DESIGNING WEBPAGE TO RECOMMEND SUITABLE CROPS FOR AGRICULTURE

PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

India has a significant agricultural sector. For the Indian economy to thrive and expand, it is crucial. India is a major producer of numerous agricultural goods. Crop cultivation depends on the quality of the soil. Life cannot exist without soil, a non-renewable dynamic natural resource. In the past, farmers with practical experience would cultivate crops. Based on the qualities and characteristics of the soil, farmers are no longer able to select the most suited crop. In order to recommend the crop that can be harvested in that specific soil, a recommendation system has been built that uses machine learning algorithms.

Selection of crop is a most important aspect in agriculture planning. When the farmers know the accurate information on the best crop in their field as per season, it minimizes the loss. Different datasets of the attributes such as rainfall, temperature humidity, geography places are collected and then analyzed. Collecting the data from the right source plays an important role in building a prediction model as it effects on accuracy of the model. The dataset is built from former historic statistics which incorporates the above attributes. Here we study the algorithm that will be used for prediction. The chosen algorithm had capabilities to predict the best crop by taking a smaller number of models. The proposed methods assist the farmers while selecting which crop to grow in the field.

Keywords: *Crop Recommendation, Fertilizer, Machine learning, Websites*

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LIST OFABBREVIATIONS

1	SVM	Support Vector Machine
2	CNN	Convolutional Neural Network
3	AI	Artificial Intelligence
4	ML	Machine Learning
5	DNN	Deep Neural Network
6	DL	Deep Learning

CHAPTER 1

INTRODUCTION

Farm = AI + Crop + Fertilizer, maintaining the health of the soil. A nation with a population of around 1.4 billion relies on farmers to provide food, but the productivity of farms is threatened by many natural elements that harm the crops and the farmers' way of life. AgroAgri is a tiny venture that improves agriculture by making wise judgements that take into account the field's demography, the elements affecting the crop, and how to maintain the farm's health for an outstanding output. This will take the shape of a website that offers features like crop and fertilizer recommendations based on site-specific criteria.

1.1 Overview

AgroAgri is a website designed for farmers to provide crop suggestions based on temperature, rainfall, pH, N, P, and K levels. If the wrong crop is picked, soil often degrades and productivity is decreased, but AgroAgri makes this decision incredibly simple by utilizing the ML model to generate the real-time prediction. Fertilizer Prediction is the second function. If the farmer decides not to change the crop to fit the land, he can grow the same crop while using fertilizer that AgroAgri will propose based on crop values for N, P, and K.

AgroAgri is sort of the farmers' next step because, generally speaking, soil testing are performed by the Indian government and results are received within a few days, but farmers really don't know much about what to do afterwards. An easy-to-use website will significantly aid farmers in understanding the whereabouts of their crops, assisting AgroAgri in every way possible.

1.2 Artificial Intelligence

Numerous documents or articles use the phrases Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL) and Neural Nets (NN). People may mistake them for being the same thing because they are frequently seen together. Therefore, the true differences between AI, ML, DL and NN is depicted in the following image.

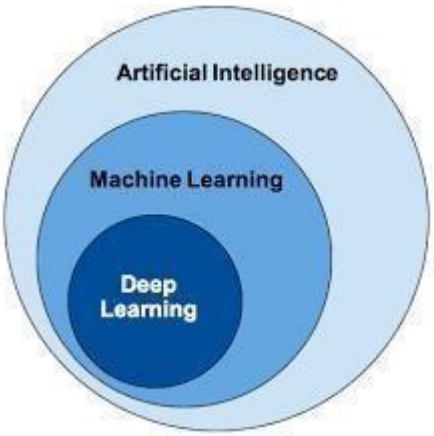

Fig 1.2 AI Structure

1.3 Performance

A performance metric P is employed to assess the model's performance. P may be a value that indicates whether the model correctly classified the object in classification challenges or not. Using this, we may determine the model's accuracy or error rate. There will be many performances metrics P for each task. Later chapters will specific neural networks are discussed will provide the exact definitions for various P metrics.

1.4 Convolutional Neural Network (CNN)

Deep neural networks are composed of multiple layers, with each layer containing a fixed number of neurons. The number of neurons in the input layer is equal to the size of the input vector, while the output layer's neuron count corresponds to the number of output classes. These networks are known as feedforward neural networks because the data moves in only one direction through the network without any looping back. One type of neural network is a convolutional neural network (CNN), which consists of an input layer, a few hidden layers, and an output layer. The main difference between CNNs and artificial neural networks (ANNs) is that CNNs have at least one layer that uses convolution, as opposed to convolutional matrix multiplication, as their primary operation. Unlike ANNs, CNNs can handle varying input sizes by using convolution.

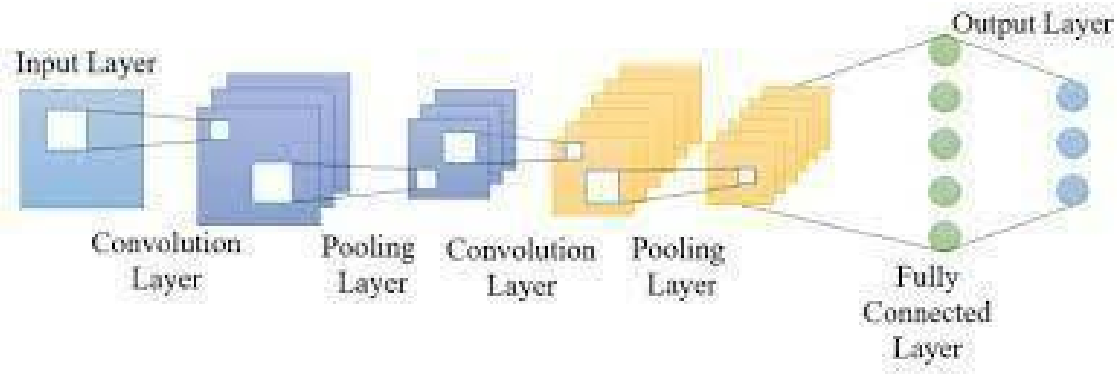

Fig 1.4 CNN Structure

CHAPTER 2
LITERATURE REVIEW

Dighe et al (2018) reviewed the CHAID, KNN, K-means, Decision Tree, Neural Network, Naive Bayes, C4.5, LAD, IBK, and SVM algorithms and produced rules for recommendation systems. To choose the most likely crops for planting, a number of elements were taken into account, including the pH level of the soil, the month of cultivation, the local climate, temperature, and the type of soil.

Gandge and Sandhya (2017) discussed the attribute selection, multiple linear regression, decision trees utilising ID3, SVM, neural networks, C4.5, K-means, and KNN. The suggested system starts by choosing an agricultural field, then choosing a crop that has already been planted. It receives input from the user, preprocesses it, then chooses an attribute in the backend, then applies a classification algorithm to the data, and finally suggests a crop.

Wu et al (2019) experimented and compiles a sizable dataset for identifying insect pests termed IP102, which includes more than 75, 000 images of 102 insects. The IP102 is more in line with the distribution of insect pests in actual environments than prior datasets. They evaluate various cutting-edge recognition systems using the dataset in the interim. According to the data, deep feature methods and handcrafted feature methods are not enough to identify pests.

TÜRKOĞLU and HANBAY (2018) have learned the identification of plant diseases and pests,the different effects are compared of deep feature extraction and transfer learning. Deep featuresfor tunings layers of these deep models

were extracted. The results of the obtained deep featureswere then determined using SVM, ELM, and KNN classifiers. Deep models were then fine-tunedusingpicturesofplantdiseaseandpests.In comparison to conventional approaches, deeplearning models achieved better outcomes, according to the evaluation results. The findings ofdeep feature extraction surpassed those of transfer learning.

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 Functional Requirements

“AgroAgri” has three different modules namely: CropRecommendation and Fertilizer Recommendation and Pesticide Recommendation. So,this section will define functional requirements for all the modules separately.

1. **Crop Recommendation:** According on the user-entered site-specific criteria, the system will recommend the crop.
2. **Fertilizer Recommendation:** The system will suggest organic fertilisers based on the user-entered values.
3. **Pesticide Recommendation:**
   - **3.1 Uploading the image:** The user will upload the image which clearly shows the pest.
   - **3.2 Manual selection of pest:** The user has the option to choose the pest (alternative to uploading an image).
   - **3.3 Pest Identification:** The pest will be identified on the webpage.
   - **3.4 Pesticide Recommendation:** The appropriate pesticide (as per ISO 9001, ISO 14001, and ISO 17025 standards) will be suggested based on the discovered pest.

3.2 Non-Functional Requirements

There are some non-functional needs listed below that significantly contribute to AgroAgri's usability, success, and effectiveness and should be used to evaluate "AgroAgri" operation as opposed to specific behaviour.

3.2.1 Performance Requirements

Crop recommendations are a part of the website. Since the crop is presented based on the pickle file generated from the ML model, accuracy scores will be the performance measuring variable for this module. >= 90% is the targeted accuracy rating. The effectiveness of organic solutions is the basis for the performance statistic for the other feature, fertiliser recommendation.

Thirdly, the Pest Identification module and associated Pesticide Recommendation form the basis of the Pesticide Recommendation module. As the DL model is used to identify the pests, performance indicators include training and testing accuracy as well as loss. The required accuracy for training and testing must be greater than 90%.

3.2.2 User friendliness

The user interface is very basic, simple to use, and intuitive.

3.2.3 Compatibility

The website may be accessed on PCs, laptops, and mobile devices and is compatible with all widely used browsers (Google Chrome, Mozilla Firefox, Microsoft Edge, Safari, and Opera). However, for the greatest experience knowledge of utilising a laptop or PC and Google Chrome (if using mobile, the user can use Moto G4, Samsung phones, iPhone 5, 6, 7, 8, Plus, X, iPad, iPad Pro, Surface Duo, Galaxy Fold).

3.2.4 Scalability

The system is expandable to support 100K+ users, 10+ pests, 22+ crops, and more insecticides and fertilisers.

3.3 Cost Analysis

There is no hardware involved in “AgroAgri”. No purchased datasets are utilised because every dataset is created from scratch using information gathered from reliable sources. To use AgroAgri's services and create an account on the website, the user needs internet access. This greatly reduces the cost for Indian farmers.

3.5 Risk Analysis

AgroAgri's crop recommendation module suggests crops based on site-specific data, so environmental considerations are taken into account but not economic concerns. Profitability of the economy is thus at jeopardy. The weather may also have an impact on crop performance. Little rainfall or a dry spell may result in low harvests, and heavy rail may harm the crops. The yields are determined by both the crop and how it is cared for. The yield could be destroyed by an unmeasured pesticide dosage.

The amount of pesticide used, the method used to use natural fertilisers, and the unknown factors could decrease or boost productivity.

CHAPTER 4
METHODOLOGY

The following modules discusses how “AgroAgri” can be implemented.

4.1 Proposed Solution

In “AgroAgri” there are three different modules. Methodology for all the recommended modules will be discussed one by one.

4.1.1 Crop Recommendation

This module can be implemented in the following four steps as shown in the figure 4.1.1.

Step 1: Data Acquisition

Data can be taken from the kaggle.

Step 2: Input Values

Users are expected to give the input in the specific site which includes the parameters like: N, P, K (all of them should be in %), temperature(must be in °C), relative humidity (in %), rainfall (in mm) and pH.

Step 3: ML Model Training and creating .pkl file

The ensemble model with majority voting technique serves as the basis for the recommendation system. These are the component models:

1. SVM
2. Random Forest
3. Naive Bayes
4. Decision Tree

After the model is trained, a .pkl file is created.

Step 4: Crop Recommendation

.pkl file is loaded to recommend the crop based on input.

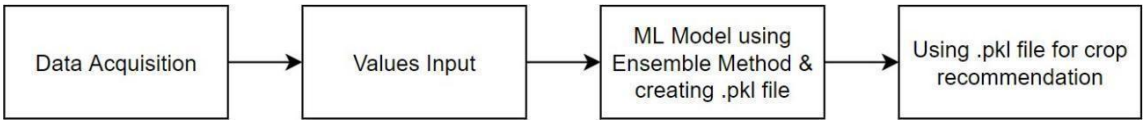

Fig 4.1.1 Methodology for Crop Recommendation

4.1.2 Fertilizer Recommendation

This module can be implemented in the following four steps as shown in the figure 4.1.2.

Step 1: Data Acquisition

Dataset will be created manually after collecting data from verified sources listed below:

1. The Fertilizer Association of India
2. Indian Institute of Water management
3. Kaggle

The columns of the dataset will be: N, P, K (all of the input should be in %) and crop.

Step 2: Input values

Users are expected to give the input values in the specific site which includes parameters like: N, P, K (all of them in %), and crop (select from the list – supports only 22 crops).

Step 3: Difference between desire and actual

Difference is calculated between desired value of N, P, K as per crop and the farm's actual value. There are 3 outcomes possible for all three nutrients:

1. High
2. Low
3. Upto the mark

Step 4: Fertilizer Recommendation

Based on the outcomes from the above step, a dictionary-based solutions (organic fertilizers) will be displayed.

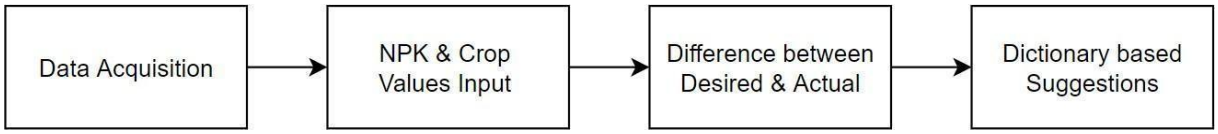

Fig 4.1.2 Methodology for Fertilizer Recommendation

4.1.3 Pesticide Recommendation

This module can be implemented in the following four steps as shown in the figure 4.1.3.

Step 1: Data Acquisition

Dataset will be created by scraping images from Google via automatic script using Selenium and Chrome Driver. Along with that, pest labels will be provided as well.

Step 2: Data Cleaning and Data Augmentation

To remove useless content, the data scraped from Google must first be manually cleaned. For instance, while collecting photographs of a nuisance called "beetle," a small number of images of "a automobile called beetle" were also found. The dataset must later be expanded to include more variability.

Step 3: DL Model Creation

This entails setting up the model, setting up the training, and evaluating the model. The model will eventually be stored in a .h5 file.

Step 4: Pest Identification and corresponding Pesticide Recommendation

To identify the pest, the .h5 model will be loaded. Based on the results, a corresponding pesticide will then be suggested using a dictionary-based approach.

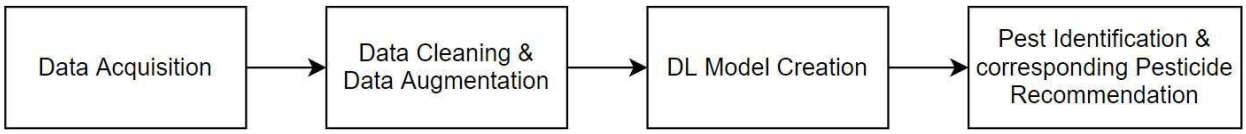

Fig 4.1.3 Methodology for Pesticide Recommendation

4.2 Tools and Technology Used

Following is the list of tools and technology used while making the “AgroAgri”:

1. numpy
    a. working with arrays
2. pandas
    a. working with csv files
3. flask
    a. app routing
    b. web application
4. pickle
    a. saving ML model

5. neural networks (keras, tensorflow, CNN)
    a. for classification and training
6. OS
    a. for manipulating files
7. matplotlib.pyplot
    a. plotting graphs for training and testing accuracy
    b. plotting graphs for training and testing loss
8. h5
    a. storing DL model
9. sklearn
    a. classifiers

4.3 Workflow diagram

4.3.1 Fertilizer Recommendation

Following displays the workflow diagram for Fertilizer Recommendation.

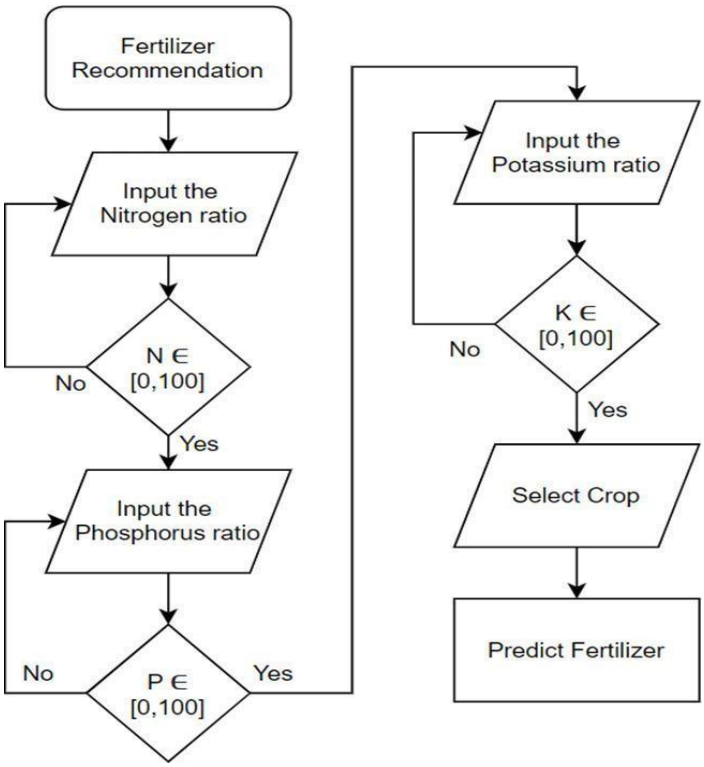

Fig 4.3.1 Fertilizer Recommendation Workflow Diagram

4.3.2 Crop Recommendation

Following displays the workflow diagram for Crop Recommendation.

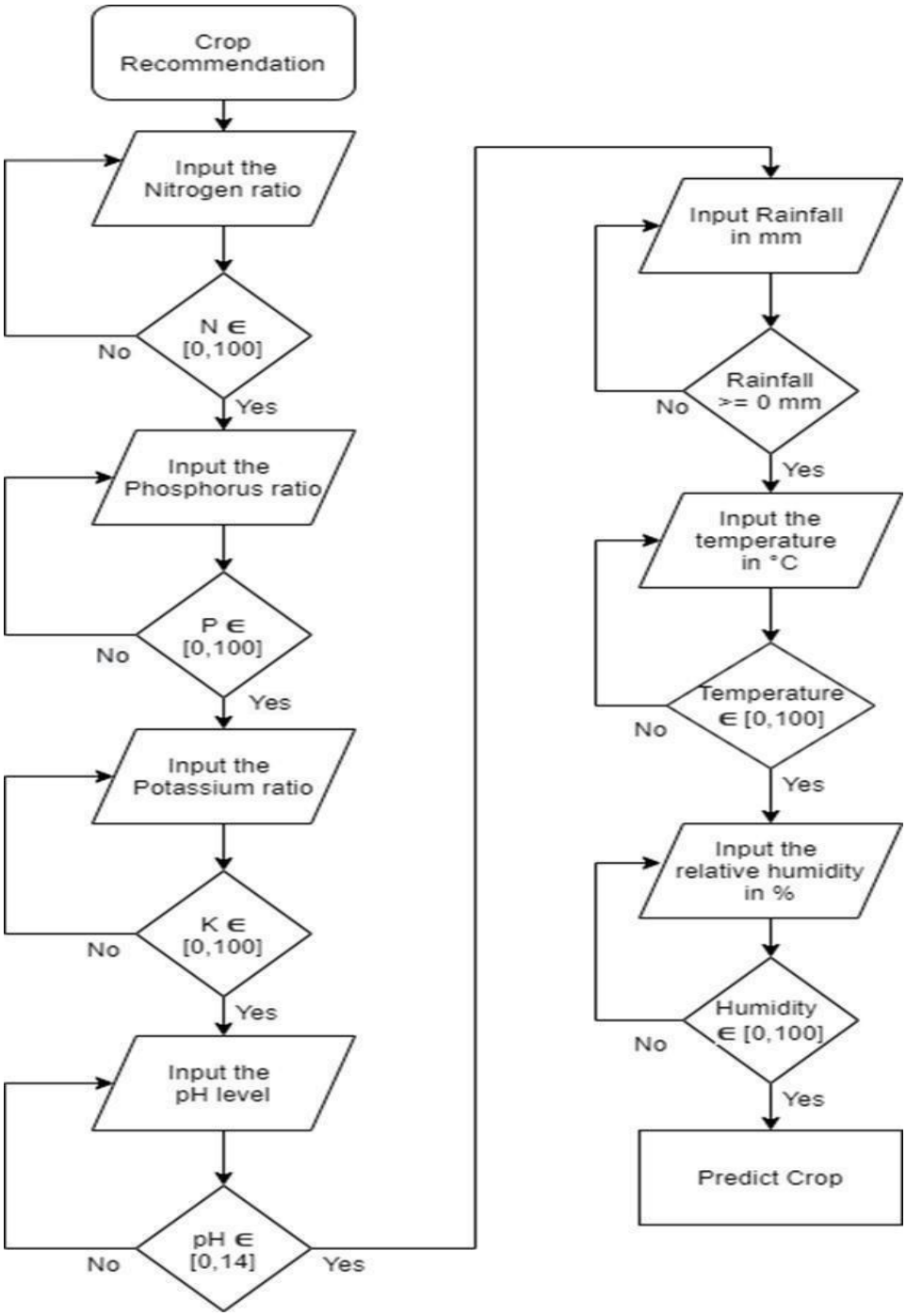

Fig 4.3.2 Crop Recommendation Workflow Diagram

4.3.3 Pesticide Recommendation

Following display the workflow diagram for Pesticide Recommendation.

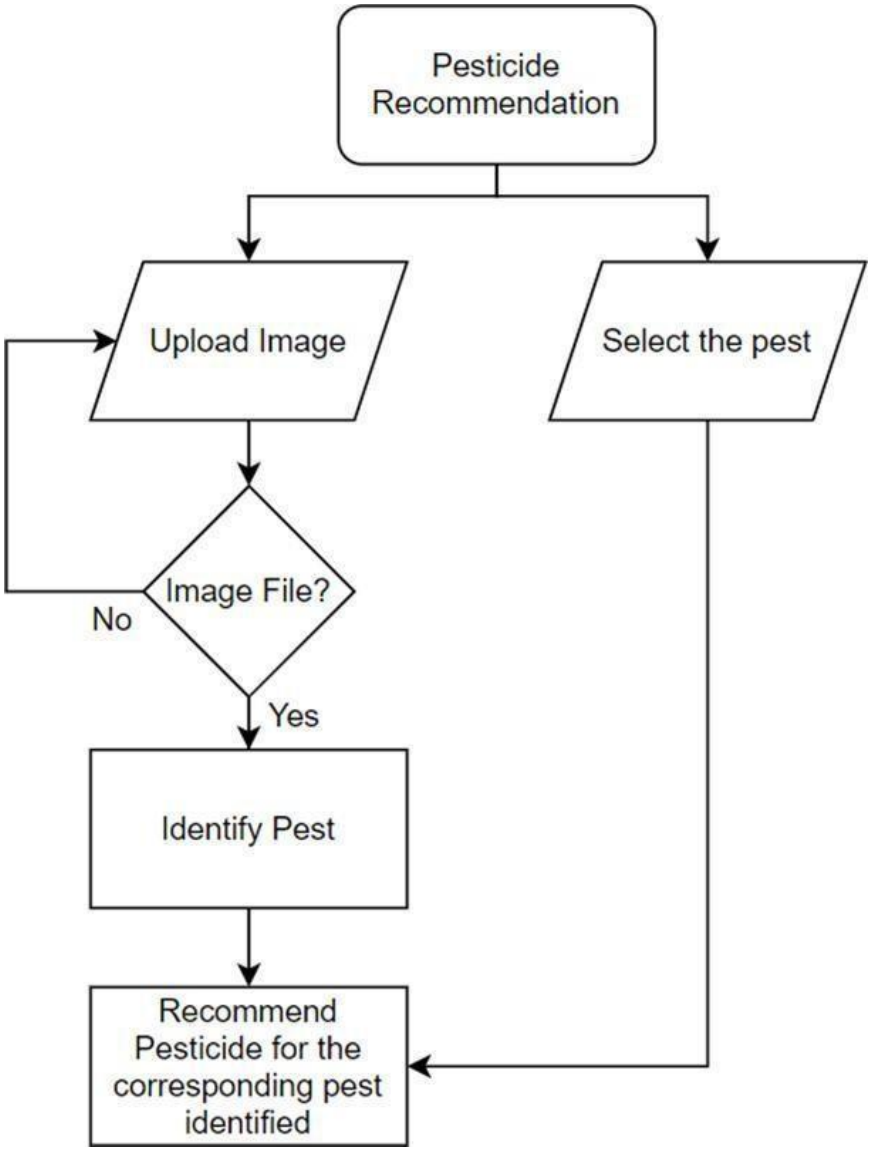

Fig 4.3.3 Pesticide Recommendation Workflow Diagram

4.4 Overall workflow diagram

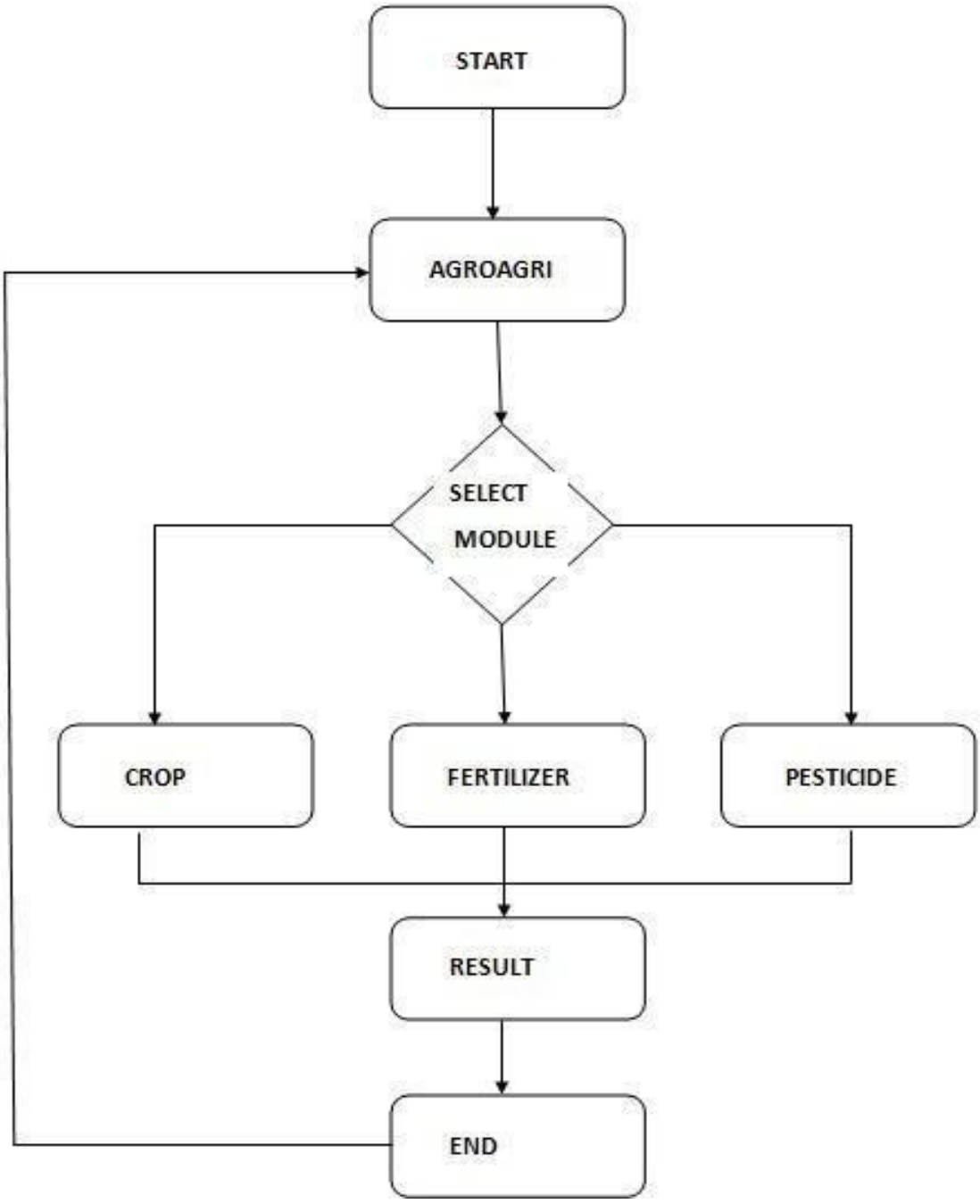

Fig 4.4 Overall Workflow Diagram

CHAPTER 5

RESULTS AND DISCUSSION

5.1. Test Results

There are several ways to evaluate the "AgroAgri" model that has been developed. Firstly, for the crop recommendation, the ML model is used to predict the crop, in that accuracy of the algorithm tells us how effective the solution is. The applied algorithms are Decision Tree, Naïve Bayes, SVM and Random Forest which has the accuracy of 96%. Fertilizer recommendation is just a dictionary based solution. In pesticide recommendation if the user uploads a picture and the pests are identified through DL model called CNN.

5.2. Output

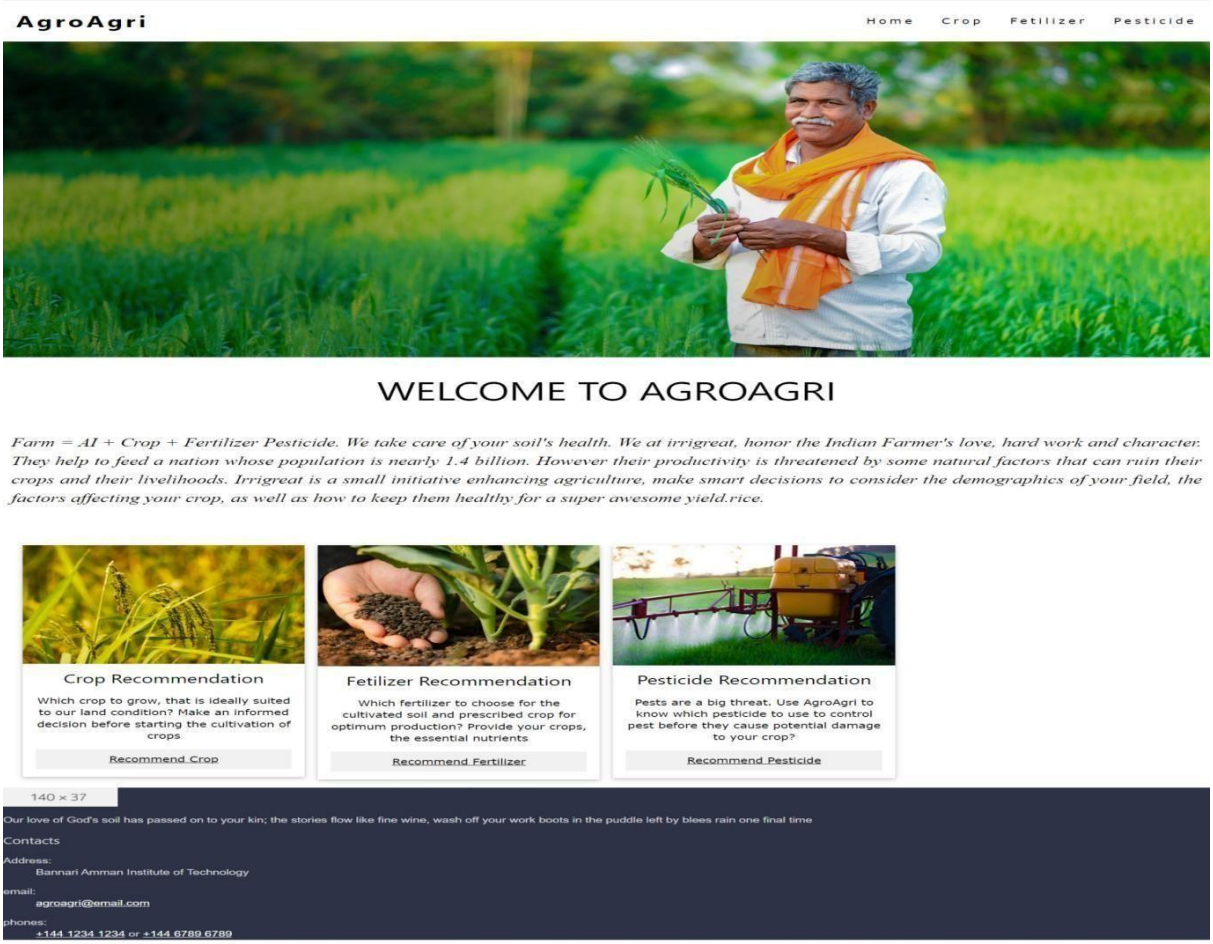

Fig 5.2.1 Home Page

Let's say the user wishes to use the Crop Suggestion service. In order to find out what crop they should grow on their farm, they can fill out the N, P, K, pH, rainfall, temperature, and relative humidity values in the units indicated.Fig 5.2.2 represents the crop recommendation.

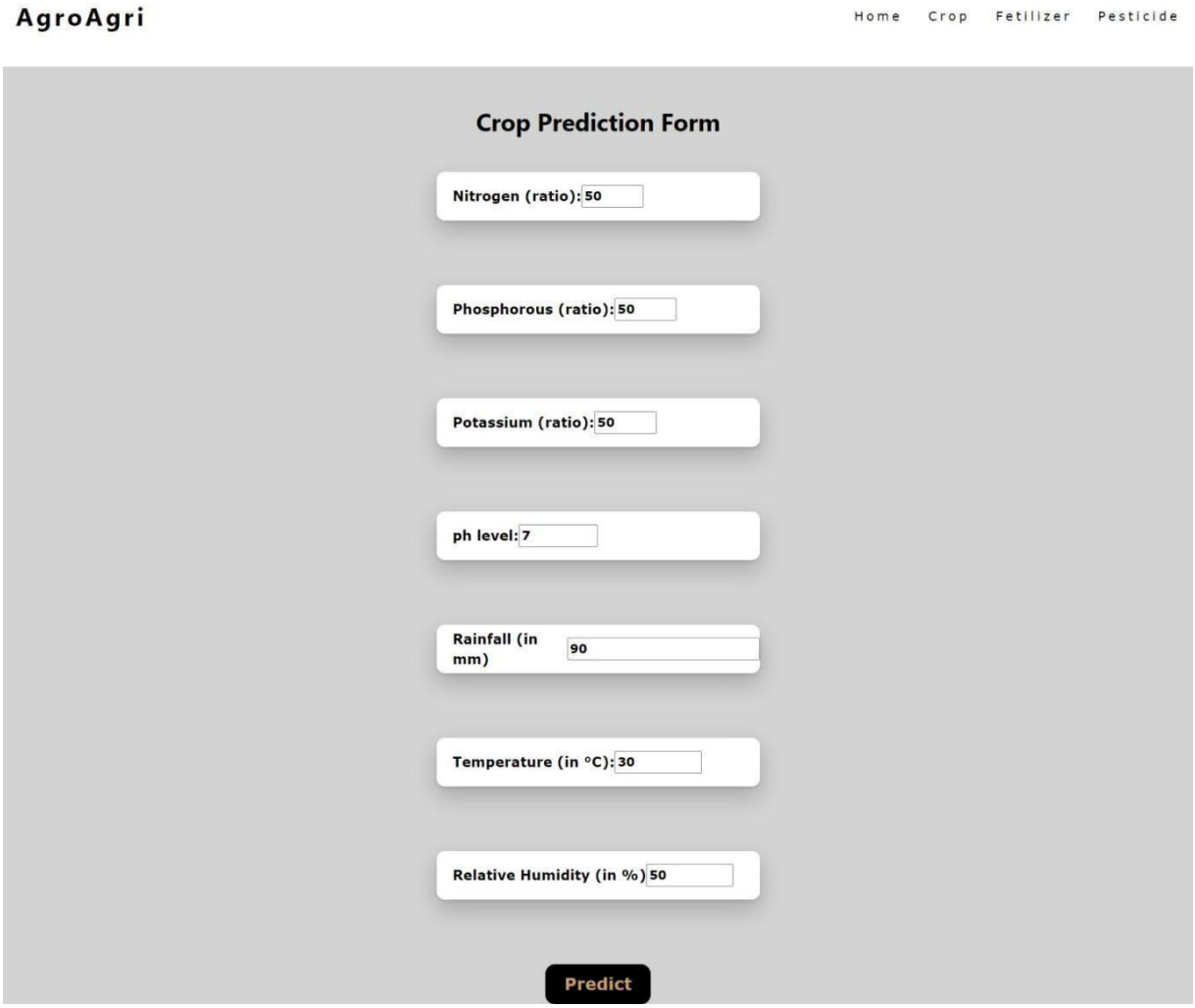

Fig 5.2.2 Crop Recommendation page

After entering all the corresponding values it recommends the suitable crops for our land , here it recommends mango.The predicted crop is given below for you reference.

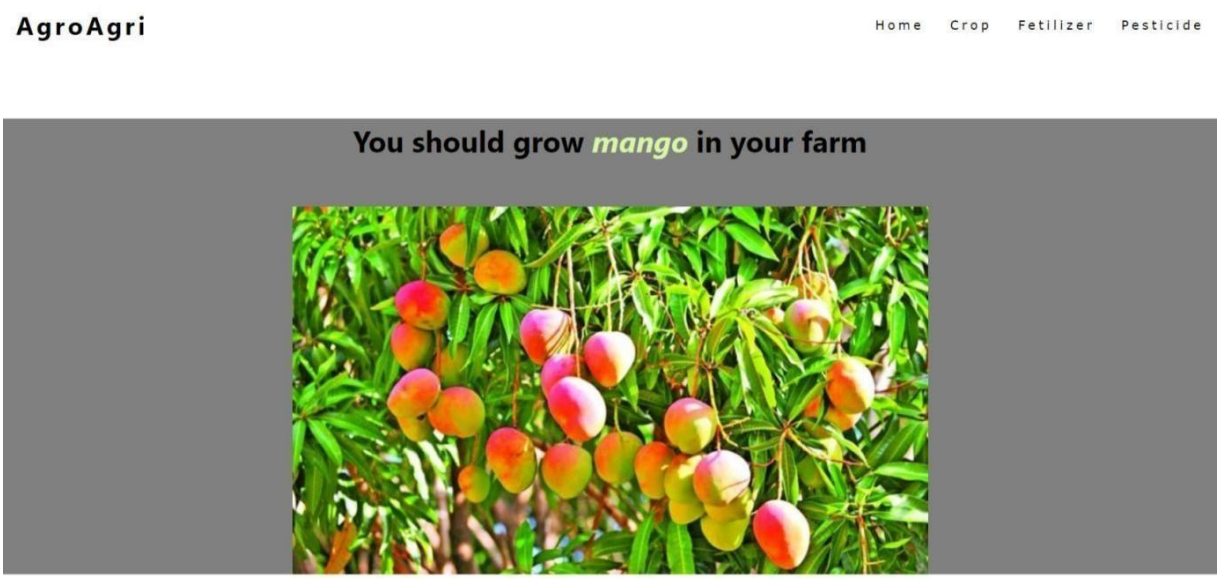

Fig 5.2.3 Crop Recommendation Output

The user can also use the "Fertilizer Suggestion" Service by entering the crop, N, P, and K values (Figure 5.2.2). After the user has gained knowledge of the soil's condition and can distinguish between the nutrients required and those present on their farm, "AgroAgri" will provide knowledgeable advise on the best organic fertilisers to employ given the soil's current state. For references, see Figure 5.2.3.

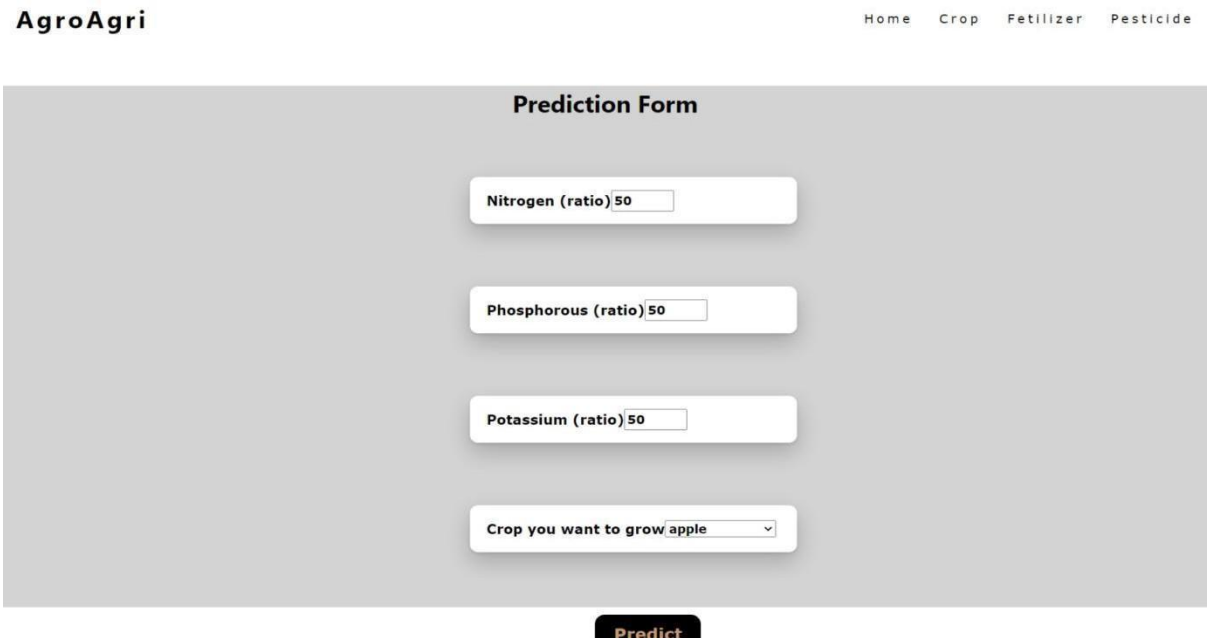

Fig 5.2.4 Fertilizer Recommendation Page

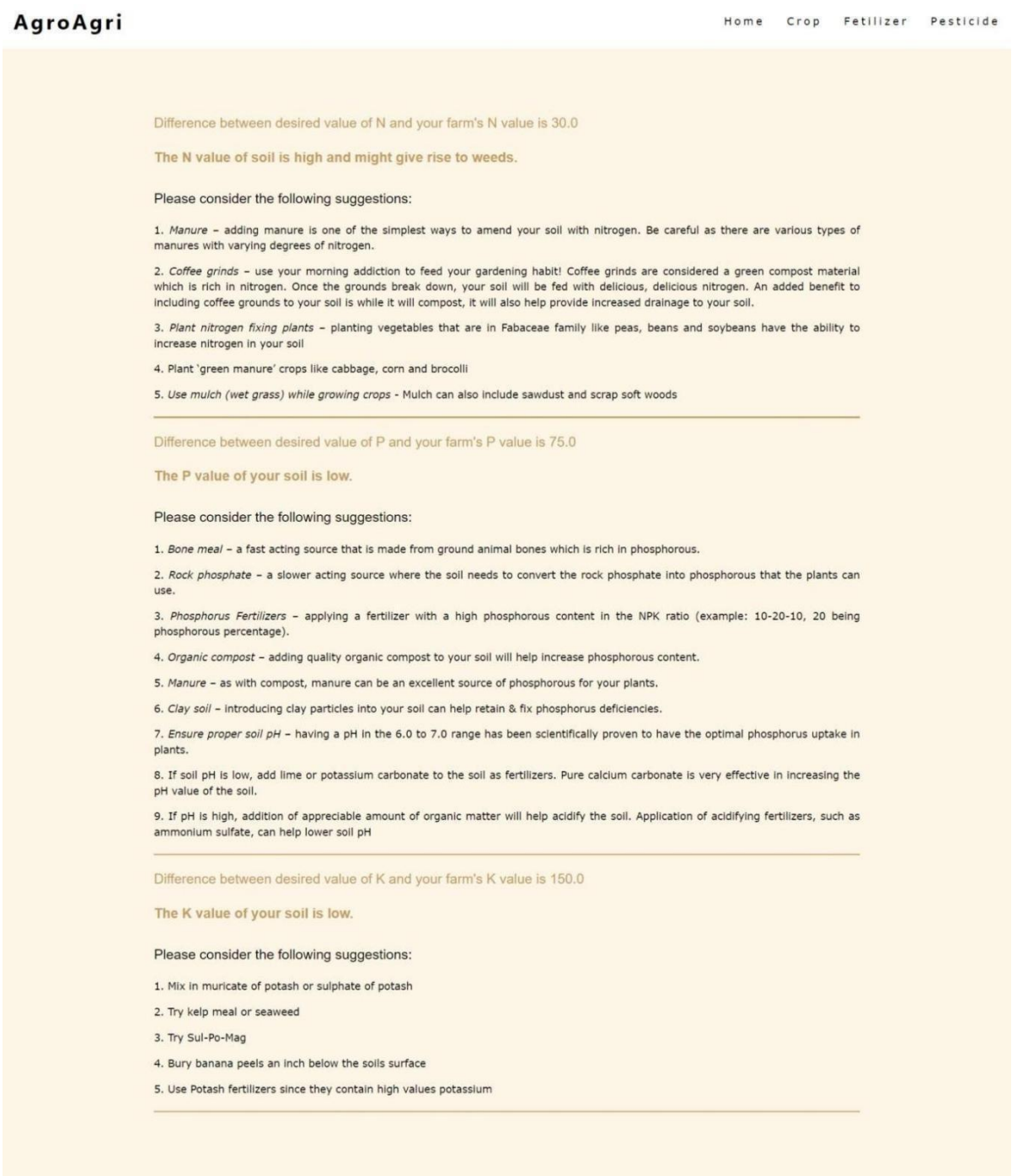

Fig 5.2.5 Fertilizer Recommendation Output

The third module, "Pesticide Recommendation," is depicted in Figure 34. Here, the user has the option to upload an image of the pest. If the user is not familiar with the pests, he or she can upload a picture of the pest that clearly depicts it (Figure 5.2.6), and "AgroAgri" will identify the insect and prescribe the

appropriate pesticides (Figure 5.3.8). The user must be careful to ensure that the image is not blurry as this could result in the pest being incorrectly identified.

Fig 5.2.6 Pesticide Recommendation Page

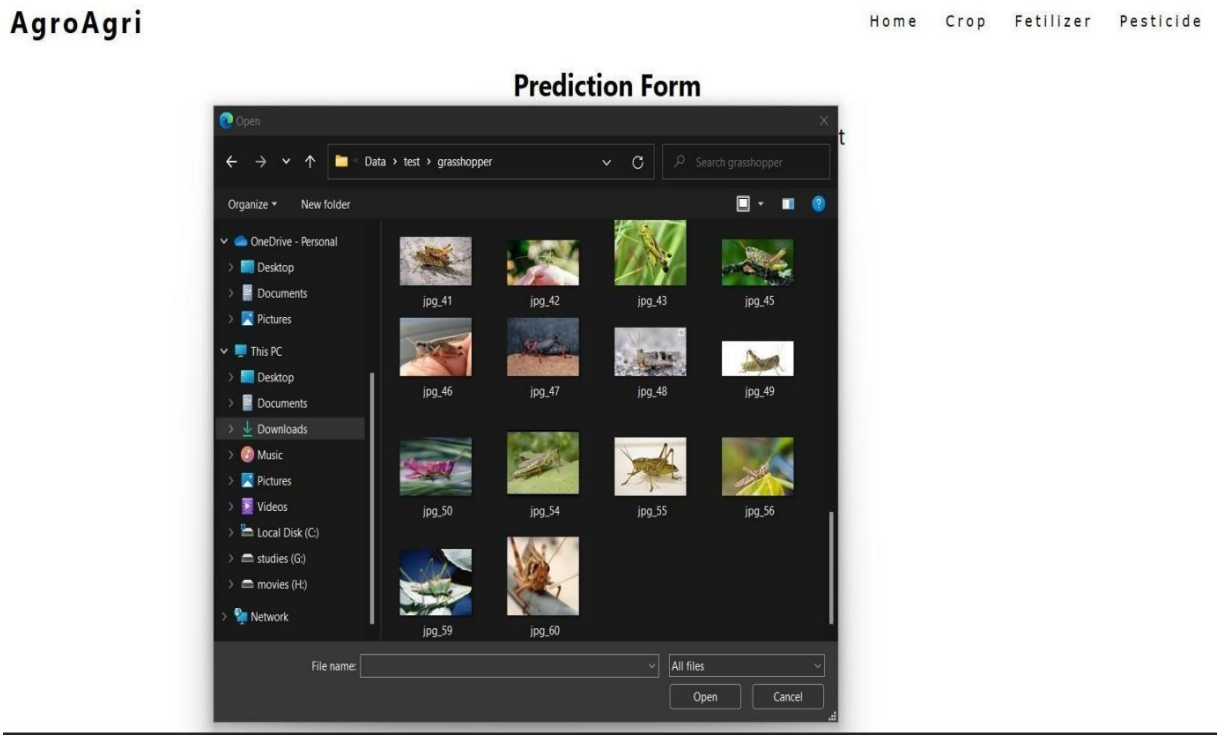

Fig 5.2.7 Uploading Image - Pesticide Recommendation

Fig 5.2.8 Pesticide Recommendation Output 1

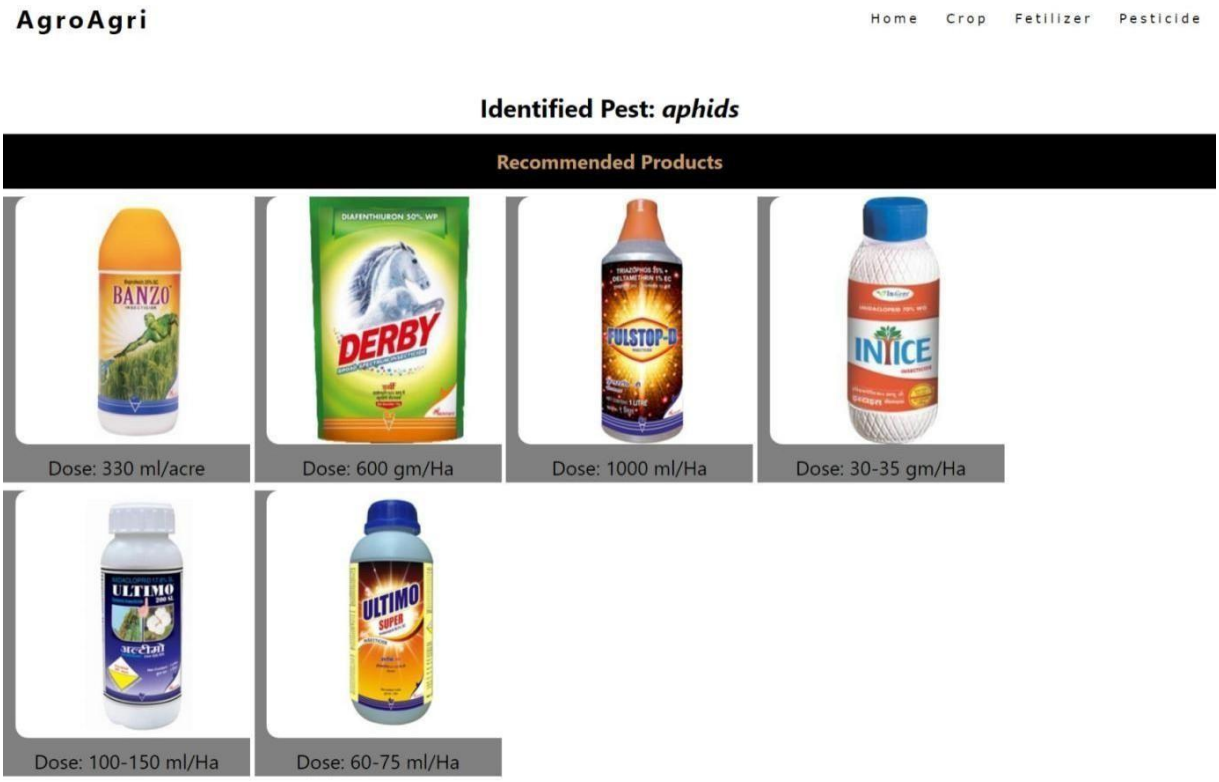

Fig 5.2.8 Pesticide Recommendation Output 2

CHAPTER 6
CONCLUSION

"AgroAgri" advises the farmers the proper crop based on their site-specific features to reduce the wrong choice of a crop and boost productivity. It does this by using research data on soil characteristics, soil types, and crop yield data gathering. A fertiliser dictionary is made for natural fertilisers according to the labels: NHigh, Nlow, NNo, PHigh, Plow, PNo, KHigh, Klow, KNo. This dictionary is used to prescribe organic fertiliser based on N, P, and K values and crop. The website was created with the aforementioned objectives in mind. Farmers in India are working arduously. They contribute to the nation's almost 1.4 billion people being fed. But, some natural phenomena that have the power to destroy their crops and way of life put their productivity in jeopardy. As a result, this solution (AgroAgri) will help farmers increase agricultural production, lessen soil erosion in cultivated fields, receive unbiased advise on organic fertilisers and other fertilisers, and choose the best crop by taking into account many features. As a result, both farmers and the ecosystem would profit from this thorough projection. Not only that, but another significant issue that would be resolved by this initiative is insect management.

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ANNEXURE – I

Individual Work Contribution

Project Title: DESIGNING WEBPAGE TO RECOMMEND SUITABLE CROP FOR AGRICULTURE

Student Name: MANISHA M Register Number: 191CS214

- My contribution towards this project is working on Data acquisition, where we can gain the knowledge of data's that is required for the project.
- Studied on crops , fertilizers , pests and pesticide and studied the research paper and identified problem solution.
- Differentiating the desired and actual data.
- Working on fertilizer recommendation and generating dictionary based solution.
- Flask coding and integrating all the modules.
- Finally, the paper was presented in conference and the expert suggestion were noted for future studies and corrections.

MANISHA M

(191CS214)

ANNEXURE – I

Individual Work Contribution

Project Title: DESIGNING WEBPAGE TO RECOMMEND SUITABLE CROP FOR AGRICULTURE

Student Name: DEEPIKA K P Register Number: 191EC125

- My contribution towards this project is working on Data acquisition and studied on crops , fertilizers , pests and pesticide.
- Differentiating the desired and actual data.
- Identify the constraints, assumptions and models for the problems. Picture of the pest must be clear and the user must have internet access so as to avail the service of AGROAGRI.
- Working on the ML algorithm like SVM, Decision Tree and Random Forest and creating .pkl file for final model.
- Designing web page for crop, fertilizer and pesticide recommendation and its corresponding output.
- Finally, the paper was presented in conference and the expert suggestion were noted for future studies and corrections.

DEEPIKA K P

(191EC125)

ANNEXURE – I

Individual Work Contribution

Project Title: DESIGNING WEBPAGE TO RECOMMEND SUITABLE CROP FOR AGRICULTURE

Student Name: KAVIPRIYA J Register Number: 192IT166

- My contribution towards this project is working on Proper research on agriculture was done in order to prepare an accurate dataset. Use appropriate methods, tools and techniques for data collection.
- Analyze and interpret results with respect to assumptions, constraints and theory and made the model portable and affordable.
- Differentiating the desired and actual data.
- Working on pest detection and corresponding pesticide recommendation.
- Designing web page for crop, fertilizer and pesticide recommendation and its corresponding output.
- Finally, the paper was presented in conference and the expert suggestion were noted for future studies and corrections.

KAVIPRIYA J

(192IT166)

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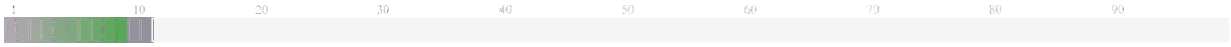

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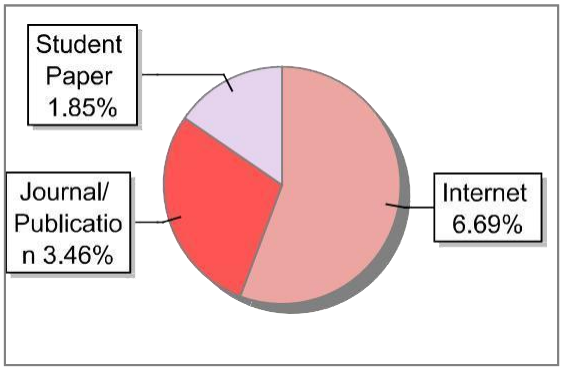

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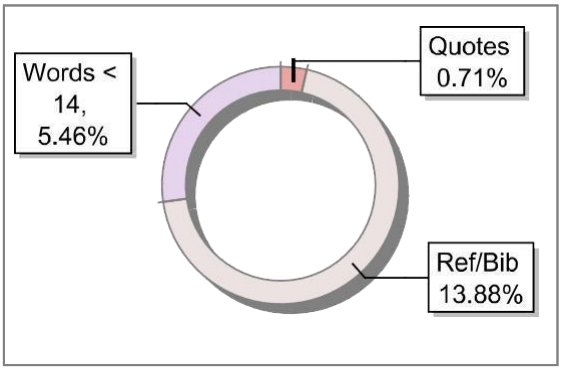

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in the 2nd National Conference on **"Recent Advances in Communicative Electronics (NCRACE 2023)"** organized by the **Department of Electronics and Communication Engineering, SRM TRP Engineering College**, Tiruchirappalli, during March 09-10, 2023.

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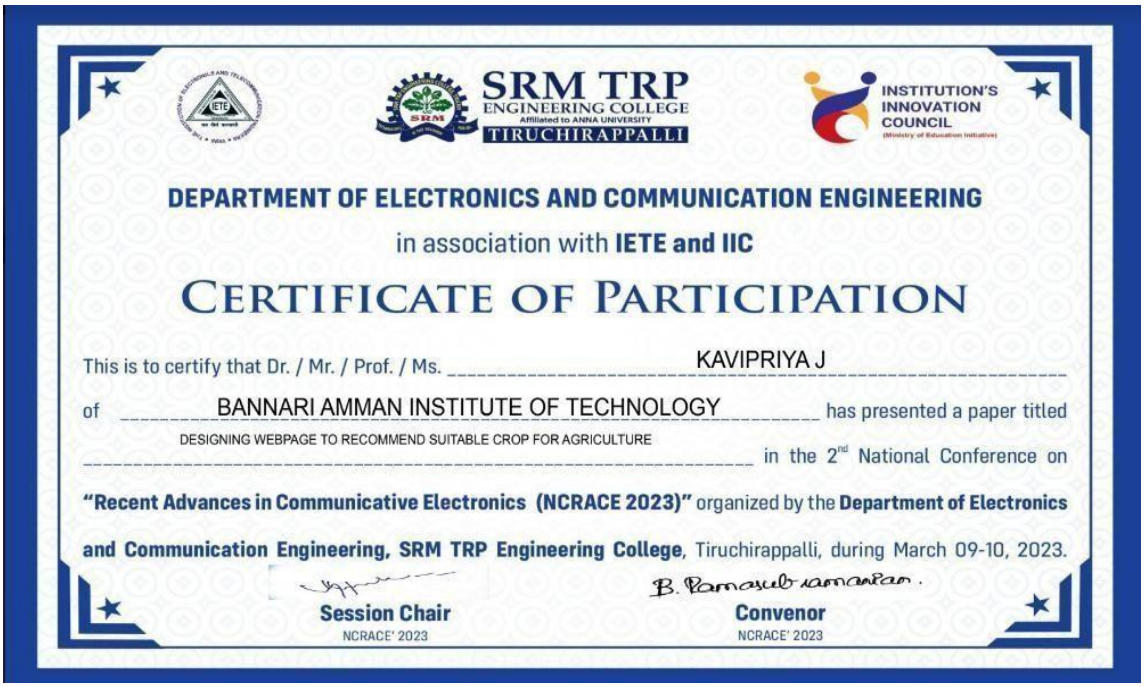

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