International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Impact of Climate on Food Supply

Prof. Dinesh S. Tharwani[1], Gayatri Nambiar[2], Siddhi Nair[3], Rasika Bagade[4], Anagha Shinde[5]

[1-5]Department of Computer Engineering & Pillai College of Engineering(Autonomous), New Panvel, India

---

Abstract - The project aims to analyze how climate change impacts food production. Through this system, we can identify soil nutrients that are affected due to climate change and eventually affect the food supply. Crop recommendation attributes are defined by multiple factors such as temperature, humidity, rainfall, etc. The agriculture crop recommender provided will assist in determining the desired crop according to the quality of the soil. This evaluates the consequences of climatic changes on primary agricultural yields and all the effects related to changes in temperature and rainfall patterns.

Key Words: Recommendation, climate change, agriculture, crops, food security, Random forest, SVM, Decision tree, heat map, accuracy, use case

1. INTRODUCTION

Being an agricultural nation, India's economy is heavily dependent on rising agricultural yields and agroindustrial goods.Climate risks impacting the agricultural sector are direct risks to the food supply chain. The accelerated variability of climate impacts all components of the food chain. A comprehensive view of the entire food chain, including food production, processing, distribution, and retailing.

Analyze the different correlated characteristics, such as the location and the pH level used to gauge the soil's acidity or alkalinity. It is also taken into account together with the proportion of nutrients like nitrogen (N), phosphorus (P), and potassium (K). All of these characteristics of the data will be examined while building a model by using several acceptable machine learning techniques on the data. The system includes a model that accurately predicts crop production and provides the end user with appropriate advice regarding the necessary crops to plant depending on atmospheric and soil conditions of the area.

2. LITERATURE SURVEY

This article presents the various advantages and limitations of various techniques that have been developed and used extensively in the literature.

Impacts of climate change on the livestock food supply chain; a review of the evidence.(2021) [1]
The potential impacts of climate change on current livestock systems worldwide are a major concern, and yet the topic is covered to a limited extent in global reports such as the ones produced by the Intergovernmental Panel on Climate Change. There are many different climate-related dangers, but it is anticipated that these risks would be higher in places that are already hot and have few socioeconomic and institutional resources for adaptation. Future climates and how interdependent human and ecological systems will react to climatic shifts remain very unclear.
This paper first examines the extent to which the livestock supply chain is exposed to climate change, by drawing on important literature and expanding on recent issues of concern. After discussing the livestock sector's societal ability to cope or adapt to changes, we turn to broader societal issues and trends. In order to highlight potential risks related to climate change, we must first identify potential risks.

2. **The Effects of Global Climate Change on Agriculture.**(2021) [2]

The authors have determined climate-related parameters such as temperature, precipitation, soil moisture, and sea level.
Agriculture is one sector, which is important to consider in terms of climate change. A changing climate will both affect and contribute to the agriculture sector. The temperature rising, changes in the patterns of plant diseases and pests, and some variations in soil moisture all have the potential to reduce agricultural productivity. However, there may be some increases in agricultural productivity as a result of CO fertilization. Some plants are anticipated to respond favorably to atmospheric CO levels, speeding up their development and decreasing transpiration rates. Under increasing CO levels, crop plants might potentially be able to use water more effectively.

3. **Implications of climate change for diseases, crop yields, and food security.**(2011) [3]

Accelerated climate change has diverse effects on different parts of complex biological relationships, frequently leading to unpredictable changes. Environmental change has an impact on crop productivity and quality both directly and indirectly through diseases, which will alter but continue to be significant. To increase our comprehension and prioritization of the difficulties, a mix of multi-factorial experimentation and integrated modeling from many disciplines is required. This will aid in prioritizing breeding goals. Additional socioeconomic, regional, and political elements are influenced by food security.

4. **The impact of climate change on global food supply and demand, food prices, and land use.**(2009) [4]

Depending on where farming operations are located, crop yield changes brought on by climate change have varied degrees of impact on a country's food output.
Crop output variations may cause the use of agricultural land to be redistributed. We simulate the effects of crop yield change due to climate change as projected under the IPCC SRES scenario A2 on global food production, prices, and land use using a multi-region, multi-sector computable general equilibrium (CGE) model, which takes crop suitability of land into account in the optimal reallocation decision of land between uses.
According to our research, developing nations are more negatively impacted by climate change than developed nations. The crop production in developed nations, which are primarily found in higher latitudes, is benefited from climate change.

3. EXISTING SYSTEM ARCHITECTURE

Information for crop yield was assembled from FAOSTAT, which offers worldwide insights on food and agribusiness and gives admittance throughout 3 million time series and cross-sectional information identifying with crop yield. The last information outline for normal precipitation incorporates; nation, year, and normal precipitation each year. The information outline begins from 1985 to 2017, on other hand, the normal temperature information outline incorporates nation, year, and normal recorded temperature. The temperature information outline begins in 1743 and closes in 2013. The variety in years will think twice about gathering information a piece was joining a year to exclude any invalid qualities. Information for pesticides was gathered from FAO, it is prominent that it begins in 1990 and closes in 2016. A number of sources are consulted, and the information is gathered in an arranged form that makes it impossible to conduct the investigation. By applying unique methods like supplanting missing qualities and invalid qualities, we can change information into a reasonable organization. The Random Forest can break down crop development identified with the current climatic conditions and biophysical change. Random forest calculation makes choice trees on various information tests and afterward foresees the information from every subset and afterward by casting a ballot gives the better answer for the Framework. Forest uses the stowing strategy to train the information which expands the precision of the Result. 68% accuracy is achieved when this algorithm is applied to our dataset.

4. PROPOSED SYSTEM ARCHITECTURE

There are four sections in the web application, which provide crop recommendations, crop guides, weather forecasts, and government schemes.
The architecture consists of the soil nutrients and climatic parameters which make the final dataset. The dataset values are divided into training and testing values for the model comparison. As a result, the Random forest algorithm is chosen for the crop recommendation on the basis of accuracy.

User is funded with multiple applications on the web application including a few like the Government Scheme, Weather, and crop guide respectively.

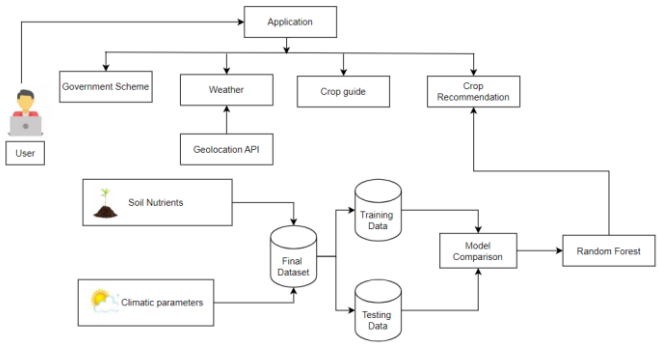

Fig -1: Proposed System Architecture

5. IMPLEMENTATION DETAILS

Farmeasy is a Web application that provides complete assistance to farmers with crop recommendations, crop guides, weather forecasts, and government schemes. The crop recommendation is done by comparing the accuracy of three machine learning models: Random forest, Support vector machine, and Decision tree. After analysis, random Forest

gives the maximum accuracy out of the three models. By taking parameters such as soil nutrients i.e. nitrogen, phosphorus, and potassium, and climatic factors like temperature, rainfall, humidity, and pH level of soil the crop is predicted. In the weather forecast section, the farmer can keep a track of the weather conditions for the upcoming seven days by using Geolocation API. The government scheme section gives the farmer access to all the current schemes for farming provided by the government. The crop guide provides general information like the climatic conditions required for the crop, soil type, seasons suitable for the crop, etc.

6. ALGORITHMS AND TECHNIQUES

1. Random forest

The class that the majority of the trees chose is the output of the random forest for classification problems. The mean or average prediction of each individual tree is returned for regression tasks.
For getting high accuracy we used Random forest. We split the data into training and testing. For each label, we had 160 samples so accordingly the decision trees were built which gave an accuracy that matched with the value of the test data giving us the algorithm that shows us how accurate our data is. This result is converted into a pickle file which is used with HTML CSS to implement and run as a website.

2. Support Vector Machine

A supervised machine learning approach called Support Vector Machine (SVM) is used for both classification and regression. However we also refer to them as regression issues, categorization is where they fit in best. Finding a hyperplane in an N-dimensional space that clearly classifies the data points is the goal of the SVM method. The number of features determines the hyperplane's size.
Svm was used to get the accuracy of the data but unlike the other two algorithms, SVM needed a normalization that involved the attribute values being scaled numerically so that they are equally important since normalized data produces better models for SVMs. The result was compared with the testing data and the accuracy was compared with the other two algorithms.

3. Decision Trees

The decision tree is a flowchart-like tree structure where each leaf node (terminal node) retains a class name, each internal node signals a test on an attribute, and each branch reflects a test result.
To have more options we implemented a decision tree to get accuracy and compare it with Random Forest. We split the data into training and testing. For each label, we had 160 samples so accordingly the decision trees were built which gave an accuracy that matched the value of the test data giving us the algorithm that shows us how accurate our data is.

7. USE CASE DIAGRAM

Use case diagrams are composed of actor graphs, use cases bounded by system boundaries, and communication associations between the actors and use cases. Each use case symbolizes a feature that a system offers to its users, and the use case diagram explains how a system interacts with external actors. A stick figure with the name of the actor beneath it is used to represent an actor, and a circle with the use case's name inside it represents a use case. The use cases are used to categorize and divide system functionality during the analysis portion of a project. Actors and use cases are used to segment the system. Actors portray the parts taken on by users of the system.

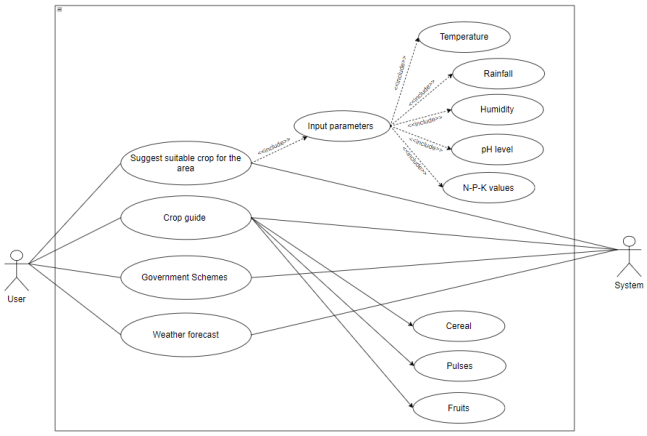

Fig -2: System Use Case Diagram

The system's use case diagram shows the direct and indirect relationships between the user and the system. The system also shows the implicit and explicit functions of the input parameters.

8. PERFORMANCE EVALUATION

Based on the input, or training, data, machine learning model accuracy is the measurement used to discover which model is best at recognizing correlations and patterns between variables in a dataset.

Accuracy:

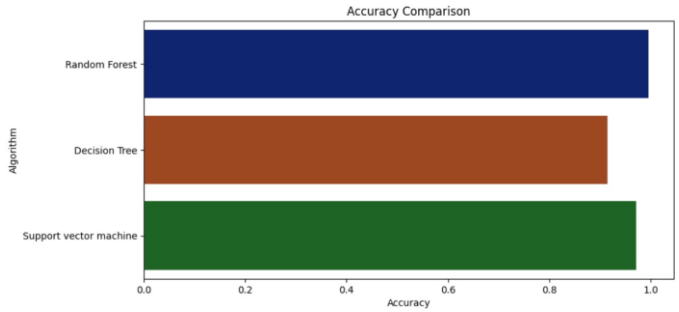

Fig -3: Algorithm Accuracy Comparison

Comparison of the accuracy of the three algorithms is performed in order to select the most accurate algorithm. According to the given graph, the Random Forest algorithm has an accuracy of 1, which is the highest on the accuracy scale compared to SVM which has an accuracy of 0.97, and the Decision tree which has an accuracy of 0.91. As a result, the Random Forest algorithm is used to solve the given problem.

Heat Map:

The heat map shows the magnitude and distribution of various input factors like temperature, humidity, pH level, rainfall, and soil nutrient values in the ratio of (NS-PS-KS). Readers are able to discern clustering or variation in color by either hue or intensity.

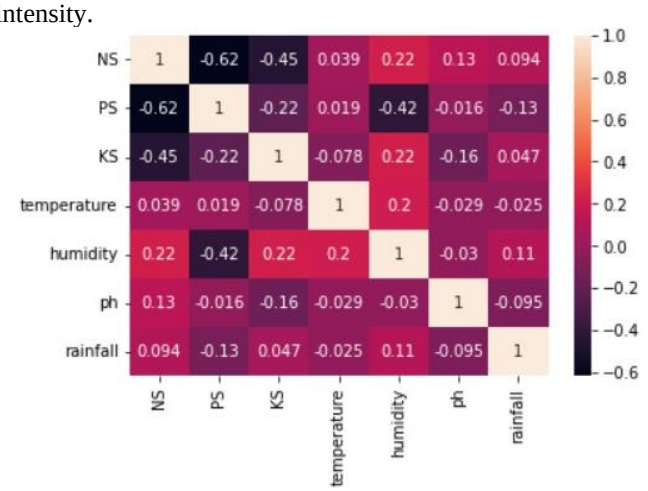

Fig -4: Algorithm Accuracy Comparison

9. DATASET USED

The dataset was downloaded from Kaggle and it offers worldwide insights on pesticides, rainfall, and temperature.

- The rainfall dataset consists of the average rainfall per area, the temperature dataset consists of the average temperature over the country/area, and the pesticide dataset consists of the unit value of pesticides used per area.
- The soil data consists of the N-P-K (Nitrogen-Phosphorus-Potassium) nutrient values of the soil in ratio for a specific region.
- The crop production of the top 10 most eaten crops worldwide was acquired from the FAO website once the necessary libraries had been imported. The following attributes of the dataset are present: nation, item, year (from 2001 to 2010), and yield value.

These datasets will help in calculating how the climate has an impact on food distribution.

10. RESULT AND DISCUSSION

The experimental results of the proposed system are provided in this given section. This presents the Home Page of our Web application, “FARMEASY” depicting the features provided on our website.

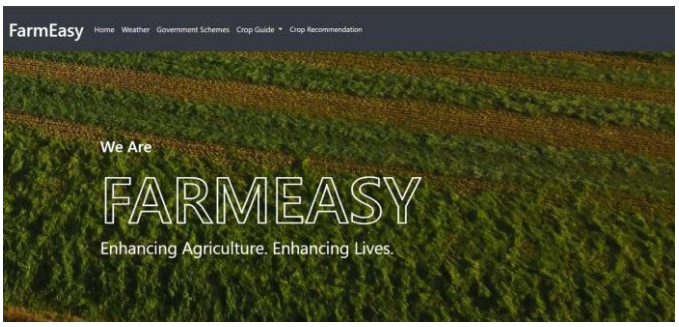

Fig -5: FARMEASY-Web Application

11. CONCLUSIONS

In this paper, the study of climatic conditions affecting the food supply chains is presented. The different algorithms such as Gradient Boosting Regressor, Random forest, Support Vector Machine, and Decision Trees used are explained. The different hybrid approaches are also described. The comparative study of various algorithms mentioned above is presented in this report. The distinct standard datasets or variable inputs are defined that may be used in experiments for this domain system. For the data exploration, data on Pesticides, Rainfall, and Temperature were used, and they could be used for further experiments.

REFERENCES

[1] Godde, C. M., et al. "Impacts of climate change on the livestock food supply chain; a review of the evidence." *Global food security* 28 (2021): 100488. [Online].Available:https://www.sciencedirect.com/science/article/pii/S2211912420301413

[2] Aydinalp, Cumhur, and Malcolm S. Cresser. "The effects of global climate change on agriculture." *American-Eurasian Journal of Agricultural & Environmental Sciences* 3.5 (2008): 672-676.

[3] Newton, Adrian C., Scott N. Johnson, and Peter J. Gregory. "Implications of climate change for diseases, crop yields and food security." *Euphytica* 179.1 (2011): 3-18. [Online].Available:https://link.springer.com/article/10.1007/s10681-011-0359-4

[4] HLee, Huey-Lin. "The impact of climate change on global food supply and demand, food prices, and land use." Paddy and Water Environment 7.4 (2009): 321-331. [Online].Available:https://link.springer.com/article/10.1007/s10333-009-0181-y

[5] Dataset used: https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset

[6] Link: https://app.diagrams.net/

[7] Link: https://github.com/atharval1/precision-agriculture-using-machine-learning