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# PLANT DISEASE DETECTION AND FARMER ASSISTANCE GUIDELINE USING WEB APPLICATION

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## ABSTRACT

Agricultural productivity is something on which economy highly depends. This is one of the reasons that disease detection in plants plays an important role in agriculture field, as having diseasing plants are quite natural. Crop diseases are a major threat to food security and rapid identification of these diseases remains difficult in many parts of the world due to the lack of the necessary infrastructure. There are some cases where farmers lost their crops due to sudden weather changes and using wrong fertilizers and growing unseasonal plants. With the increasing of global smart-phone and advancements in computer vision and deep learning made possible for the farmers to overcome the above problems. So we made a farmer assistance web application where the farmer or user can detect the disease of a plant by uploading the infected leaf image and he/she can get the description and suggestions of the disease in English and selected local language, user can predict next day weather conditions in his place based on past 3 months weather data, Question Answering Platform where farmers can post questions/doubts regarding farming and people with agriculture background can answer them. By this application, the above mentioned problems can be minimized. Along with these, we also incorporated market price platform where any user can access it and check the vegetable prices in his place. We used deep learning, machine learning, and web scrapping techniques to develop this application.

**Keywords:** Deep Learning, Plant Leaf Disease Detection, Machine Learning, Visualisation.

## I. INTRODUCTION

Agriculture in India is livelihood for a majority of the population where in 2020, 41.49 percent of the workforce in India were employed in agriculture [1]. Major crops grown in India are rice, wheat, millets, pulses, tea, coffee and jute, etc [2]. Economic growth of Farmers depends on the quality of the products they produce, which relies on the plant's growth and the yield they get. Plants are prone to diseases and late detection of these diseases leads to loss of crop and waste of money. An estimated 15-25 percent of potential crop production is lost due to plant diseases. Manual search and getting solutions of plant diseases is quite difficult for farmers. Even the disease is identified there should know the solutions to overcome the disease. So we need an application which helps the farmers to detect the disease in early stages. Using deep learning we can design a web application where farmers can click the image of the leaf of the crop and identify the disease. They can know the solutions in their local language and they can even assist doubts to overcome the disease in Question answering platform. Another problem is due to sudden weather changes and calamities, there is chance of loss of crop. Weather forecasting helps to predict the future weather conditions and famers can take appropriate measures.

Farming is the main source of raw materials, international trade, nation's revenue, employment, etc. If this great work is incorporated with technology then we may achieve even better results. The main problem for farming is plant diseases due to pests, growing un-seasoned plants and non soil suitable plants, water problem, etc. With the technology we have today we can try to solve some of these problems. The existing method and mostly used for plant disease detection is simply through naked eye observation by experts through which plant disease detection is done. If there are no experts and just by identifying some malicious plants, farmers cannot decide what type of disease that the plant is having and through text search it quite difficult for anyone. So, we thought of developing an application that reduces the crop wastage by easy and early detection of crop diseases. We need to develop an application that is easy and feasible to use by anyone.

Different endeavors have been created to avoid edit misfortune due to illnesses. Chronicled approaches of broad application of pesticides have within the past decade progressively been supplemented by coordinates bother administration (IPM) approaches (Ehler, 2006). Autonomous of the approach, identifying a illness accurately when it first shows up could be a vital step for proficient infection administration.

Truly, malady recognizable proof has been upheld by agricultural expansion organizations or other teach, such as neighborhood plant clinics. In more later times, such endeavors have additionally been backed by giving data for disease determination online, leveraging the expanding Internet penetration around the world. Indeed more as of late, devices based on portable phones have multiplied, taking advantage of the verifiably unparalleled fast take-up of versatile phone technology in all parts across globe.

Smartphones in specific offer exceptionally novel approaches to help recognize maladies since of their computing control, high-resolution shows, and broad built-in sets of adornments, such as progressed HD cameras. It is broadly evaluated that there will be between 5 and 6 billion smartphones on the globe by 2020. At the conclusion of 2015, as of now 69% of the world's populace had access to versatile broadband scope, and portable broadband penetration come to 47% in 2015, a 12-fold increment since 2007 (ITU, 2015). The combined variables of broad smartphone penetration, HD cameras, and tall execution processors in mobile gadgets lead to a circumstance where malady conclusion based on mechanized picture acknowledgment, in case in fact doable, can be made accessible at an exceptional scale.

Profound neural systems have as of late been effectively applied in numerous different spaces as cases of conclusion to conclusion learning. Neural systems give a mapping between an input—such as an picture of a unhealthy plant—to an output—such as a crop disease combine. The hubs in a neural arrange are mathematical capacities that take numerical inputs from the incoming edges, and give a numerical yield as an outgoing edge. Profound neural systems are basically mapping the input layer to the yield layer over a arrangement of stacked layers of hubs. The challenge is to make a profound organize in such a way that both the structure of the organize as well as the capacities (hubs) and edge weights accurately outline the input to the yield.

Profound neural networks are prepared by tuning the arrange parameters in such a way that the mapping makes strides amid the preparing handle. This process is computationally challenging and has in later times been moved forward significantly by a number of both conceptual and engineering breakthroughs.

The main aim of the project is to assist farmers in farming practices. So, the application needs to be understandable and easily handable. The predictions need to be accurate, so that mistakes won't occur while predicting of diseases. Since, English is not understandable for all; we need to implement local language assistance. Suggestions provided by us may not be enough to address the doubts of farmers, so volunteers with agriculture background can assist them.

## II. LITERATURE REVIEW

S.Santhana Hari et al [1] proposed a new architecture for effective classification of plant diseases. The dataset they used consists of several varieties of plants of both affected and healthy. They trained for 5 different plant diseases using plant leaf images. The proposed CNN architecture consists of 2 sets of 3 convolution layers followed by a Max pooling and dropout layer, 2 sets of convolution layer followed by max pooling layer, 2 fully connected layers and finally a softmax layer where we get output. Regularization is done here by applying Batch Normalization and dropout. During training phase they used mixed dataset of open source images (Plant Village) and field images which were captured by them. The results show that their proposed architecture (86%) achieved better accuracy than MobileNet (50%).

S.Yegneshwar Yadhav et al [2] designed an optimized real time detection of diseases that affect the plant and the area affected using CNN and K-mean clustering models. They developed a new optimized activation function to improve convergence which is better than other activation functions like ReLU, tanh, sigmoid, softmax. The CNN model is trained with the new activation function achieved an accuracy of 95%. They used K-means clustering (K = 3) to segment the affected area of predicted infected leaf image.

Sammy V. Militante et al [3] designed a system detect to recognize several plant varieties specifically apple, corn, grapes, potato, sugarcane, and tomato and also detect several diseases of plants. The trained dataset consists of approximately 35,000 images with 32 different classes' plant varieties and diseases. The data is trained with CNN model for 75 epochs with 32 batch size and achieved an accuracy of 96.5%.

Manoj kumar et al [4] designed a system that detect the disease in coffee plant using convolution neural network and transfer learning. The dataset consists of 1747 images with 5 categories - Healthy leaves, Infected leaves with Phoma, Leaf Miner, Coffee Leaf Rust and Cercospora Spots. 70% of images are used for training the model, 15% each for validation and testing. To create a varied dataset, data augmentation is implemented. They used inception v3 model for transfer learning, which is a 48-layer deep neural network. Accuracy of the model increased with increase in learning rate at first, reaching a maximum at 0.005 with an accuracy of 97.61%, and started to decrease further. Hence, final value of the learning rate in the model is 0.005.

Ms.L.Pavithra et al [5] designed a system detects the banana leaf and fruit diseases using image processing and classify the diseases by ANN algorithm. Dataset which consists of various images of leafs and fruits of the banana plant for testing process. Each image is transferred from RBG to gray image and histogram equalization enhancement process is applied. They used Fuzzy cmeans clustering to segment the area of interest (banana).Features are extracted using statistical features. Finally the model is trained using ANN and detects the infected banana.

Achyut Morbekar et al [6] developed a system which makes use of a novel approach of the object detection technique to detect plant disease, YOLO. YOLO processes the leaf images at 45 frames per second in real-time, which is faster than other object detection techniques. The dataset consists of thousands of images classified into 25 classes of healthy and diseased plants of 9 various plant species. The two types of bounding boxes are used, one for the entire leaf and other for just to detect infected areas. A darknet-53 network containing 53 Convolutional layers is used in YOLOv3 which is used for training the model. The model is able detect multiple diseases (if any) at a time for the given image.

Vinod Kumar et al [7] developed a plant leaf disease detector using ResNet34 model. The dataset consists of 15200 images that covers 14 crops and is divided into 38 different classes. Residual network34 (ResNet34) is a CNN architecture with 34 layer Convolutional layers whose core building element is a residual block. A residual block makes the use of skip connections to address the degradation problem. They achieved an accuracy of 99.40%.

Neha Rale et al [8] used machine-learning techniques to develop a prediction model for crop yield production. They compared the performance of various linear and non-linear regressor models and concluded that random forest regressor performed the best. The dataset contains two years' of wheat data, geo-located to specific latitude-longitude and counties during winter. The tuned model achieved an R2 Value of ~0.83 with a root mean square error (RMSE) of 5.3 (yield values in the dataset range from 10 to 80). The mean absolute percentage error is ~5%.

Ankita H. Tidake [9] developed a farmer assistance application using Machine learning models. The modules included are leaf disease detection and weather forecasting. The climate data obtained from www.indianwaterportal.org The time series historical data over 100 years is taken into study for this experiment. The record attributes are placed as Year/Month, Average Temperature, Cloud Cover, Diurnal Temperature, Maximum Temperature, Minimum Temperature, Cotton production quantity, soya production quantity, Groundnut production quantity for every month of a specified year. The predicted information is sent to the farmer mail.

## III. MODELING

### 3.1 Dataset Description

We used the famous "Plant disease" dataset to train our model. The dataset contains 35 categories, which includes diseases of different plants. (Apple, Cherry, Grape, Orange, Peach, Pepper, Potato, Strawberry and Tomato). We used 42,191 images for training and 5266 images for testing.

Across all our experiments, we use three different versions of the whole Plant disease dataset. We start with the Plant disease dataset as it is, in color; then we experiment with a gray-scaled version of the Plant disease dataset, and finally we run all the experiments on a version of the Plant disease dataset where the leaves were segmented, hence removing all the extra background information which might have the potential to introduce

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some inherent bias in the dataset due to the regularized process of data collection in case of Plant disease dataset. Segmentation was automated by the means of a script tuned to perform well on our particular dataset. We chose a technique based on a set of masks generated by analysis of the color, lightness and saturation components of different parts of the images in several color spaces (Lab and HSB).

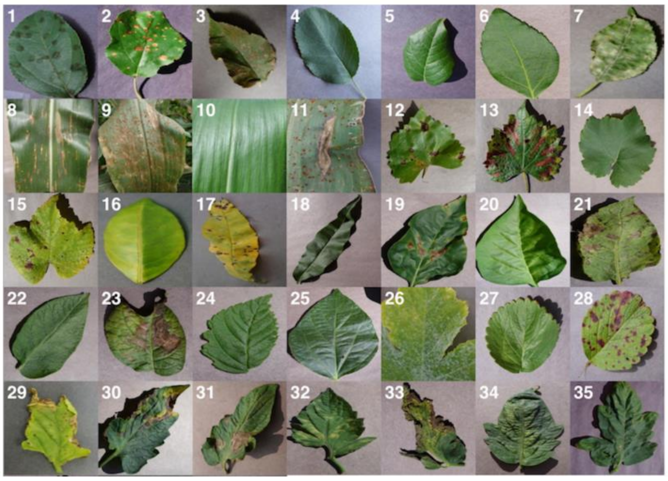


**Fig 1**

### 3.2 Plant Disease Detection

We used CNN deep learning model to train our plant disease detection model. We used the famous "Plant disease" dataset to train our model. The dataset contains 35 categories, which includes diseases of different plants. (Apple, Cherry, Grape, Orange, Peach, Pepper, Potato, Strawberry and Tomato). We used 42,191 images for training and 5266 images for testing. We used Keras library as a framework to implement CNN model. We achieved an accuracy of 94% for testing data. Fig 2 represents the CNN model we used to train the model. The images are resized to 200*200 pixels (height and width). Four sets of Convolution layer and Maxpooling layer are used to train the model. Number of filters in four convolution layers are 32, 64, 64, 64 respectively with kernel size (3,3) for all the layers. All the kernels of four max pooling layers are of size (2,2). After the convolution operations, all the nodes are flattened and finally the output layer contains 35 nodes which is equal to number of classes we have.

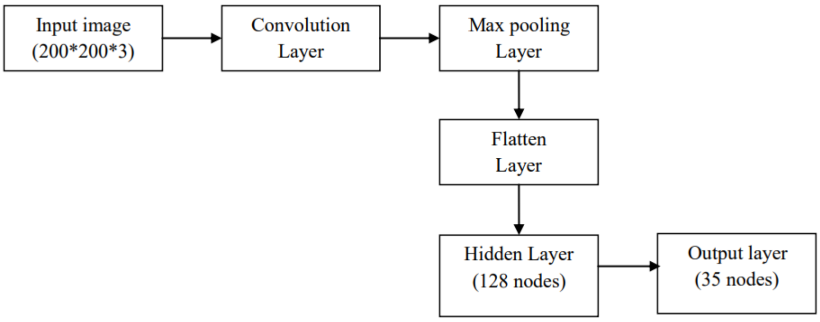


**Fig 2:** CNN Model

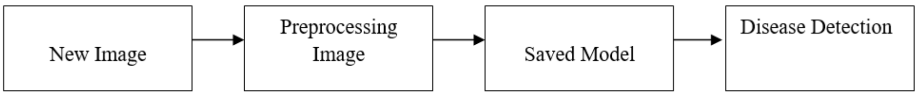


**Fig 3:** Detecting new images

### 3.3 Weather Forecasting

Fig 4 and 5 describes the fetching and training of weather dataset for predicting next day weather conditions. Once the user provides the city name as input, a dataset will be downloaded for the past 3 months weather data using API. Out of 24 features, we Fig 4 and 5 describes the fetching and training of weather dataset for predicting next day weather conditions. Once the user provides the city name as input, a dataset will be downloaded for the past 3 months weather data using API. Out of 24 features, we are selecting 6 features of data, ('maxtempC','mintempC', 'humidity','precipMM','pressure','tempC'). Two months data is used for training and for each day, we got 8 entries in the dataset which tells weather condition at 8 different times. (with 3 hr difference). A total of 706 entries are used in which 564 for training and 142 for testing. The model is trained in such a way that for every 30 days we are predicting the 31st day temperature, precipitation and humidity. Since weather details are different for different places we can't use a fixed dataset for all type of places and all for all seasons. This can help to more focus weather details on particular region.

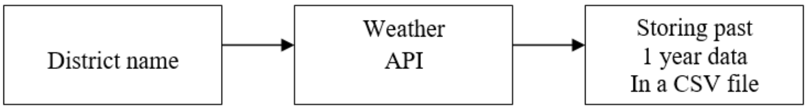


**Fig 4:** Getting weather dataset using API

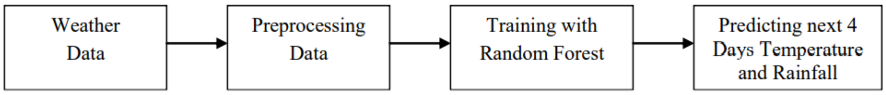


**Fig 5:** Training of weather dataset

### 3.4 Market Price

We used Market today price website (https://market. todaypricerates.com/vegetables-daily-price) to fetch Market price of different vegetables. User can select state and nearby city to check the prices. With the selected city name and state name a URL will be made which is used to scrap the website and fetch the data.

URL= "https://market.todaypricerates.com/'+cname+'-vegetables-price-in-'+sname"

The fetched data is then displayed in application user interface.

### 3.5 Suggestions and Translation

Once the disease is detected, user will be displayed with disease name, disease description and suggestion to overcome the disease. User can select his/her local language and can get the results in the selected one along with English language results. We used "googletrans" API with given input as selected language and English results to convert results into selected language.

## IV. RESULTS AND DISCUSSION

### 4.1 Plant disease detection

We used 5 layers of CNN layer and achieved an accuracy of 94.68% for testing data. If we use transferring learning approaches like VGG16, resnet we may achieve even better results but due to unavailability of local GPU and huge dataset of 46,000 images we were unable to perform that step. We are comparing the results of using 3 CNN layers and 2 CNN layers below.

| Model | Accuracy |
|---|---|
| 5 CNN Layers | 94.68% |
| 3 CNN Layers | 90.47% |
| 2 CNN Layers | 83.21% |

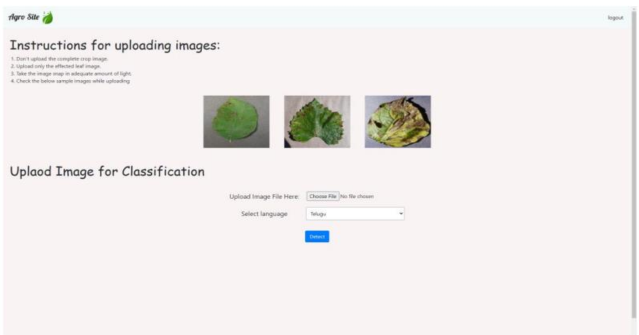


**Fig 6**

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Fig 6 is the snippet from developed website where user needs to upload the image file and can select a language. As shown in Fig 7, the output consists of detected disease name, description of disease and suggestions. The output will be in English language as well as selected local language.

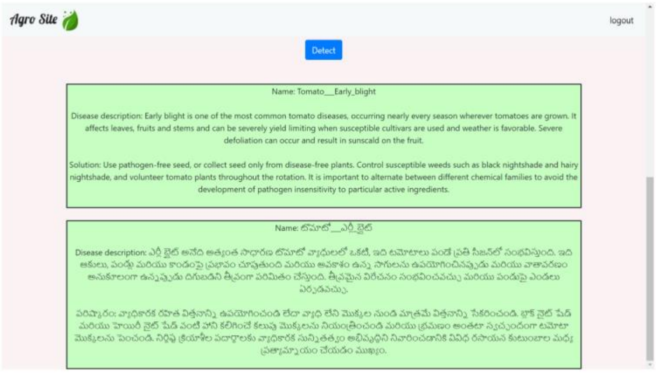



**Fig 7**

### 4.2 Weather forecasting

Mean absolute error for

**Singapore dataset:**

| Feature | Baseline Model | Training | Testing |
|---|---|---|---|
| Temperature | 1.40 | 0.14 | 0.34 |
| Precipitation | 0.72 | 0.13 | 0.41 |
| Humidity | 6.34 | 0.65 | 1.57 |

**Nellore dataset:**

| Feature | Baseline Model | Training | Testing |
|---|---|---|---|
| Temperature | 2.26 | 0.19 | 0.56 |
| Precipitation | 0.12 | 0.03 | 0.08 |
| Humidity | 11.03 | 1.03 | 1.95 |

We experimented with linear regression and Random forest regressor models. Below are the results obtained for the Nellore dataset.

Mean absolute error for predicting Temperature with baseline value 2.26,

| Data | Linear Regression | Random Forest Regressor |
|---|---|---|
| Training | 0.11 | 0.03 |
| Testing | 0.23 | 0.08 |

Mean absolute error for predicting Precipitation with baseline value 0.12,

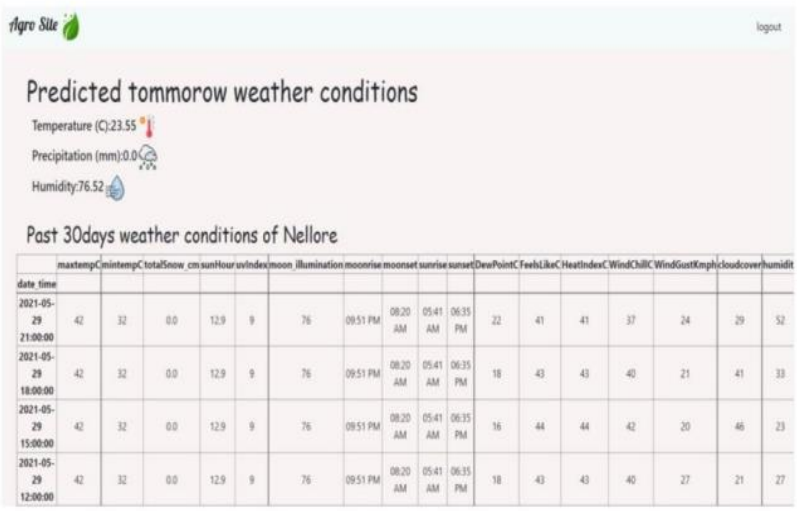
| Data | Linear Regression | Randon Forest Regressor |
|---|---|---|
| Training | 0.11 | 0.033 |
| Testing | 0.23 | 0.08 |

Mean absolute error for predicting humidity with baseline value 11.03,

| Date | Linear Regression | Random Forest Regressor |
|---|---|---|
| Training | 0.11 | 1.03 |
| Testing | 0.23 | 0.08 |

From the above results, it is clear that random forest regression model is working better than linear regression model.

Once the user provides the city name as input, a dataset will be downloaded for the past 3 months weather data using API. The model is trained in such a way that for every 30 days of data, we are predicting the 31st day temperature, precipitation and humidity. The results of training using Random forest regressor for two datasets/cities are provided below.




| date_time | maxtempC | mintempC | totalSnow_cm | sunHour | uvIndex | moon_illumination | moonrise | moonset | sunrise | sunset | DewPointC | FeelsLikeC | HeatIndexC | WindChillC | WindGustKmph | cloudcover | humidit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2021-05-29 21:00:00 | 42 | 32 | 0.0 | 12.9 | 9 | 76 | 09:51 PM | 08:20 AM | 05:41 AM | 06:35 PM | 22 | 41 | 41 | 37 | 24 | 29 | 52 |
| 2021-05-29 18:00:00 | 42 | 32 | 0.0 | 12.9 | 9 | 76 | 09:51 PM | 08:20 AM | 05:41 AM | 06:35 PM | 18 | 43 | 43 | 40 | 21 | 41 | 33 |
| 2021-05-29 15:00:00 | 42 | 32 | 0.0 | 12.9 | 9 | 76 | 09:51 PM | 08:20 AM | 05:41 AM | 06:35 PM | 16 | 44 | 44 | 42 | 20 | 46 | 23 |
| 2021-05-29 12:00:00 | 42 | 32 | 0.0 | 12.9 | 9 | 76 | 09:51 PM | 08:20 AM | 05:41 AM | 06:35 PM | 18 | 43 | 43 | 40 | 27 | 21 | 27 |

**Fig 8**

Fig 8 is the output snippet of predicted weather conditions for Nellore city.

**4.3 Q/A Portal**

Once farmer login to his account, he can post a question as shown in Fig 9 in Q/A portal.

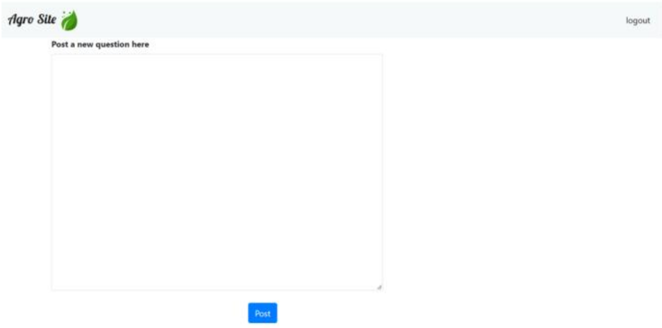



**Fig 9**

Farmer will displayed with the questions he raised and volunteers are displayed with the farmer questions in his Village/District. This helps to reduce the count of questions volunteers are displayed with. The questions are displayed as shown Fig 10.

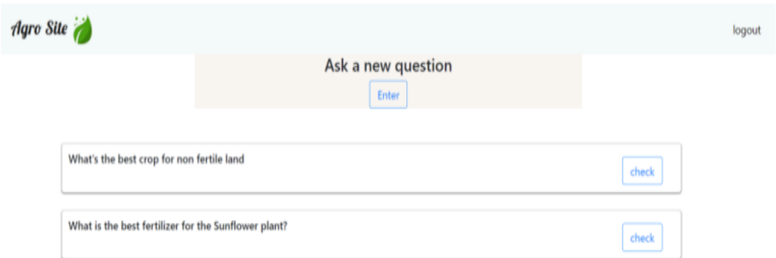



**Fig 10**

Volunteer can comment his suggestions which are displayed to user. Fig 11 is website snippet showing the conversation for the question raised.

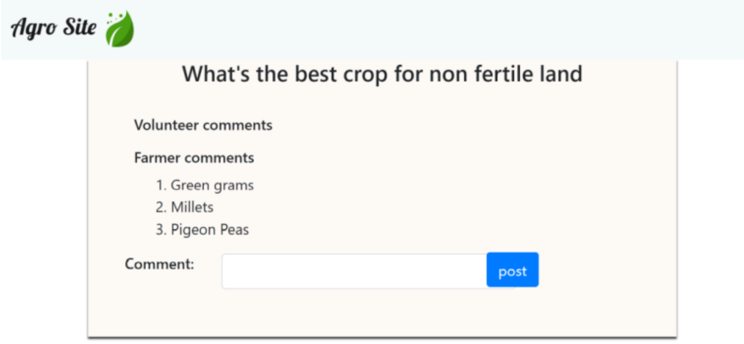



**Fig 11**

### 4.4 Market Price

User can select state and district as shown in Fig 12 and vegetable prices will be displayed to the user as shown in Fig 13 using web scrapping from the website https://market.todaypricerates.com/vegetablesdaily-price.

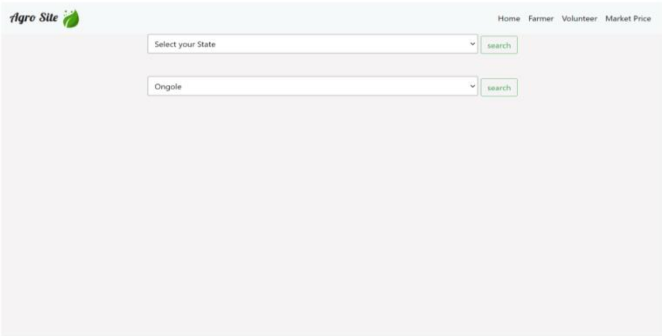
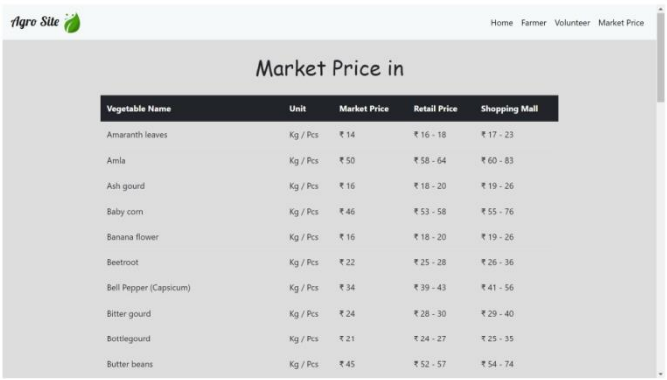



**Fig 12**




| Vegetable Name | Unit | Market Price | Retail Price | Shopping Mall |
|---|---|---|---|---|
| Amaranth leaves | Kg / Pcs | ₹ 14 | ₹ 16 - 18 | ₹ 17 - 23 |
| Amla | Kg / Pcs | ₹ 50 | ₹ 58 - 64 | ₹ 60 - 83 |
| Ash gourd | Kg / Pcs | ₹ 16 | ₹ 18 - 20 | ₹ 19 - 26 |
| Baby corn | Kg / Pcs | ₹ 46 | ₹ 53 - 58 | ₹ 55 - 76 |
| Banana flower | Kg / Pcs | ₹ 16 | ₹ 18 - 20 | ₹ 19 - 26 |
| Beetroot | Kg / Pcs | ₹ 22 | ₹ 25 - 28 | ₹ 26 - 36 |
| Bell Pepper (Capsicum) | Kg / Pcs | ₹ 34 | ₹ 39 - 43 | ₹ 41 - 56 |
| Bitter gourd | Kg / Pcs | ₹ 24 | ₹ 28 - 30 | ₹ 29 - 40 |
| Bottlegourd | Kg / Pcs | ₹ 21 | ₹ 24 - 27 | ₹ 25 - 35 |
| Butter beans | Kg / Pcs | ₹ 45 | ₹ 52 - 57 | ₹ 54 - 74 |

**Fig 13**

## V. CONCLUSION

In this project we made a farmer assistance application in which farmers and any user can detect plant diseases by uploading the affected part image and get the description in local language and English language, can check next weather conditions of his/her place, can communicate with agriculture experts and clear their doubts and also can check the current vegetable places in his place. We used CNN for plant disease detection and achieved an accuracy of 94%, we compared Random forest regressor and linear regression training values in terms of mean absolute error and choose Random forest algorithm as it achieved better results. Future work includes, including more diseases in the dataset and using Transfer learning approach to improve the accuracy. For weather forecasting we can predict and display the results for next week weather conditions instead of a single day. In question answering portal, we are displaying the questions of farmers to volunteers who are in same village/ district to reduce the number of questions that volunteers need to check. The other solutions which can improve the performance are using filters to filter out the villages/districts/states the volunteers want to check for, displaying farmer/volunteer details which can help them to contact with phone and also can understand the experience of volunteers. For market price prediction, currently we are displaying only vegetable prices of selected district and this only works for Indian states and districts. We can extend this to prices of fruits and other farming products.

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