-145, DOI: 10.1109/ICSTM.2015.7225403.

[2] H. Lee and A. Moon, "Development of yield predict ionsystem based on real-t ime agricultural meteorologicalinformat ion", 16t h Int ernational Conference on AdvancedCommunication Technology, Pyeongchang, 2014, pp. 1292-1295, DOI: 10.1109/ICACT.2014.6779168.

[3] T.R. Lekhaa, "Efficient Crop Yield and P esticide P redict ionfor Improving Agricultural Economy using Data MiningT echniques", Int ernational Journal of Modern T rends inEngineering and Science (IJMTES), Volume 03, Issue10, 2016.

[4] Jay Gholap, Anurag Ingole, Jayesh Gohil, Shailesh Gargadeand Vahida At t ar, " Soil Data Analysis Using Classificat ion T echniques and Soil At tribut e P rediction", International Journal of ComputerScience Issues, Volume 9, Issue 3,2012.

[5] S. R. Rajeswari, ParthKhunteta, Subham Kumar, Amrit RajSingh, Vaibhav Pandey, "Smart Farming Predict ion usingMachine Learning", International Journal of InnovativeTechnology and Exploring Engineering, 2019, Volume-08, Issue-07.

[6] Z. Doshi, S. Nadkarni, R. Agrawal, and N. Shah,"AgroConsultant : Intelligent Crop Recommendat ion SystemUsing Machine Learning Algorithms", Fourt h Int ernationalConference on ComputingCommunicat ion Control andAutomat ion (ICCUBEA), Pune,India, 2018, pp. 1-6, DOI:10.1109/ICCUBEA.2018.8697349.

[7] S. Pudumalar, E. Ramanujam, R. H. Rajashree, C. Kavya, T.Kiruthika and J. Nisha, "Crop recommendat ion system forprecision agriculture," Eighth International Conference onAdvanced Computing (ICoAC), 2017, pp. 32-36, DOI:10.1109/ICoAC.2017.7951740.

[8] Konstantinos G. Liakos, PatriziaBusato, DimitriosMoshou,Simon P earson and DionysisBocht is, "Machine Learning inAgriculture: A Review", Art icle on sensors, 2018, pp 1 -29,doi:10.3390/s18082674.

[9] M. T. Shakoor, K. Rahman, S. N. Rayta and A. Chakrabarty,"Agricultural product ion output predict ion using SupervisedMachine Learning t echniques", 1st International Conference

onNext Generat ion ComputingApplicat ions (NextComp),Mauritius, 2017, pp. 182-187, DOI:10.1109/NEXTCOMP.2017.8016196.

[10] Marion Olubunmi Adebiyi, Roseline OluwaseunOgundokunand Aneoghena Amarachi Abokhai, "Machine Learning-BasedPredict ive Farmland Optimization and Crop Monitoring System",open-access art icledistributed Volume 2020, pp 1-12,ht tps://doi.org/10.1155/2020/9428281

[11] DimitriadisSavvas and Christos Goumopoulos. " Applyingmachine learning to extract new knowledge in precisionagricultureapplicat ions", 2008 P anhellenic Conference onInformatics, IEEE, (2008), pp:100-104.

[12] N. Kussul, M. Lavreniuk, S. Skakun, and A. Shelestov,"Deep Learning Classificat ion of Land Cover and Crop TypesUsing Remot e Sensing Dat a", IEEE Geoscience and Remot eSensing Let ters, vol. 14, no. 5, pp. 778-782, May 2017, DOI:10.1109/LGRS.2017.2681128.

[13] Kevin Tom Thomas, Varsha S, Merin Mary Saji, LishaVarghese, Er. Jinu T homas, " Crop P redict ion Using MachineLearning", Int ernational Journal of FutureGenerat ionCommunicat ion and Networking Vol. 13, No. 3, (2020), pp.1896–1901.

[14] www.india.gov.in/topics/agriculture

[15] www.ibef.org/indust ry/agriculture-india.aspx

[16] ht tps://data.gov.in/g

[17] ht tps://www.kaggle.com/notebook

[18] Chandy, Abraham. "Pest Infestat ion Ident ificat ion inCoconut Trees Using Deep Learning." Journal of Art ificialIntelligence 1, no. 01 (2019): 10-18.

[19] Vijayakumar, T., and Mr R. Vinothkanna. "Mellownessdetect ion of dragon fruit using deep learning strategy." Journal ofInnovative Image Processing (JIIP) 2, no. 01 (2020): 35-43.