AGRICULTURAL CROP RECOMMENDATION BASED ON PRODUCTIVITY AND SEASON

MAJOR PROJECT REPORT

Submitted by

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20BCM502

Under the Guidance of

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Department of Computer Science

In partial fulfillment of the requirements for the award of the degree of

Bachelor of Science in Computer Science

of Bharathiar University

PSG COLLEGE OF ARTS & SCIENCE

DEPARTMENT OF COMPUTER SCIENCE

An Autonomous College-Affiliated to Bharathiar University

Accredited with 'A++' grade by NAAC (4th Cycle)

College with Potential for Excellence

(Status Awarded by the UGC)

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Coimbatore -641 014

MAY 2023

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CERTIFICATE

This is to certify that this Project work entitled **"AGRICULTURAL CROP RECOMMENDATION BASED ON PRODUCTIVITY AND SEASON"** is a bonafide record of work done by **ABINAYA.V(20BCM502)** in partial fulfillment of the requirements for the award of Degree of **Bachelor of Science in Computer Science** of Bharathiar University.

Signature of Faculty Guide

Signature of the HOD

Submitted for Viva-Voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I, **ABINAYA.V(20BCM502),** hereby declare that this Project work entitled **"AGRICULTURAL CROP RECOMMENDATION BASED ON PRODUCTIVITY AND SEASON"**, is submitted to PSG College of Arts & Science (Autonomous), Coimbatore in partial fulfillment for the award of Bachelor of Science in Computer Technology, is a record of original work done by me under the supervision and guidance of **S.S.Yuvaraj MCA, M.Phil.,M.E(Ph.D)** Assistant Professor in Department of Computer Science, PSG College of Arts & Science, Coimbatore.

This Project work has not been submitted by me for the award of any other Degree/ Diploma/ Associate ship/ Fellowship or any other similar degree to any other university.

PLACE : Coimbatore **ABINAYA V**

DATE : **20BCM502**

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With great gratitude, I would like to acknowledge the help of those who contributed with their valuable suggestions and timely assistance to complete this project work.

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INTRODUCTION

1.INTRODUCTION

1.1.SYNOPSIS

The project entitled **"AGRICULTURAL CROP RECOMMENDATION BASED ON PRODUCTIVITY AND SEASON"** is developed to keep track of all the crop production and maintaining a database for same which may be used for future references .In order to analyze and have a response ahead this type of crop productions, it is necessary to understand the season productivity. This imposes one such crop production analysis by using crops data obtained from Kaggle open source which in turn used for the prediction of crop cultivation. The major aspect of this project is to estimate which type of crop production contributes the most along with duration and crop types.It consists of crop information like season,temperature,rainfall,soil etc. Some machine learning algorithms such as Random Forest Classifier is implied in this work in order to classify among various crop production and the accuracy achieved was comparatively high when compared to precomposed works.

1.2.PROJECT OVERVIEW

Agriculture is the backbone of Indian Economy. In India, majority of the farmers are not getting the expected crop yield due to several reasons. The agricultural yield is primarily depends on weather conditions. Rainfall conditions also influences the rice cultivation. In this context, the farmers necessarily requires a timely advice to predict the future crop productivity and an analysis is to be made in order to help the farmers to maximize the crop production in their crops. Machine learning is the process of extract helpful and significant information from huge sets of data. Data Mining in agriculture field is a comparatively novel research field. In the earlier period, yield prediction was performing by considering farmer's experience on particular field and crop. In any of Data Mining actions the training data is to be collected from past data and the gathered data is used in terms of training which has to be exploited to study how to categorize future yield predictions. There are multiple ways to increase and improve the crop yield and the quality of the crops. Data mining also useful for predicting the crop yield production. Generally, data mining is the process of analyzing data from different perspectives and summarizing it into useful information. Data mining software is an analytical tool that allows users to analyze data from many different dimensions or angles, categorize, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases. The patterns, associations, or relationships among all this data can provide information. Information can be converted into knowledge about historical patterns and future trends. For example, summary information about crop production can help the farmers identify the crop losses and prevent it in future.

OBJECTIVE OF THE PROJECT

2.OBJECTIVE OF THE PROJECT

2.1. MODULES

- Data Collection
- Dataset
- Data Preparation
- Model Selection
- Analyze and Prediction

2.2. MODULE DESCRIPTION

Data Collection

This is the first real step towards the real development of a machine learning model, collecting data. This is a critical step that will cascade in how good the model will be, the more and better data that we get, the better our model will perform.There are several techniques to collect the data, like web scraping, manual interventions and etc.The dataset used in this crop recommendation in India taken from some other source.

Dataset

The dataset consists of 821 individual data.There are 14 columns in the dataset,which are described below.

1.States → number of states in India
2.Rainfall → rainfall in mm
3Groundwater →total groundwater level
4.Temperature→temperature in degree celsius
5.Soil type →name of the soil type
6.Season→which season is suitable for crops
7.Crops →types of crops
8.Fertilizer required →type of fertilizer required
9.Cost of cultivation →total cost for cultivation
10.Expected revenues→total expected revenues
11.Quantity of seeds per hectare →seeds quantity per hectare

12.Duration of cultivation→number of days for crop cultivation

13.Demand for crop→demand for crop(high,low)

14.Crops for mixed cropping→which crop can be mixed for cropping

Data Preparation

Wrangle data and prepare it for training. Randomize data, which erases the effects of the particular order in which we collected and/or otherwise prepared our data. Visualize data to help detect relevant relationships between variables or class imbalances or perform other exploratory analysis split into training and evaluation sets.

Model Selection

We used Random Forest Classifier machine learning algorithm.

Random Forest Algorithm

It technically is an ensemble method (based on the divide-and-conquer approach) of decision trees generated on a randomly split dataset. This collection of decision tree classifiers is also known as the forest. The individual decision trees are generated using an attribute selection indicator such as information gain, gain ratio, and Gini index for each attribute. Each tree depends on an independent random sample. In a classification problem, each tree votes and the most popular class is chosen as the final result. In the case of regression, the average of all the tree outputs is considered as the final result. It is simpler and more powerful compared to the other non-linear classification algorithms.

Analyze and Prediction

In the actual dataset, we chose only 7 features:

1.States → number of states in India

2.Rainfall → rainfall in mm

3Groundwater →total groundwater level

4.Temperature→temperature in degree celsius

5.Soil type →name of the soil type

6.Season→which season is suitable for crops

7.Crops →types of crops

SYSTEM SPECIFICATION

3.SYSTEM SPECIFICATION

3.1. HARDWARE SPECIFICATION

- System : Pentium i3 Processor.
- Hard Disk : 500 GB.
- Monitor : 15'' LED
- Input Devices : Keyboard, Mouse
- Ram : 4 GB

3.2. SOFTWARE SPECIFICATION

- Operating system : Windows 10.
- Coding Language : Python
- Web Framework : Flask

3.3. SOFTWARE DESCRIPTION

Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed. Python provides a better structure and support for large programs than shell scripting.

Python Features

Python has few keywords, simple structure, and a clearly defined syntax. Python code is more clearly defined and visible to the eyes. Python's source code is fairly easy-to-maintaining. Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows .Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

It allows to add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.

Python provides interfaces to all major commercial databases. One of the key aspects of Python is its object-oriented approach. This basically means that Python recognizes the concept of class and object encapsulation thus allowing programs to be efficient in the long run.

Python is one of the most dynamic languages available in the industry today. There is no need to specify the type of the variable during coding, thus saving time and increasing efficiency.

Python is an open-source programming language which means that anyone can create and contribute to its development. Python is free to download and use in any operating system, like Windows, Mac or Linux.

Flask Framework

Flask is a web application framework written in Python. Armin Ronacher, who leads an international group of Python enthusiasts named Pocco, develops it. Flask is based on Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects.

Http protocol is the foundation of data communication in world wide web. Different methods of data retrieval from specified URL are defined in this protocol.

SYSTEM ANALAYSIS

4.SYSYEM ANALYSIS

4.1. EXISTING SYSTEM

- Tripathy et al., provided a system to have management of pesticides for crop cultivation using data mining process.
- Pritam Bose developed a SNN model to have a spatiotemporal analysis with crop estimation.
- Crop and Yield Prediction Model suggested by Shreya S. Bhamose used Modified k-means clustering algorithm predicts the amount of harvest of crops and also water requirement for crops.

DISADVANTAGES OF EXISTING SYSTEM

- In the existing system, they considered only about a particular State and not about all the states and other parameters.
- Relatively slower to build.
- Hard to interpret.
- Computationally expensive.

4.2. PROPOSED SYSTEM

- Crop production depends on many agricultural parameters. Proposed work is based on the production of crops in previous years, crops can be recommended to the farmers.
- This kind of suggestions will make farmer to know that whether that particular is yielding a good production in recent years. Production of crops may become less due to any crop disease, water problem and many other factors. While considering about the production, farmers may get knowledge about which crop is in high volume in the market in that year. Based on this farmer can take decision of trend on crops in recent years. Farmers will be given recommendation by considering the season of crop production.

- The problem statement of the project is to recommend crops to the farmers using Decision Tree Classifier. The basic process of this project is that we will preprocess the data provided to us, then it is used to prepare the model for the backed and using flask to connect it to the UI interface to show the full and final output.

ADVANTAGES OF PROPOSED SYSTEM

- In our proposed system, we have used a large dataset considering all the states of India, whereas in the existing system only a particular state was taken into the consideration.
- These recommendations can be extracted for educating the famers. Pictorial representation shows the farmer a deeper knowledge about the crops to choose for cultivation.
- Does not require normalization or Scaling
- Easily built
- Easy to interpret
- Computationally less expensive

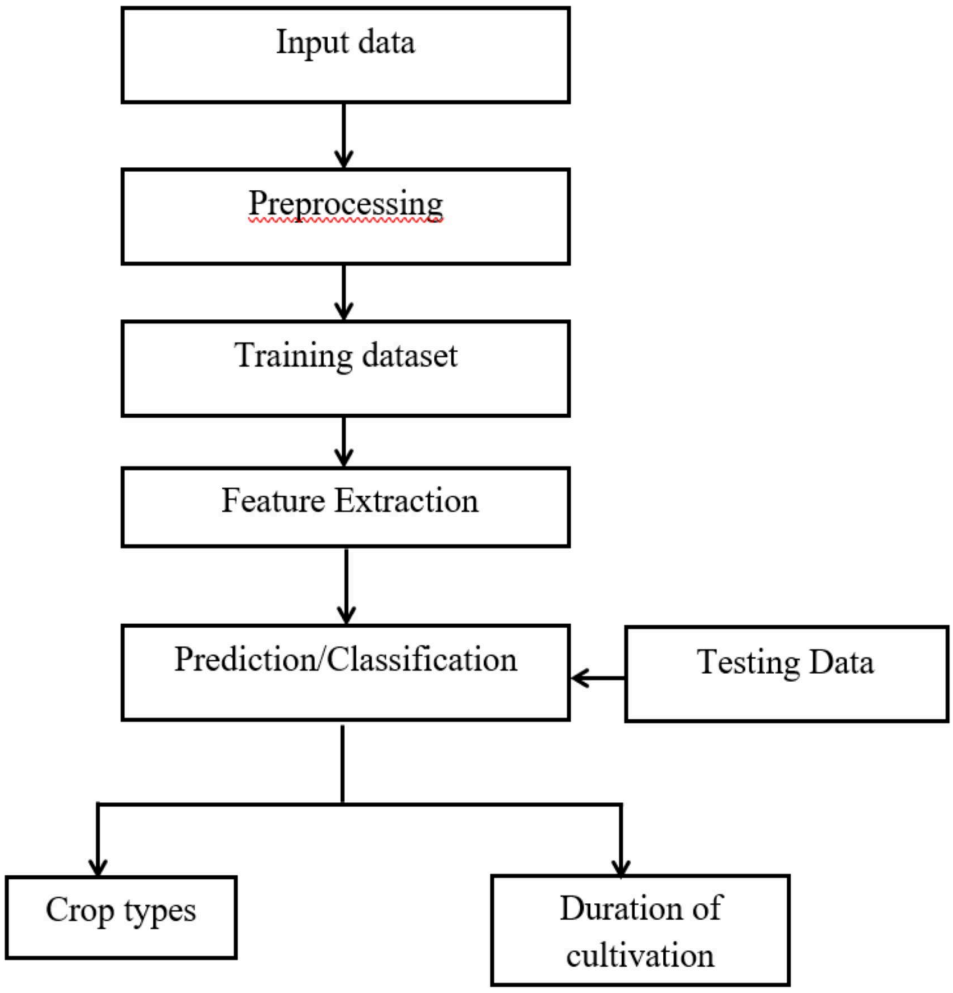
SYSTEM DESIGN

5.SYSTEM DESIGN

5.1. DATAFLOW DIAGRAM

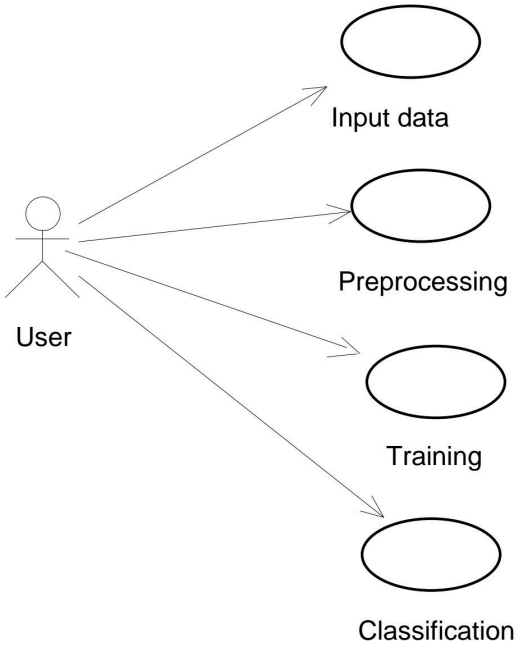
A data-flow diagram (DFD) is a graphical representation of the "flow" of data through an information system. DFDs can also be used for the visualization of data processing (structured design). On a 0DFD, data items flow from an external data source or an internal data store to an internal data store or an external data sink, via an internal process. The purpose of a DFD is:

- To show the scope and boundaries of a system
- To show that the whole system has been considered
- May be used as a communications tool between a systems analyst and any person who plays a part in the system



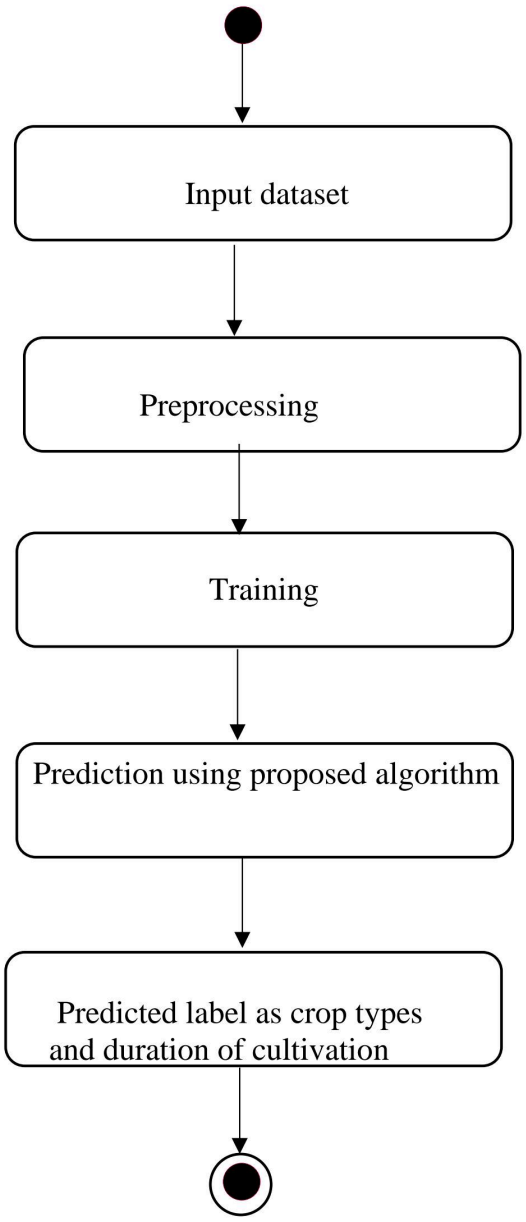
5.2. USECASE DIAGRAM

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted.



5.3. ACTIVITY DIAGRAM

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.



5.4. INPUT DESIGN

- The input design is the process of entering data to the system. The input design goal is to enter to the computer as accurate as possible. Here inputs are designed effectively so that errors made by the operations are minimized. The inputs to the system have been designed in such a way that manual forms and the inputs are coordinated where the data elements are common to the source document and to the input.
- The quality of the system input determines the quality for system output. Input specification describes the manner in which data entered the system processing.
- Input design is the process of converting user-originated inputs to a computer-based format input data are collected and organized into group of similar data. Once identified, appropriate input media are selected for processing.
- The input design also determines the user to interact efficiently with the system. Input design is a part of overall system design that requires special attention because it is the common source for data processing error. The goal of designing input data is to make entry easy and free from errors.

5.5. OUTPUT DESIGN

- The output design was done so that results of processing could be communicated to the users. The various outputs have been designed in such a way that they represent the same format that the office and management used to.
- Computer output is the most important and direct source of information to the user. Efficient, intelligible output design should improve the systems relationships with the user and help in decision making. A major form of output is the hardcopy from the printer.
- Output requirements are designed during system analysis. A good starting point for the output design is the Data Flow Diagram (DFD). Human factors educe issues for design involves addressing internal controls to ensure readability.

SYSTEM TESTING AND IMPLEMENTATION

6. SYSTEM TESTING AND IMPLEMENTATION

Implementation is last stage of the project, when the theoretical design is turned into a working system. The test ontologies are meant to be created and grown during the maintenance of the ontology. Every time an error is encountered in the usage of the ontology, the error is formalized and added to the appropriate ontology. Experienced ontology engineers may add appropriate axioms in order to anticipate and counter possible errors in maintenance. Ontologies in information systems often need to fulfill the requirement of allowing reasoners to quickly answer queries with regards to the ontology. Light weight ontologies usually fulfill this task best.

Also, for these pre-use consistency tests, more expressive logical formalisms could be used, like reasoning over the ontology meta model, or using the transformation of the ontology to a logic programming language like datalog and then add further integrity constraints to that resulting program.

6.1 SYSTEM TESTING

Systems are modeled in order to bridge the gap between real world problems and virtual solutions: portrayed as single or multiple elements of existence existing within a defined boundary, systems can be recursively defined through different levels of abstraction.

This project aims to facilitate the testing and evaluation of systems through novel ways of their modeling, by using ontologies to describe their domains and building machines capable of understanding the software and hardware entities systems contain. Evaluation and testing also have important roles to play in demonstrating how systems can affect their own environment and the natural world, and this project postulates modeling the environment as a single domain. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

System testing is the process of exercising software with the intent of finding and ultimately correcting errors. This fundamental philosophy does not change for web applications, because Web-based systems and application reside on a network in operate with many different operating system, browsers, hardware platforms, and communication protocols; the search for errors represents a significant challenge for web application.

Testing Methodologies

"Agricultural crop recommendation based on productivity and season" is developed in modular fashion. That is, the system is broadly classified into modules. Each module in turn consists of a number of programs to achieve a specified goal. This modular approach not only makes design easier but also makes testing simpler.

White box testing

This testing is sometimes called "Glass Box Testing". White box testing follows the logical errors and incorrect assumptions. This method uses the control structure of the procedural design to derive test cases. With this white box testing it is able to test all the independent paths are examined or exercised with their true and false. It also uses the external data structure to ensure their validity.

Black Box Testing

This method focuses on the functional requirements of the software. This tests the fully functional conditions of the program. This is used likely uncover the errors than the white box testing. Black box testing is not an alternative to white box testing technique; rather it is a complementary approach to uncover a different class of errors.

Comparison Testing

This is a method that a way of alternate software exactly as the existing one is developed by another team and this will be very useful in critical situations. This new software is tested with the identical inputs as the previous one to check whether it satisfies the existing terms and conditions.

Unit Testing

Ontologies behave quite differently than program units. As there is no information hiding in ontology engineering and thus no black box components. Ontologies are different. As of now, no forms of information hiding or interfaces are available – and it remains an open research issue in the field of ontology modularization.Unit tests are easy manageable tests for small parts of a program – single units. They proved especially useful to capture unwanted changes.

Integration Testing

Integration testing focuses on the design and the construction of the software architecture. Data can be lost across an interface; one module can have adverse effect on another sub function and so on. Thus this project meets software meets all functional, behavioral and performance requirements. The errors, which are uncovered during integration testing, are corrected during this phase.

Validation Testing

Formalizing the queries, instead of writing them down in natural language, and formalizing the expected answers as well, allows for a system that automatically checks if the ontology meets the requirements stated with the competency questions. Thus the proposed system under consideration has been tested by using validation testing and found to be working satisfactorily.

User Acceptance Testing

User acceptance of a system is the key factor for the success of any system. The system under consideration is tested for user acceptance by constantly keeping in touch with the prospective system users at time of developing and making changes wherever required.

The above testing is done, by taking various kinds of test data. Preparation of test data plays a vital role in the system testing. After preparing the test data the system under study is tested using that test data. While testing the system by using test data errors are again uncovered and corrected by using above testing steps and corrections are also noted for future use.

6.2 SYSTEM IMPLEMENTATION

System implementation is the stage of the project when the theoretical design is turned into a working system. If the implementation stage is not correctly planned and controlled, it can be choice. The following are the main stages in the implementation:

- Planning
- Training
- Maintenance

Planning

Planning plays an important role in the implementation. The planning should face any practical problems of controlling various activities of people out their own data processing department.

Training

Successful implementation needs trained computer staff. So some staff can teach them about the computer implementation, which only then becomes a well-designed system.

Maintenance

Maintenance involves recovery on crash such as the backups and the end user should be given only executable format of the system.

SCOPE FOR FUTURE ENHANCEMENT

7. SCOPE FOR FEATURE ENHANCEMENT

This system is very flexible so that the maintenance and further amendments based on the changing environment and requirements can be made easily.

This project can be extended in future to provide additional facilities

- In Future, more security features will be added in future when detecting beacon Movement.
- In feature crop recommendation view in android and IOS app format.
- Users can view all crop details and enter some input and answers send through mobile format.
- This project done with detailed analysis of existing system and a careful design. So that future modification can be done in efficient manner with minimum disturbance to the system.
- Later by use of some other techniques the system will achieve 100% accuracy

This project is mainly supported for multi user environment. That is more than one user can use simultaneously. The system developed should be secured and protected against all possible hazards.

CONCLUSION

8.CONCLUSION

In this project, significance of management of crops was studied vastly. Farmers need assistance with recent technology to grow their crops. Proper prediction of crops can be informed to agriculturists in time basis. Many Machine Learning techniques have been used to analyze the agriculture parameters. Some of the techniques in different aspects of agriculture are studied by a literature study. Blooming Neural networks, Soft computing techniques plays significant part in providing recommendations. Considering the parameter like production and season, more personalized and relevant recommendations can be given to farmers which makes them to yield good volume of production.

APPENDICES

9.APPENDICES

9.1.SCREENSHOTS

Login page

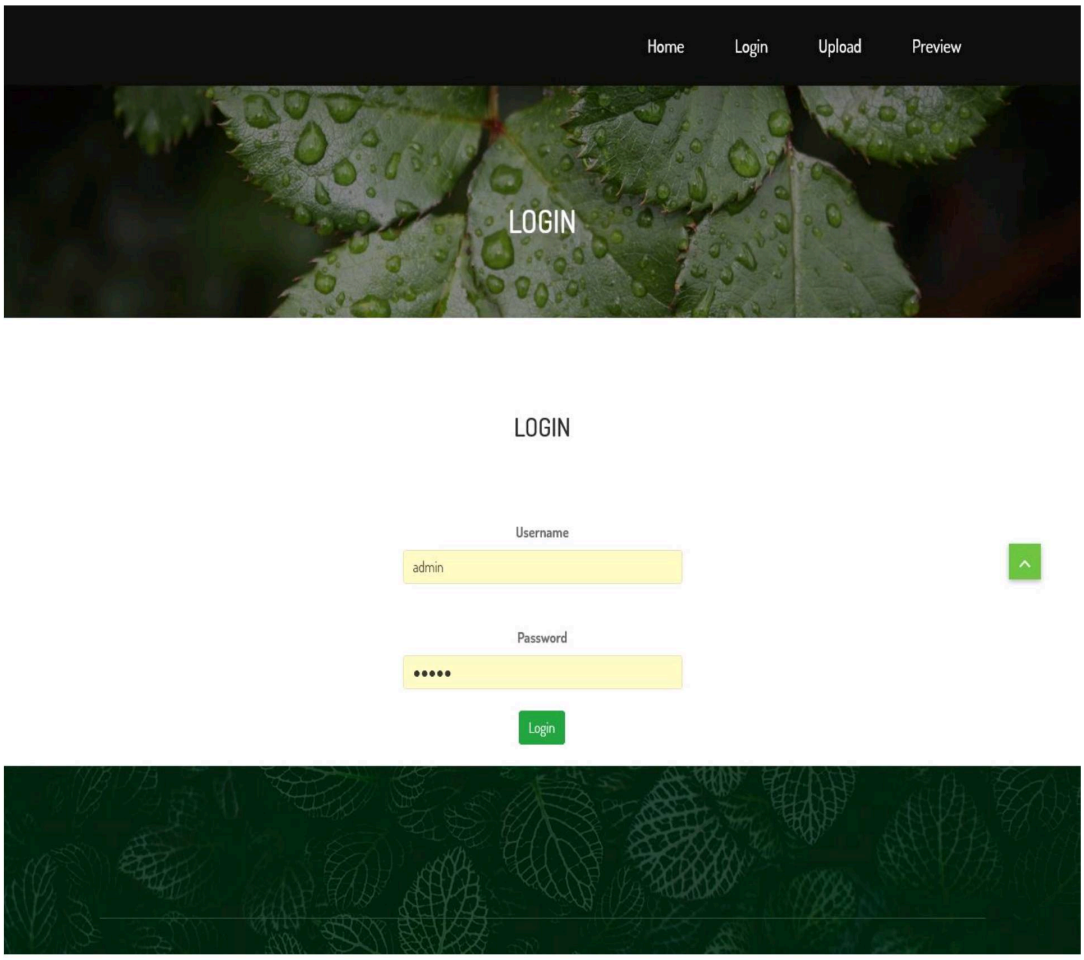


Figure-9.1.1

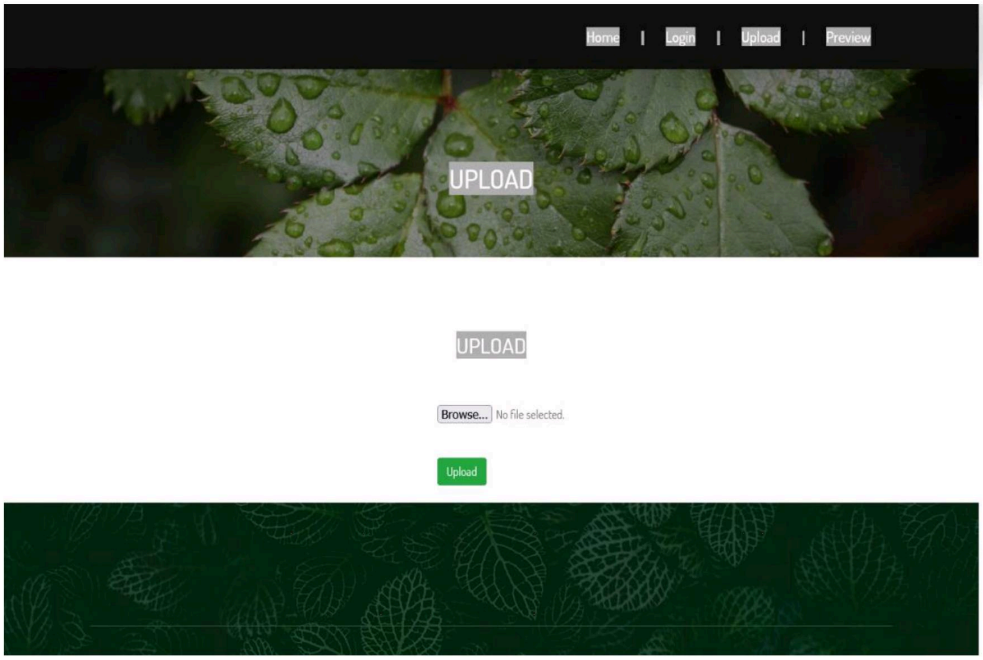


Figure-9.1.2

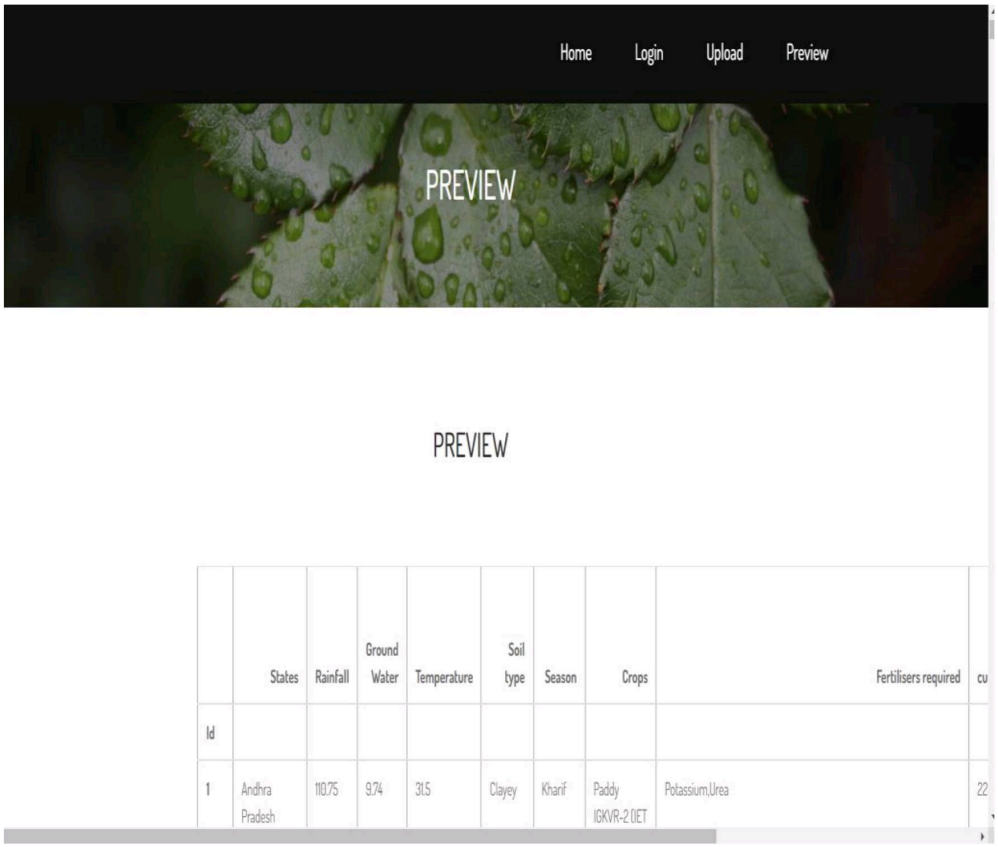


Figure-9.1.3

820	Uttarakhand	164.50	7.50	37.5	Black	winter	Sweet potato	NPK(low)
821	Pudducherry	137.50	12.30	23.5	Alluvial	Kharif	Cotton VBCH 2231	NPK

Click to Train I Test

Figure-9.1.4

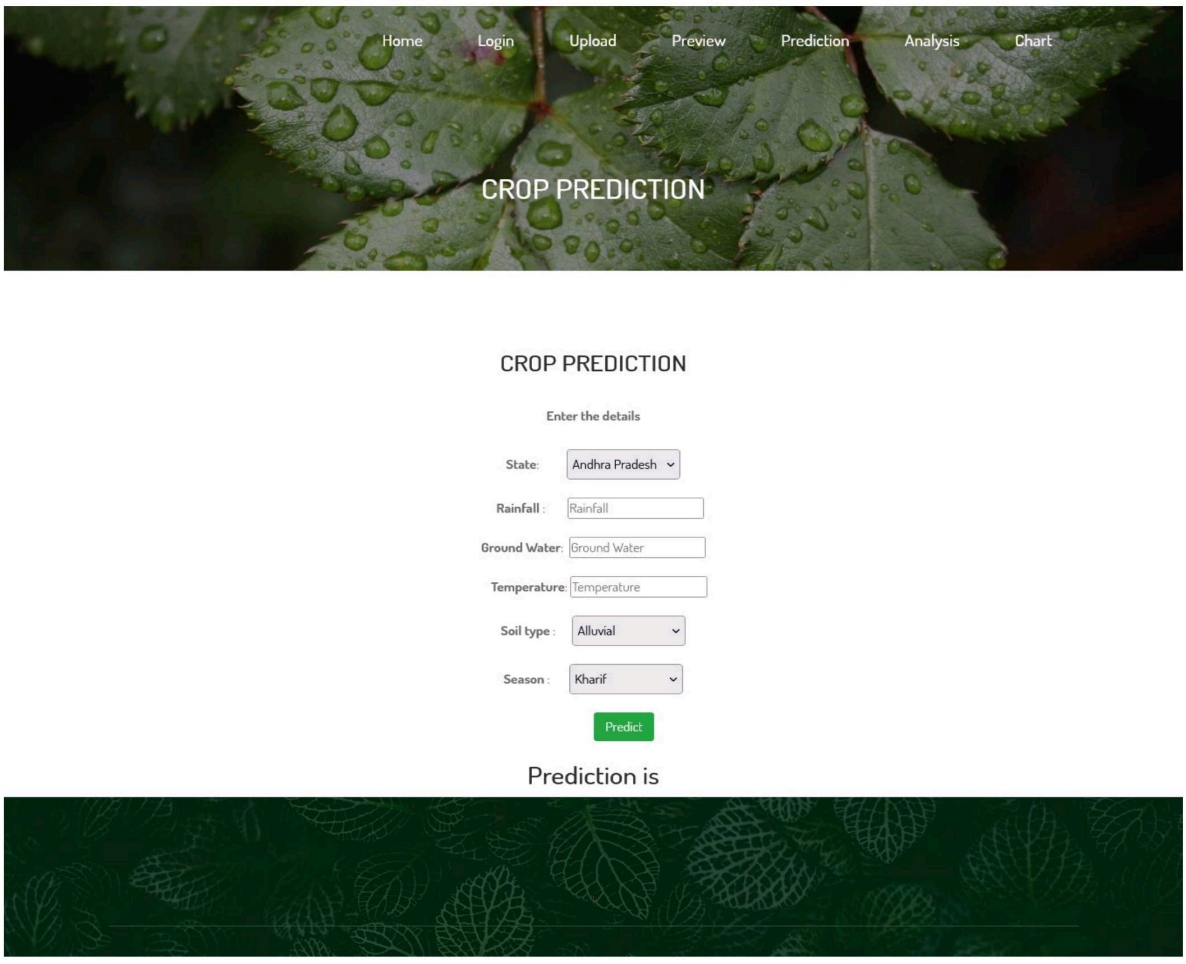


Figure-9.1.5

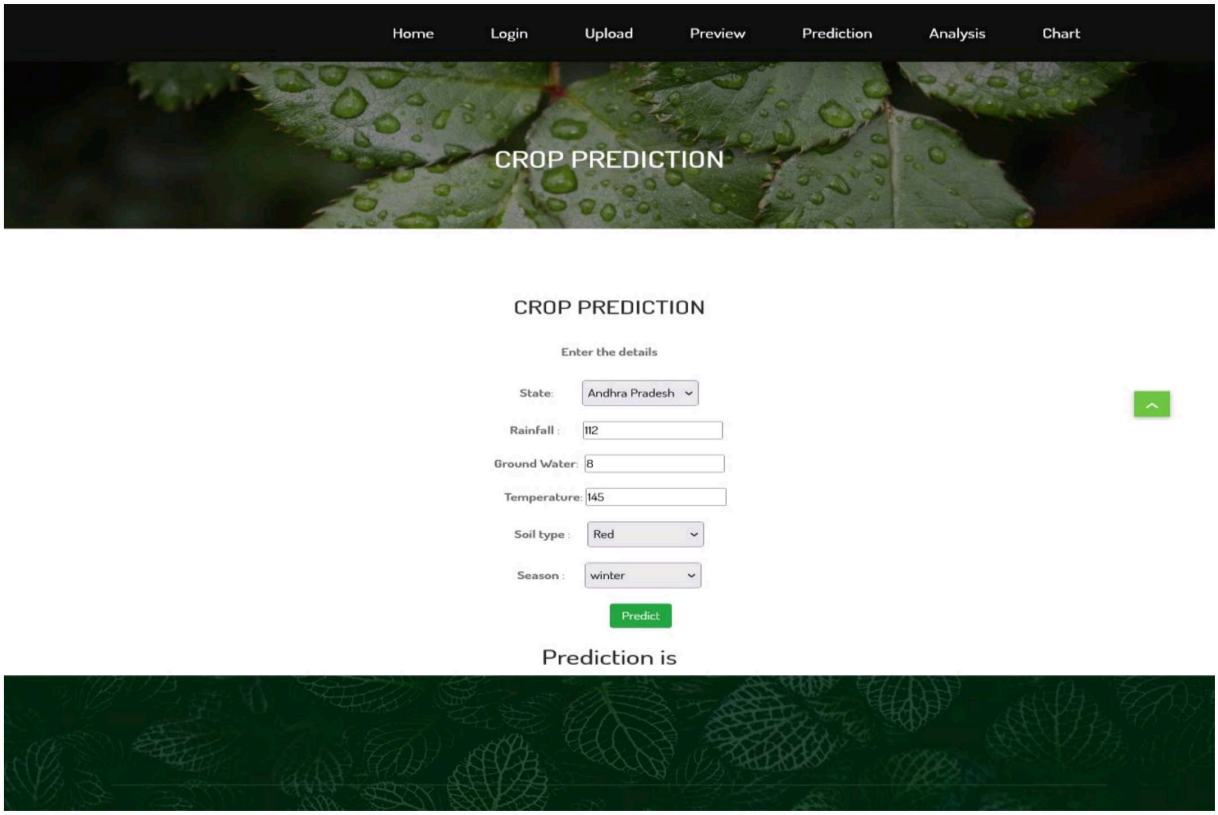
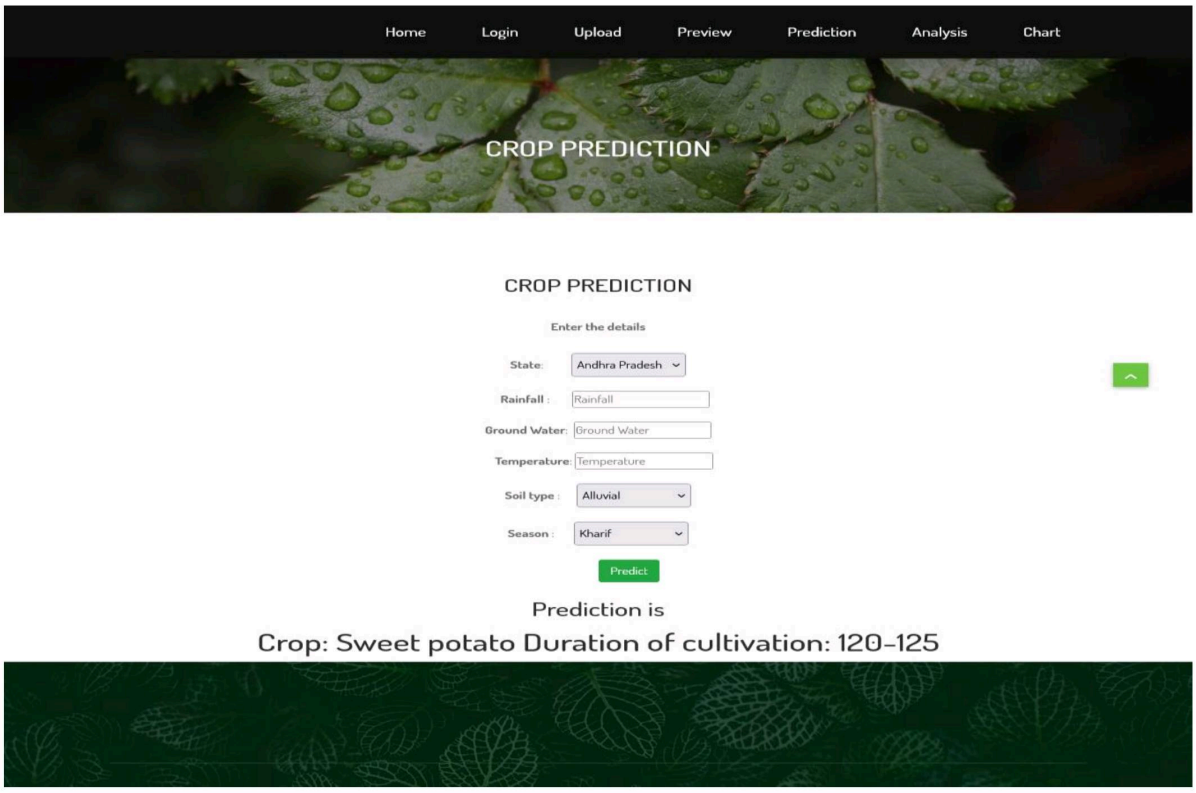


Figure-9.1.6



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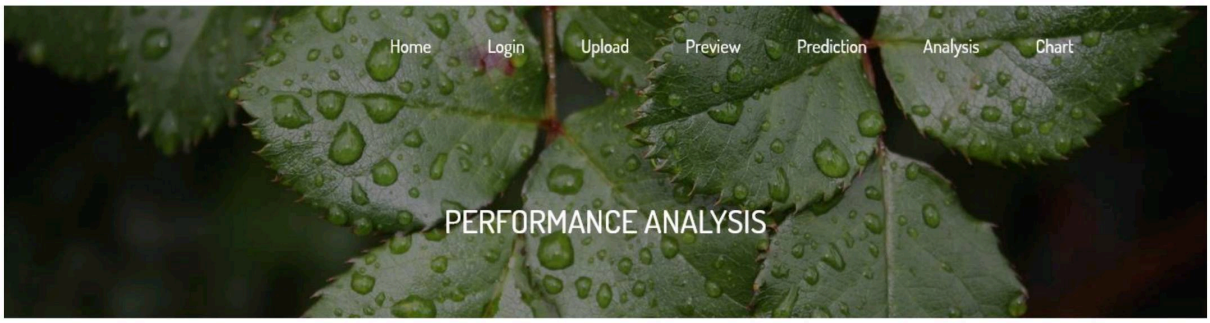


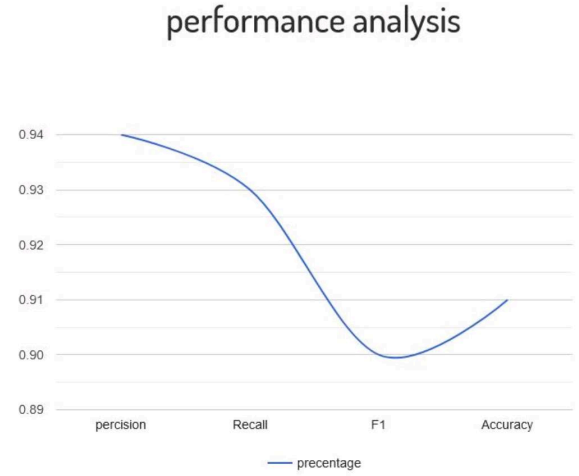
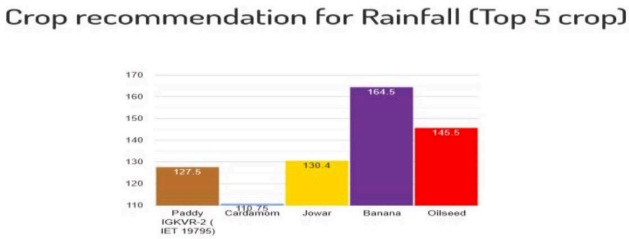


Figure-9.1.8



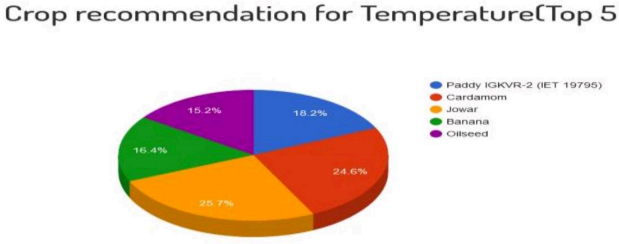


Figure-9.1.9

9.2.SAMPLE CODE

```
import numpy as np
import pandas as pd
from flask import Flask, request, jsonify, render_template, redirect, flash, send_file
from sklearn.preprocessing import MinMaxScaler
from werkzeug.utils import secure_filename
import pickle
import numpy as np
import pandas as pd
from flask import Flask, request, jsonify, render_template, redirect, flash, send_file
from sklearn.preprocessing import MinMaxScaler
from werkzeug.utils import secure_filename
import pickle
import numpy as np
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, BaggingClassifier,
AdaBoostClassifier, VotingClassifier
app = Flask(__name__) #Initialize the flask App
#forest = pickle.load(open('boosting.pkl','rb'))
crop = pickle.load(open('crop.pkl','rb'))
@app.route('/')
@app.route('/index')
def index():
        return render_template('index.html')
@app.route('/analysis')
def analysis():
        return render_template('analysis.html')
@app.route('/chart')
def chart():
        return render_template('chart.html')
```

```
#@app.route('/future')
#def future():
#         return render_template('future.html')
@app.route('/login')
def login():
         return render_template('login.html')
@app.route('/upload')
def upload():
   return render_template('upload.html')
@app.route('/preview',methods=["POST"])
def preview():
   if request.method == 'POST':
      dataset = request.files['datasetfile']
      df = pd.read_csv(dataset,encoding = 'unicode_escape')
      df.set_index('Id', inplace=True)
      return render_template("preview.html",df_view = df)
#@app.route('/home')
#def home():
 #   return render_template('home.html')
@app.route('/prediction', methods = ['GET', 'POST'])
def prediction():
   return render_template('prediction.html')
#@app.route('/upload')
#def upload_file():
#   return render_template('BatchPredict.html')
@app.route('/predict',methods=['POST'])
def predict():
         int_feature = [x for x in request.form.values()]
         final_features = [np.array(int_feature)]
         y_pred=crop.predict(final_features)
         if y_pred[0] == 'Paddy IGKVR-2 (IET 19795)':
                  label="Crop: Paddy IGKVR-2 (IET 19795) Duration of cultivation: 105-123"
         elif y_pred[0] == 'Paddy CR Dhan 501 (IET 19189)':
```

```
            label="Crop: Paddy CR Dhan 501 (IET 19189) Duration of cultivation: 105-
126"
        elif y_pred[0] == 'Wheat VL Gehun 907 (VL 907)':
            label="Crop: Wheat VL Gehun 907 (VL 907)) Duration of cultivation: 60-154"
        elif y_pred[0] == 'Wheat WHD 943':
            label="Crop: Wheat WHD 943 Duration of cultivation: 60-157"
        elif y_pred[0] == 'Millet Nandi-65 (MH-1549)':
            label="Crop: Millet Nandi-65 (MH-1549) Duration of cultivation: 65-70"
        elif y_pred[0] == 'Lentil Pant Lentil-8(Pant L-063)':
            label="Crop: Lentil Pant Lentil-8(Pant L-063) Duration of cultivation: 45-60"
        elif y_pred[0] == 'Bajra':
            label="Crop: Bajra Duration of cultivation: 45-50"
        elif y_pred[0] == 'Cardamom':
            label="Crop: Cardamom Duration of cultivation: 730-735"
        elif y_pred[0] == 'Urad':
            label="Crop: Urad Duration of cultivation: 70-85"
        elif y_pred[0] == 'Jowar':
            label="Crop: Jowar Duration of cultivation: 65-75"
        elif y_pred[0] == 'Paddy CR Dhan 401 (REETA)':
            label="Crop: Paddy CR Dhan 401 (REETA) Duration of cultivation: 105-124”
        elif y_pred[0] == 'Millet MH 1540 (86M64) (Hybrid)':
        label="Crop: Millet MH 1540 (86M64) (Hybrid) Duration of cultivation: 65-73"
        elif y_pred[0] == 'Sugarcane Karan 5 (Co 0124)':
            label="Crop: Sugarcane Karan 5 (Co 0124) Duration of cultivation: 300-451"
        elif y_pred[0] == 'Banana':
            label="Crop: Banana Duration of cultivation: 365-370"
        elif y_pred[0] == 'Arhar':
            label="Crop: Arhar Duration of cultivation: 120-200"
        elif y_pred[0] == 'Clove':
            label="Crop: Clove Duration of cultivation: 120-180          "
        elif y_pred[0] == 'Oilseed':
            label="Crop: Oilseed Duration of cultivation: 110-115"
        elif y_pred[0] == 'Tea':
            label="Crop: Tea Duration of cultivation: 60-65"
```

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    elif y_pred[0] == 'Coffee':
        label="Crop: Coffee Duration of cultivation: 240-270"
    elif y_pred[0] == 'Turmeric':
        label="Crop: Turmeric Duration of cultivation: 210-270"
    elif y_pred[0] == 'Cashewnut':
        label="Crop: Cashewnut Duration of cultivation: 1030-1035"
    elif y_pred[0] == 'Ragi':
        label="Crop: Ragi Duration of cultivation: 5.0-7.0"
    elif y_pred[0] == 'Soyabean':
        label="Crop: Soyabean Duration of cultivation: 45-65"
    elif y_pred[0] == 'Black Gram':
        label="Crop: Black Gram Duration of cultivation: 70-85"
    elif y_pred[0] == 'Khesari':
        label="Crop: Khesari Duration of cultivation: 125-130"
    elif y_pred[0] == 'Wheat MACS 6222':
        label="Crop: Wheat MACS 6222 Duration of cultivation: 60-151"
    elif y_pred[0] == 'Black Pepper':
        label="Crop: Black Pepper Duration of cultivation: 120-150"
    elif y_pred[0] == 'Chillies':
        label="Crop: Chillies Duration of cultivation: 40-45"
    elif y_pred[0] == 'Garlic':
        label="Crop: Garlic Duration of cultivation: 120-150"
    elif y_pred[0] == 'Wheat MPO(JW) 1215 (MPO 1215)':
        label="Crop: Wheat MPO(JW) 1215 (MPO 1215) Duration of cultivation: 60-
150"
    elif y_pred[0] == 'Maize PMH 5 (JH 3110)':
        label="Crop: Maize PMH 5 (JH 3110) Duration of cultivation: 95-105"
    elif y_pred[0] == 'Groundnut Kadiri Harithandhra (K 1319)':
        label="Crop: Groundnut Kadiri Harithandhra (K 1319) Duration of cultivation:
110-121"
    elif y_pred[0] == 'Groundnut GPBD 5':
        label="Crop: Groundnut GPBD 5 Duration of cultivation: 110-122"
    elif y_pred[0] == 'Lentil Pant Lentil-7(Pant L-024)':
        label="Crop: Lentil Pant Lentil-7(Pant L-024) Duration of cultivation: 45-61"
```

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    elif y_pred[0] == 'Tobacco':
        label="Crop: Tobacco Duration of cultivation: 90-120"
    elif y_pred[0] == 'Tomato':
        label="Crop: Tomato Duration of cultivation: 50-60"
    elif y_pred[0] == 'Cocoa':
        label="Crop: Cocoa Duration of cultivation: 150-180"
    elif y_pred[0] == 'Rubber':
        label="Crop: Rubber Duration of cultivation: 120-130"
    elif y_pred[0] == 'Masoor':
        label="Crop: Masoor Duration of cultivation: 120-130"
    elif y_pred[0] == 'Sunhemp':
        label="Crop: Sunhemp Duration of cultivation: 60-90"
    elif y_pred[0] == 'Varagu':
        label="Crop: Varagu Duration of cultivation: 160-165"
    elif y_pred[0] == 'Paddy CR Dhan 601 (IET 18558)':
        label="Crop: Paddy CR Dhan 601 (IET 18558) Duration of cultivation: 105-
125"
    elif y_pred[0] == 'Wheat Netravati (NIAW 1415)':
        label="Crop: Wheat Netravati (NIAW 1415) Duration of cultivation: 95-100"
    elif y_pred[0] == 'Maize HSC1':
        label="Crop: Maize HSC1 Duration of cultivation: 95-100"
    elif y_pred[0] == 'Millet Nandi-61 (MH-1548)':
        label="Crop: Millet Nandi-61 (MH-1548) Duration of cultivation: 65-71"
    elif y_pred[0] == 'Millet 86M64 (MSH 203) (Hybrid)':
        label="Crop: Millet 86M64 (MSH 203) (Hybrid) Duration of cultivation: 65-
72"
    elif y_pred[0] == 'Barley Pusa Losar (BH- 380)':
        label="Crop: Barley Pusa Losar (BH- 380) Duration of cultivation: 60-72"
    elif y_pred[0] == 'Maize DHM 119 (BH 4062)':
        label="Crop: Maize DHM 119 (BH 4062) Duration of cultivation: 95-103"
    elif y_pred[0] == 'Millet HHB 226 (MH 1479)':
        label="Crop: Millet HHB 226 (MH 1479) Duration of cultivation: 65-76"
    elif y_pred[0] == 'Jute':
        label="Crop: Jute Duration of cultivation: 120-150"
```

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    elif y_pred[0] == 'Paddy Chinsurah Rice (IET 19140)':
        label="Crop: Paddy Chinsurah Rice (IET 19140) Duration of cultivation: 105-
120"
    elif y_pred[0] == 'Paddy (CNI 383-5-11)':
        label="Crop: Paddy (CNI 383-5-11) Duration of cultivation: 105-121"
    elif y_pred[0] == 'Paddy IGKVR-1 (IET 19569)':
        label="Crop: Paddy IGKVR-1 (IET 19569) Duration of cultivation: 105-122"
    elif y_pred[0] == 'Onion':
        label="Crop: Onion Duration of cultivation: 80-150"
    elif y_pred[0] == 'Cotton CNH012':
        label="Crop: Cotton CNH012 Duration of cultivation: 80-150"
    elif y_pred[0] == 'Cotton CICR-3 (CISA 614)':
        label="Crop: Cotton CICR-3 (CISA 614) Duration of cultivation: 105-120"
    elif y_pred[0] == 'Rice':
        label="Crop: Rice Duration of cultivation: 105-120"
    elif y_pred[0] == 'Flax':
        label="Crop: Flax Duration of cultivation: 120-140"
    elif y_pred[0] == 'Barley BH-902':
        label="Crop: Barley BH-902 Duration of cultivation: 60-70"
    elif y_pred[0] == 'Sunflower':
        label="Crop: Sunflower Duration of cultivation: 90-100"
    elif y_pred[0] == 'Maize HQPM-4':
        label="Crop: Maize HQPM-4 Duration of cultivation: 95-101"
    elif y_pred[0] == 'Groundnut Girnar - 3 (PBS 12160)':
        label="Crop: Groundnut Girnar - 3 (PBS 12160) Duration of cultivation: 175-
180"
    elif y_pred[0] == 'Dry Ginger':
        label="Crop: Dry Ginger Duration of cultivation: 175-180"
    elif y_pred[0] == 'Horse Gram':
        label="Crop: Horse Gram Duration of cultivation: 120-180"
    elif y_pred[0] == 'Castor Seed':
        label="Crop: Castor Seed Duration of cultivation: 7.0-10"
    elif y_pred[0] == 'Sesame':
        label="Crop: Sesame Duration of cultivation: 40-45"
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        elif y_pred[0] == 'Sugarcane Karan 6 (Co 0239)':
                label="Crop: Sugarcane Karan 6 (Co 0239) Duration of cultivation: 300-450"
        elif y_pred[0] == 'Peas':
                label="Crop: Peas Duration of cultivation: 50-100"
        elif y_pred[0] == 'Paddy RC Maniphou 11 (IET 20193)':
                label="Crop: Paddy RC Maniphou 11 (IET 20193) Duration of cultivation: 105-
127"
        elif y_pred[0] == 'Cowpea':
                label="Crop: Cowpea Duration of cultivation: 45-90"
        elif y_pred[0] == 'Maize MCH 36 (Hybrid) (DKC 9099)':
                label="Crop: Maize MCH 36 (Hybrid) (DKC 9099) Duration of cultivation: 95-
102"
        elif y_pred[0] == 'Pulses':
                label="Crop: Pulses Duration of cultivation: 95-102"
        elif y_pred[0] == 'Sugarcane Co-0218':
                label="Crop: Sugarcane Co-0218 Duration of cultivation: 300-452"
        elif y_pred[0] == 'Wheat PDW 314':
                label="Crop: Wheat PDW 314 Duration of cultivation: 60-152"
        elif y_pred[0] == 'Sweet potato':
                label="Crop: Sweet potato Duration of cultivation: 120-125"
        elif y_pred[0] == 'Cotton VBCH 2231':
                label="Crop: Cotton VBCH 2231 Duration of cultivation: 150-180"
        return render_template('prediction.html', prediction_text=label)
#@app.route('/performance')
#def performance():
        return render_template('performance.html')
if __name__ == "__main__":
   app.run(debug=True)
```

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10.BIBLIOGRAPHY

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