

# WE-FARM

by

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A project report submitted to

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in

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# BONAFIDE CERTIFICATE

Certified that this project report entitled “**We-Farm**” is a bonafide work of SUVAM JAIN (16BCE1138), SANKALP JAIN (16BCE1183), SAMRIDDHI VERMA (16BCE1375), RAJ CHOUDHARY (16BCE1384) and ABHIRAJ CHAUDHARY (16BCE1385) who carried out this project work under my supervision and guidance for **CSE3999 – Technical Answers to Real-World Problems (TARP)**.

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## INTRODUCTION

“India is a land of villages, and farmers are the soul of the country”. Majority of Indians are directly or indirectly involved in agricultural activities. It would not be wrong to say that farmers are the backbone of our economy. As suggested by many scientists, agriculture is a profession that should be practiced by most educated people of a country because of the level of complexity involved in this profession, such as the value of farming. Many farmers of our country are illiterate and use conventional crops and agricultural practices. The farmers contact the municipal head who advises the farmers based on some traditional methods like type of the soil, climatic conditions and rainfall to predict the crop that should be grown. Over the years due to change in weather, change in type of soil due to use of pesticides, availability of new crops (which they may not be aware of like cross pollinated seeds) and other factors have resulted in rapid decline of yield as in many areas as compared to the past which have led to suicidal farmers or they get stuck into cycle of debt. One of the major issues is that farmers are not getting the right price for their harvest due to monopoly of few individuals in the mandi or selection of wrong vendor and many other reasons. Other issue which persists is unavailability of news/trends related to agriculture or unawareness related to government schemes for farmers, due to lack of proper place where all consolidated content related to agriculture is present.

To solve this major issue, we decided to take the opportunity to engineer a project that may solve this issue raging in society. We tried to establish contacts with the farmers, block development officers and other government officials, to understand the root cause of these issues. Our application is developed to address this section of the society.

We-Farm is an application which comprises of a mobile application as well as a web application. We-Farm gives the farmers/ government officials the opportunity to predict crops, to check weather data, to stay in touch with current news and trends, this application also digitalizes the whole process of selling and buying crops.

## FINALIZATION OF PROBLEM STATEMENT

After thorough survey and deep analysis, we found out eleven solutions to critical real-life problems:

1. Remote Patient Care/Monitoring
2. Early Flood Detection and Avoidance
3. Toll Booth Manager System
4. Smart Dustbin/ Garbage Monitoring System
5. Fire Department Alerting System
6. Prognosis of Harvest
7. Underground Cable Fault Detector
8. Person/Wheelchair Fall Detection
9. Prison Break Monitoring & Alerting System
10. Air & Sound Pollution Monitoring System
11. Traffic Signal Monitoring & Controller System

Eleven criteria have been identified to find the problem to work upon:

1. Type of Technology – this criterion relates to level of technology required during development of the solution.
2. Cost - this criterion describes the cost involved during development and maintenance phase of the project.
3. Degree of Difficulty - this criterion describes the amount of difficulty during design and development phase of the solution.
4. Extent of use to respective target audience - this criterion stands for the importance and usefulness of the solution to the people for whom it was developed and conceptualized.
5. Environmental Effects - this criterion reflects upon the effect of the solution on the environment in accordance to damage.
6. Scaling - this criterion describes level of scalability of the solution.
7. Feasibility - this criterion describes the viability of the solution.
8. Political Factors - this criterion reflects upon the political effect of the product on society, when launched.
9. Socio Economic Factor - this criterion reflects upon the socio-economic effect of the product on society, when launched.
10. Negative Effects - this criterion showcases the number of negative impacts it may have on user of the solution.
11. Existing System – this criterion inform about existing solution to the problem addressed, in the market.

*Below is the analysis of critical real life problems on above criteria, weightage has been assigned for each criterion for each problem to identify the problem we should work upon:*

Problems	Type of Technology	Cost	Degree of Difficulty	Extent of use to common man to respective target audience	Environmental Effects	Scaling	Feasibility	Political Factors	Socio Economic Factor	Negative Effects	Existing System	Total score	Acceptance
Remote Patient Care/Monitoring	2	1	2	2	3	1	3	1	2	1	1	19	Rejected
Early Flood Detection and Avoidance	3	1	3	2	3	2	2	3	2	3	2	26	Rejected
Toll Booth Manager System	1	2	1	2	3	3	3	1	1	1	1	19	Rejected
Smart Dustbin/ Garbage Monitoring System	3	1	3	2	3	2	2	3	2	2	2	25	Rejected
Fire Department Alerting System	1	2	1	2	3	2	3	3	2	2	1	22	Rejected
Prognosis of Harvest	3	2	3	3	3	2	2	2	3	2	3	28	Accepted
Underground Cable Fault Detector	1	2	2	2	2	2	2	3	1	3	1	21	Rejected
Person/Wheelchair Fall Detection	3	1	3	2	3	1	2	1	1	2	2	21	Rejected
Prison Break Monitoring & Alerting System	2	1	1	2	1	3	2	1	1	2	2	18	Rejected
Air & Sound Pollution Monitoring System	2	2	2	3	3	2	3	2	3	2	1	25	Rejected
Traffic Signal Monitoring & Controller System	1	1	1	2	3	3	3	3	1	3	1	22	Rejected

**Hence the it is clearly analyzed, our problem statement will be an application to aid farmers**

## FIELD VISIT AND SURVEY

We conducted a field survey with 11 questions. Questions were asked from farmers, block development officers and government officials working in the field of agriculture belonging to all parts of the country. Main aim of the survey is to understand whether problems identified by our team, exists or not and to understand their importance. This field survey also helped us in giving a confirmation about our project and features to be included.



The image shows a screenshot of a survey form titled "Field Survey of Block Development Officers and Farmers". The form is presented on a white background with a purple header bar at the top. Below the title, the text "We-Farm" is visible, followed by a red asterisk and the word "Required". The first question is "What is your role in the field of agriculture? \*", with three radio button options: "Farmer", "Block Development Officer", and "Government Official (holding office related to Agriculture)". The second question is "Which part of country you are currently residing in / employed in ? \*", with four radio button options: "North India", "South India", "East India", and "West India". The third question is "Are you aware of any technical solution like Website / Application to aid farmers? \*", with two radio button options: "Yes" and "No". A small speech bubble icon is located in the bottom left corner of the form area.

Field Survey of Block Development Officers and Farmers

We-Farm

\*Required

What is your role in the field of agriculture? \*

☐ Farmer

☐ Block Development Officer

☐ Government Official (holding office related to Agriculture)

Which part of country you are currently residing in / employed in ? \*

☐ North India

☐ South India

☐ East India

☐ West India

Are you aware of any technical solution like Website / Application to aid farmers? \*

☐ Yes

☐ No



What kind of problems are faced by farmers in India? \*

- ☐ Not getting proper yield
- ☐ Not aware of current news/trend/advancement in the field of agriculture
- ☐ Not able to get right advice for any query related to agriculture
- ☐ Not aware of current schemes
- ☐ Unable to get right prices for their harvest

Why do you think the farmers are not being able to get required yield? \*

- ☐ Growing conventional crop
- ☐ Not aware of weather data
- ☐ Unaware of the suitable crop

Why do you think farmers are not aware of current advancements by government or private cooperations? \*

- ☐ Content is available but it gets buried under so much other content which is not related to the field
- ☐ Misleading content
- ☐ Not aware of resources where required information is available

If you are facing some queries related to agriculture or agricultural practices, what farmers do? \*

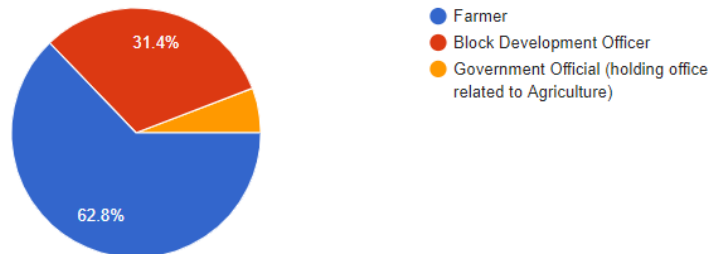
- ☐ Go to fellow farmers
- ☐ Go to block development officer
- ☐ Hire some professional help



# HIGHLIGHTS OF THE FIELD VISIT / SUMMARY

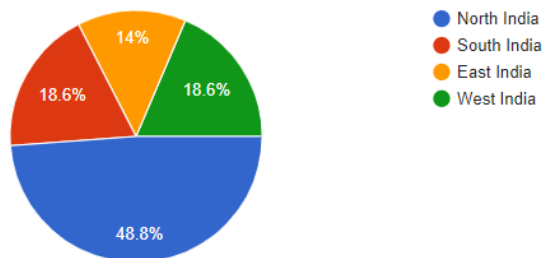
What is your role in the field of agriculture?

86 responses



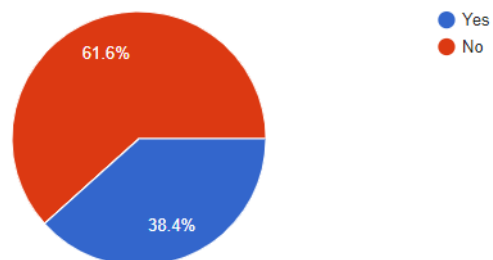
Which part of country you are currently residing in / employed in ?

86 responses



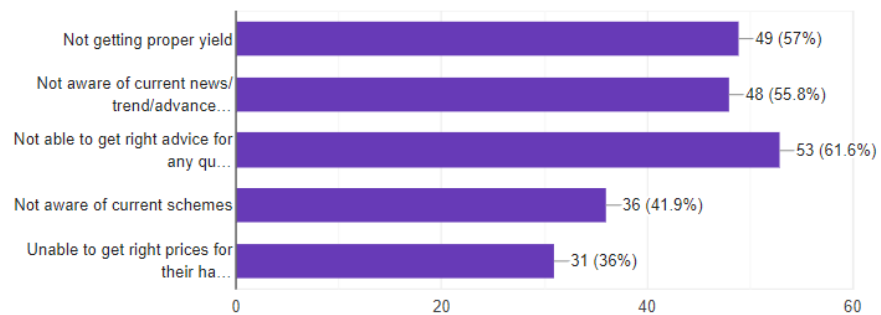
Are you aware of any technical solution like Website / Application to aid farmers?

86 responses



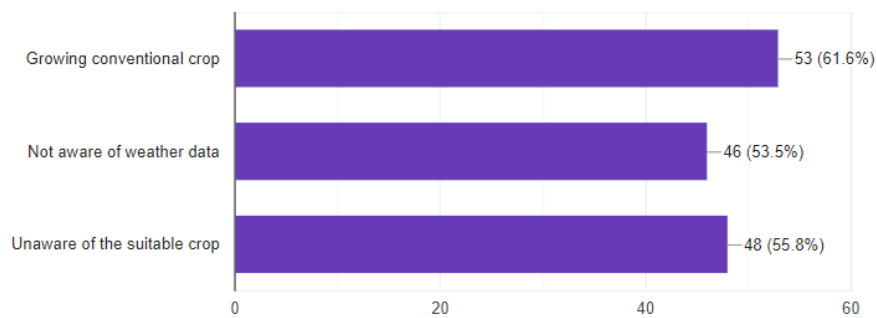
### What kind of problems are faced by farmers in India?

86 responses



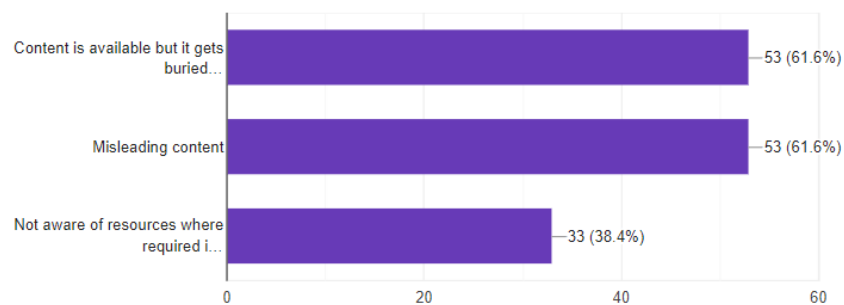
### Why do you think the farmers are not being able to get required yield?

86 responses



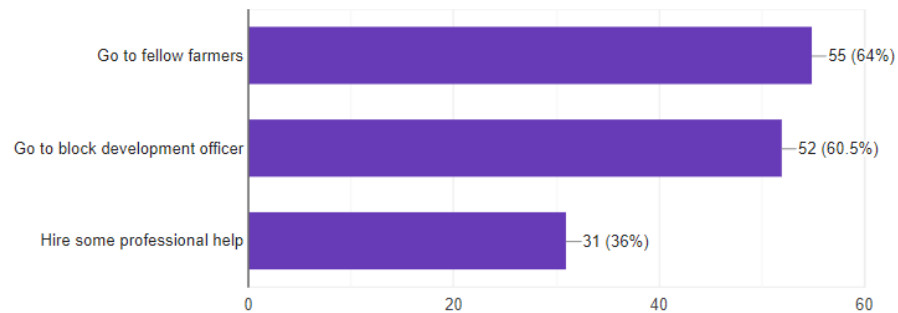
### Why do you think farmers are not aware of current advancements by government or private cooperations?

86 responses



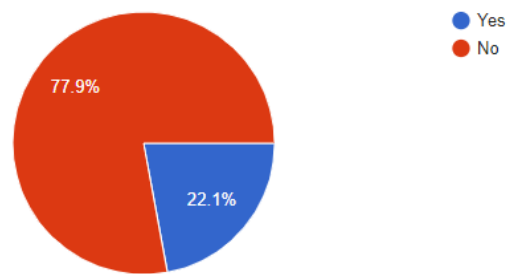
If you are facing some queries related to agriculture or agricultural practices, what farmers do?

86 responses



Are farmers aware of all the schemes launched by government of India?

86 responses



Farmers are not able to get right price for their harvest, why?

86 responses



How do farmers get affected due to improper yield or not able to get the right price for their harvest?

86 responses



## Analysis:

After thorough analysis of field survey, some problems have been identified which needs dire attention and the below will be pillars of our project

- Predict Crops for farmers
- Weather Data for specific locations
- Information about current trends / news/ and schemes of agriculture
- Question – Answer Forum for farmers so that queries can be attended to

After collecting 86 responses, a staggering 93% feel the need for a solution which covers all the problems of farmers in one place.

## **PROPOSED WORK**

We propose a mobile application and a web application which can be used by farmers, Block Development Officers and government officials (working in the field of agriculture). We-Farm will be an application catering to numerous problems faced by farmers as observed above. Hence we have titled our project We-Farm which signifies our attempt to help farmers and represents we are standing by their side during times of crisis.

**Target User:** Farmer, Block Development Officers and Other Government Officials

Mobile Application will have numerous features catering to various facets of problems faced by farmers. We-Farm will be able to predict the most suitable crop that should be grown on basis on various inputs location, duration of sowing, soil contents and weather data. This feature will help farmers getting over the problem of poor yield or failed crops. Next feature is to provide on spot weather data of any location. Next comes the question – answer forum which help the user in posting his/her query, which could be easily answered by any other user using the app. Following the above features comes, presenting news related to farmers in one place (news other field will not be shown). Other features including personal voice assistant and e-commerce option to buy seeds from within the application.

Website end of We-Farm is to digitalize the process of buying and selling of harvest in mandi, it can be stated like an Amazon for farmers. Once the farmer makes a request to sell their product or buy seeds from other sellers, the admin which is the local municipal head or BDO can approve their request. So, we try to connect the farmers one to one by removing a middle man. With the help of our website, farmers will be able to buy crop seeds, sell seeds and also see the latest ongoing Government schemes. They can also check their order status. While for the admin, they can see the details of farmers and approve their request to sell or buy.

## **IMPLEMENTATION AND WORKING (MOBILE APPLICATION)**

Our mobile application WE-FARM is a one place stop for solutions to the farmers. When you open the application, the front page contains a button which on pressing displays a list of options to choose from. This includes- Personal Assistant, News, Weather Forecast, Chat Forum, E-Commerce, Crop Prediction.

### **Crop prediction:**

This module provides the user with the facility to input the data about the different constituents of their field, weather data and regional information to get the best crops that can be grown during that time frame. After getting the input from the user, the data is sent to the server which after running the predictive model on the data returns the different types of crops that can be grown in decreasing order of relevance. The output also provides a video guiding the user about the crop and its important features, these videos are retrieved using YouTube player API. Also, detailed information for better cultivation requirements and insights of the particular crop can be viewed separately.

### **Weather forecast:**

The user will be notified of the weather change and can also view a detailed analysis of the weather condition in his area for a range of 2 weeks. This data is automatically retrieved using the GPS facility of the device to get the coordinates of the location and passing the same to the OpenWeatherMap API that returns the data for the location in JSON format.

### **Chat Forum:**

The application has an in-built chat forum in which the user can interact with fellow users, BDO (Block Development Officer) as well as with the representatives of the agricultural community to get their queries cleared as well as provide feedback and suggestions.

**Personal Assistant:**

An AI configured chatbot already trained on agriculture related queries and topics is also available to aid the queries of the user. It uses a NLP based model for speech-to-text recognition so that the user ask the queries to the bot and then a text-to-speech model is used to read the result to the user.

**E-Commerce:**

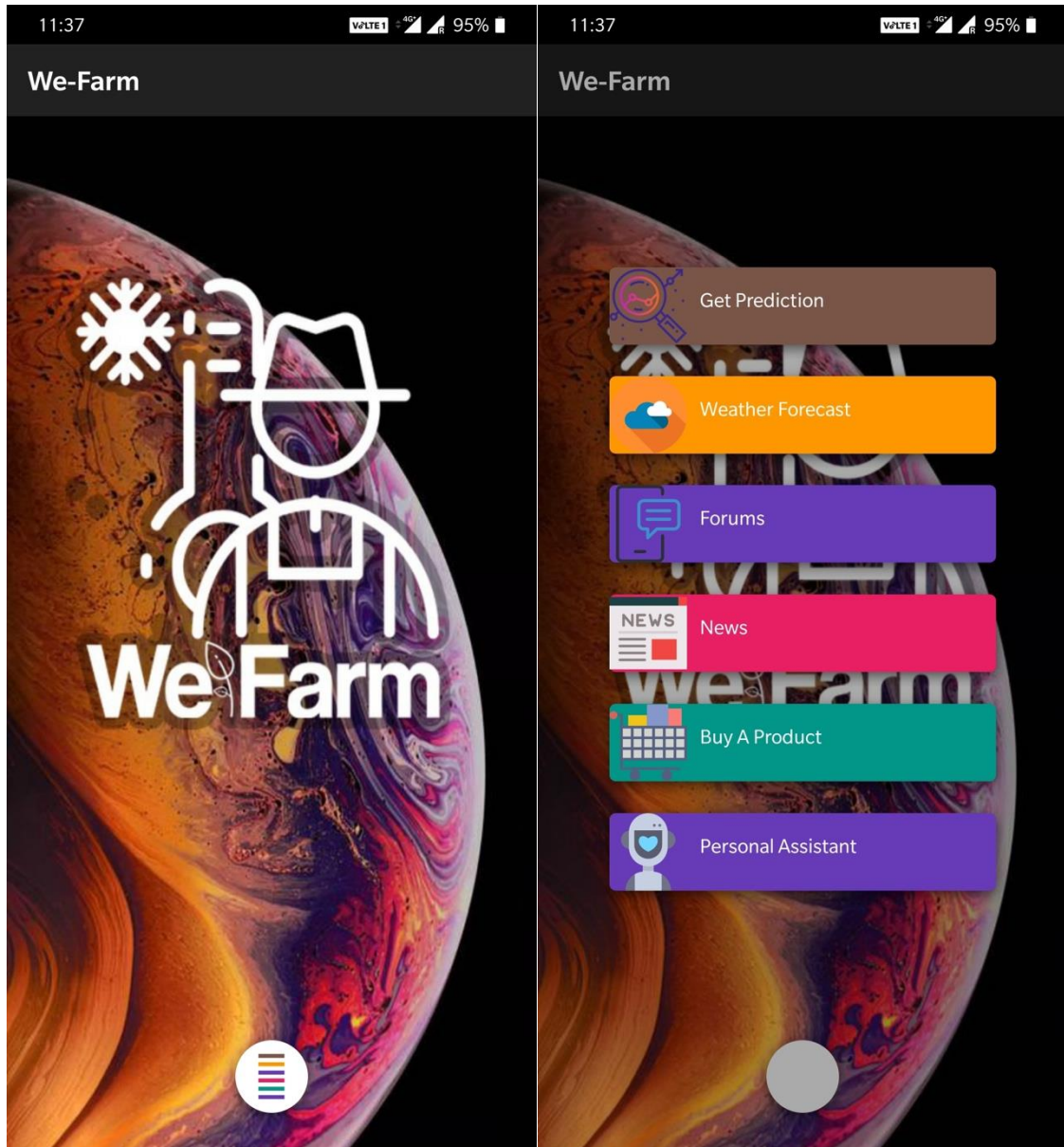
To help the farmer from the hassle to go to the mandi and sell their crops in a lower price because of the monopoly of the buyers there, the application has an in-built e-commerce where the farmer can sell their produce at the price decided by the government for that day so that they are not cheated by the buyers. Also, the farmers can buy quality seeds from the e-store based on his needs at government subsidized prices.

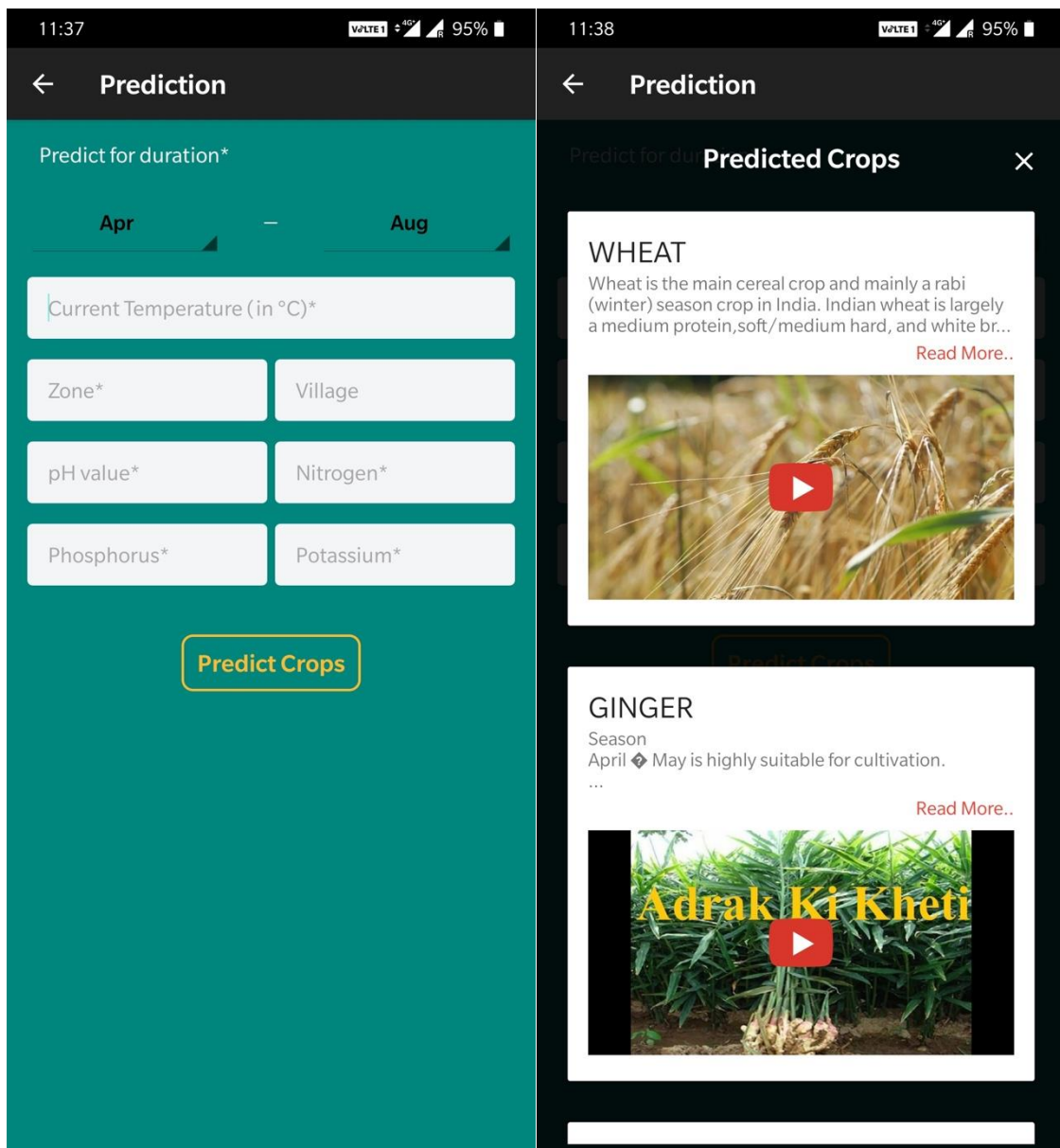
**News:**

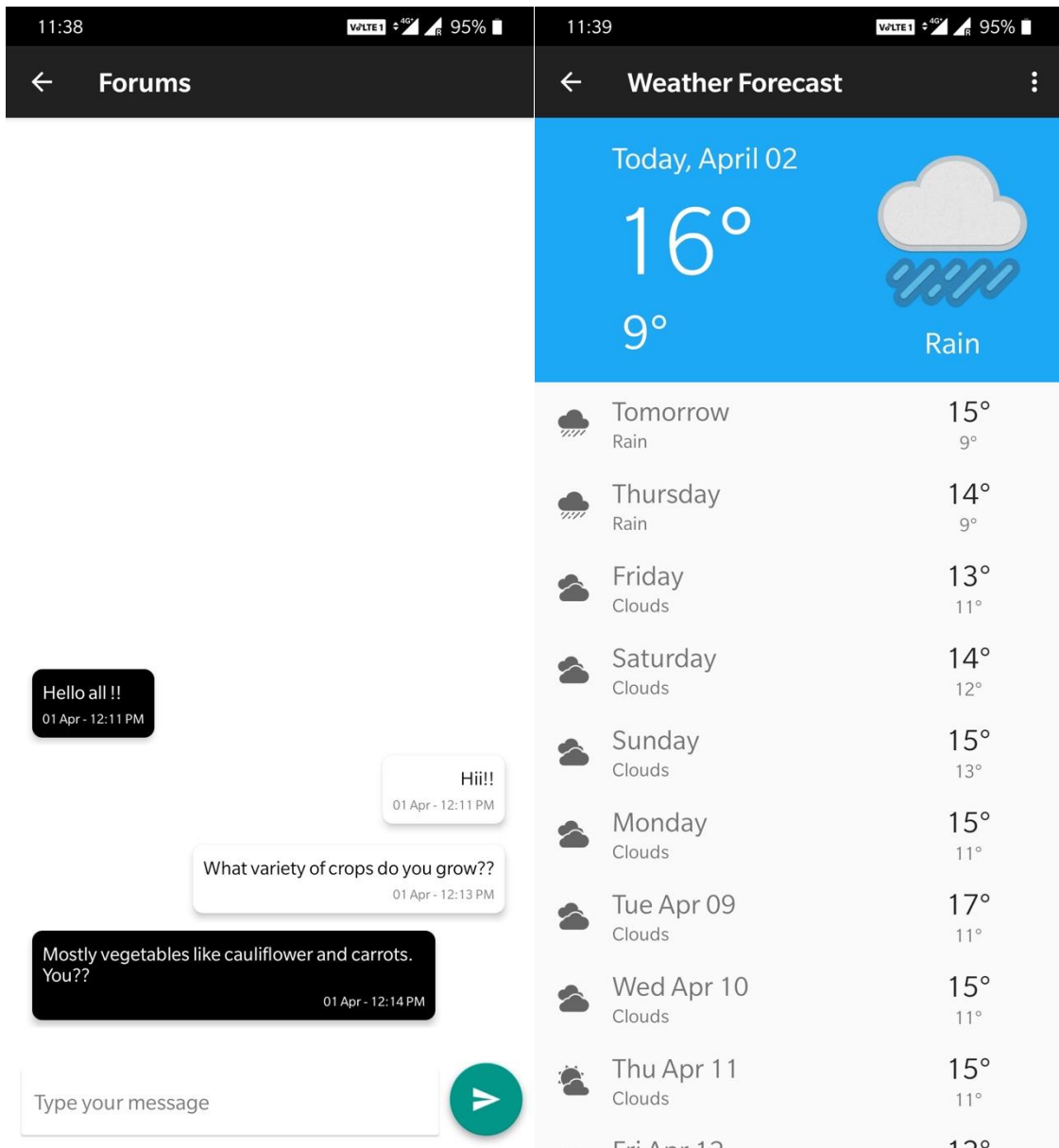
To keep the users up to date with the latest government schemes and news in the agricultural sector the user is notified with the latest news using the TOI news API.

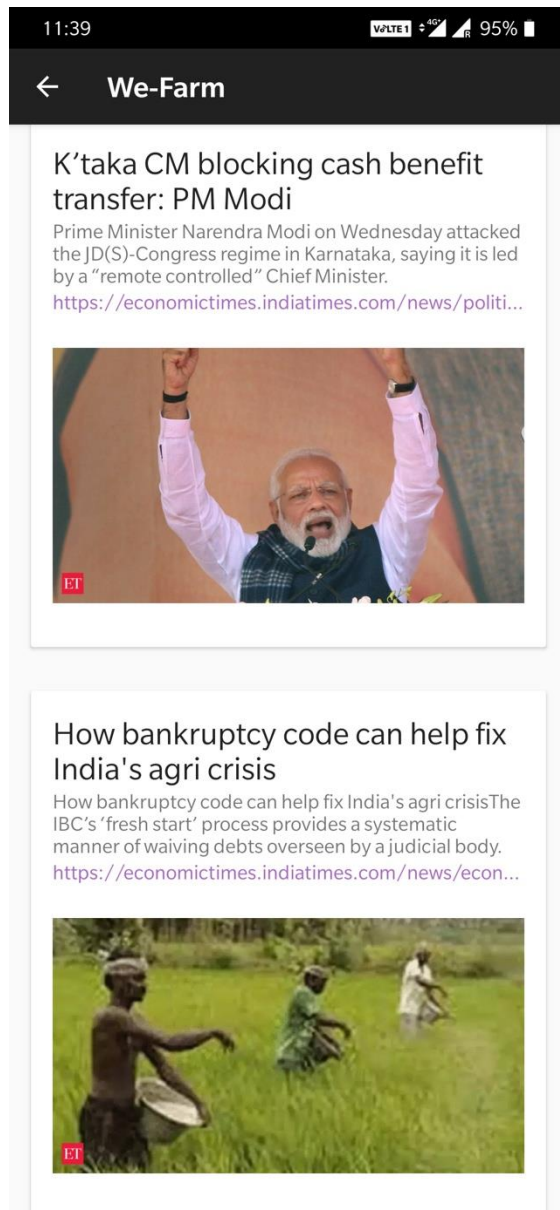


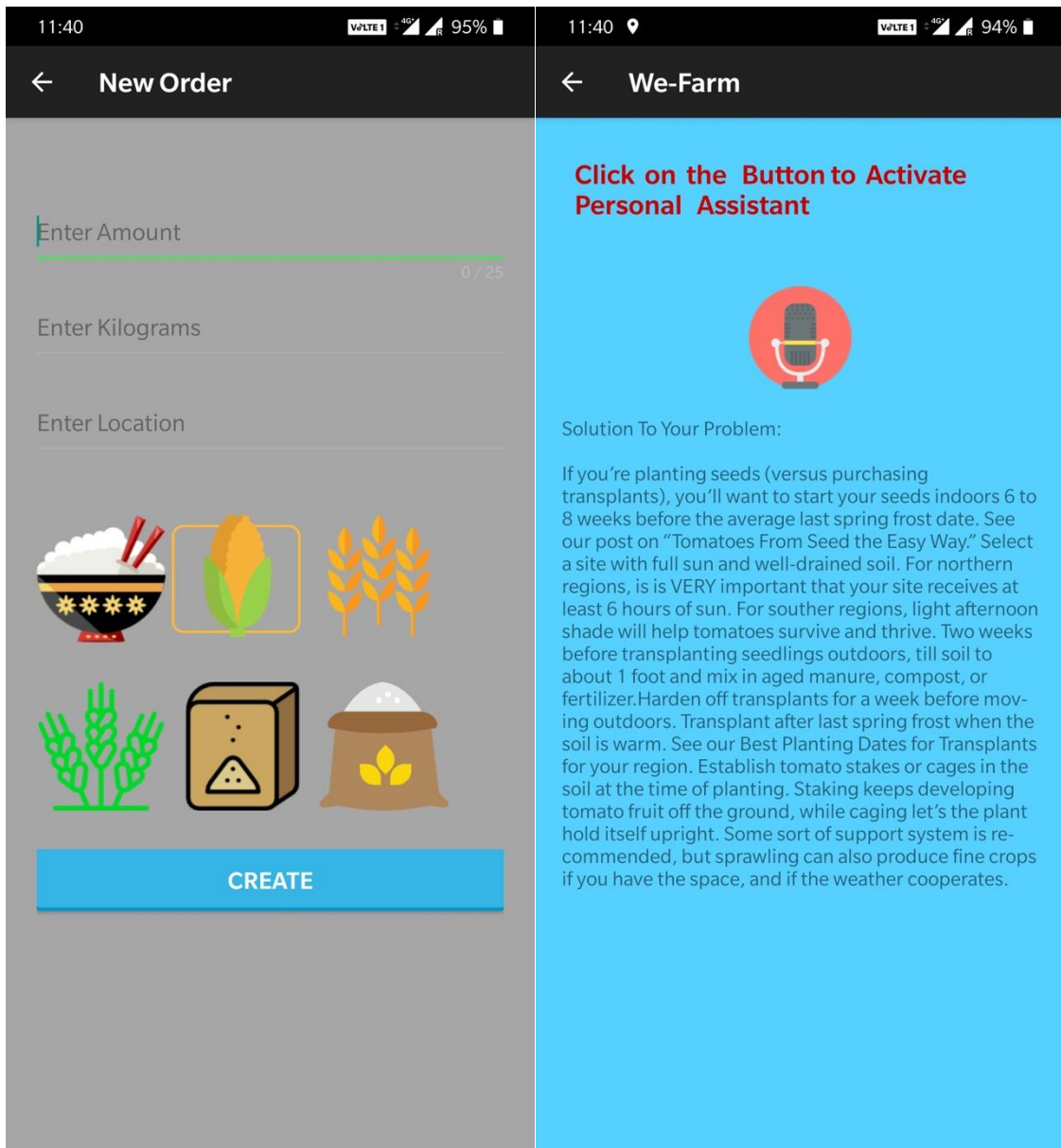
## SCREENSHOTS (MOBILE APPLICATION)











# **CROP PREDICTION**

## **Data collection**

First of all, the data for training different models was collected from <https://data.gov.in>, which consisted historical data of the features which affected the crops grown in these past years. The different factors that affect the crops grown are – temperature, rainfall, soil type which is mostly affected by the different components of the soil such as nitrogen, potassium, phosphorus, iron and even the pH value of the soil. Also the type of the crop grown depends on the season as different crops have different affinities for different seasons.

## **Data pre-processing**

The dataset was first of all pre-processed to make the complete dataset processing ready. First of all, the unnecessary columns which don't affect the type of crop to be grown much were removed such as the area of land, distance from nearest market, profit ratio, irrigation facility available or not, etc. The datatype of the columns were fixed so that they depict their actual meanings in the models. The missing value of temperature and rainfall were imputed by first of all grouping the data by crop type and then in the second level of grouping, it was done based on the region. This led to getting the specific data according to the crop grown and the region in which they are grown. Then, the missing values were imputed using the median value of the second order grouping, to make the model more robust towards outliers in the data. Then, the crops field was label encoded to change if from string type to categorical type to make the complete problem multiclass classification problem. After this, all the numerical columns were scaled on the same scale so that they contribute equally towards making the prediction.

## **Random Forest Classifier**

After pre-processing, the first model which was implemented for making the prediction is Random Forest Classifier which is an ensemble learning model which uses Decision Tree Classifier as the base estimator. This model basically, creates a number of Decision Trees for making prediction using a subset of training samples along with a subset of features for making the prediction for that iteration. After making the predictions for the different iterations, the final prediction is made by normalizing the prediction from all the different base estimators used while training. The



predictions are made by the different Decision Trees using the rules they learn from the training dataset using the concept of entropy change and Gini index. The main concept behind making rules using Decision Tree is that, it tries to split the dataset into different categories using a feature which leads to the different classification of the crop. This entropy change is calculated from Gini index for all the features and the features that leads to the most information gain in the split i.e. the minimum change in global entropy and the split entropy. This then leads to multiple splits in the datasets and this leads to formation to rules based on the splits made. Then the process is done iteratively for the splits formed. Now the entropy of the splits acts as the global entropy of that split. Then new rules are formed for dividing the data present in that split. This process is continued until there is no change in the entropy or the max depth for the tree is reached. The new data is inputted into the model, it traverses the tree using the rules in each level of the tree and then the final label to which the tree leads to, is the final prediction of the model.

Also the advantage of using Random Forest as a classification algorithm is that it helps us to find the feature importance of the different attributes in the dataset. From this, we can remove the less important fields that doesn't affect the accuracy of the model much but in turn, leads to decrease in the variance present in the model. This helps us to maintain the bias-variance tradeoff. From the model, we came to know that among the different constituents of the soil present, organic carbon, iron and humus content didn't play any major role in predicting the crop type. This helped us reduce the overfitting of the model as these fields were removed before training the model.

## **Support Vector Machine Classifier**

Support Vector Machine is a supervised machine learning algorithm that can be used for solving both regression and classification problem. SVM plots, data in the dataset in a  $n$ -dimensional space where value for each axis represents the values of the different features for that sample. Then the algorithm, finds the optimal  $(n-1)$ -dimensional hyperplane that perfectly separates the data for the different classes by optimizing the distance between the hyperplane and the support vectors for each classes data point. These support vectors helps in increasing the margin between the data points of the classes and the decision hyperplane. Sometimes, the hyperplane is not able to completely separate the data points of the different classes so it uses the concept of slack variable which during the classification process, moves these kinds of data points to the correct decision area with some cost associated with it. Also SVM uses different types of kernels to simplify this process. The kernel acts as

a mapping function that converts the data points from one domain to another. The different types of kernel functions present in SVM are – linear, polynomial, rbf (radial basis function), etc. These functions map the data from their present domain to another based on their mapping function formula. To control the overfitting of the SVM kernel, a regularization parameter  $\alpha$  is used to penalize the algorithm for each error it makes so that it generalizes well. Usually SVM are binary classification algorithm but the libraries present, themselves use one vs all concept to train  $n$  SVMs to differentiate between one class and rest  $n-1$  classes treated as a single class. When a new data is given to this SVM algorithm, it gets prediction from all the  $n$  SVMs trained in the form of probability and the class that gets the maximum probability from the  $n$  SVMs is assigned to the data point.

### **Naïve Bayes Classifier**

Naïve Bayes classifier belongs to the family of simple 'probabilistic classifier' based on applying Bayes Theorem with strong independence assumptions between the features. It assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. It works by calculating posterior probability  $P(c|x)$  from  $P(c)$ ,  $P(x)$  and  $P(x|c)$ . Here,  $P(c)$  is the prior probability of the class,  $P(x|c)$  is the likelihood which is the probability of predictor given class and  $P(x)$  is the prior probability of the predictor. It first of all, converts the dataset into a frequency table for each feature and then calculates the likelihood probabilities given the predictor and the class. Then, Bayes theorem is used to calculate the posterior probability and the class for which it is the maximum is assigned as the class for the sample. This algorithm works well for multiclass classification problem and if the independence assumption holds, it outperforms many complex algorithm. It predicts faster than many algorithms and requires less training set.



## **Hyperparameter tuning the models**

The different parameters of the above models are tuned using GridSearchCV using 5 cross validation set using holdout technique. This led to increase in accuracy as well as f1 score for both the validation set as well as test set.

## **Stacked Ensemble models**

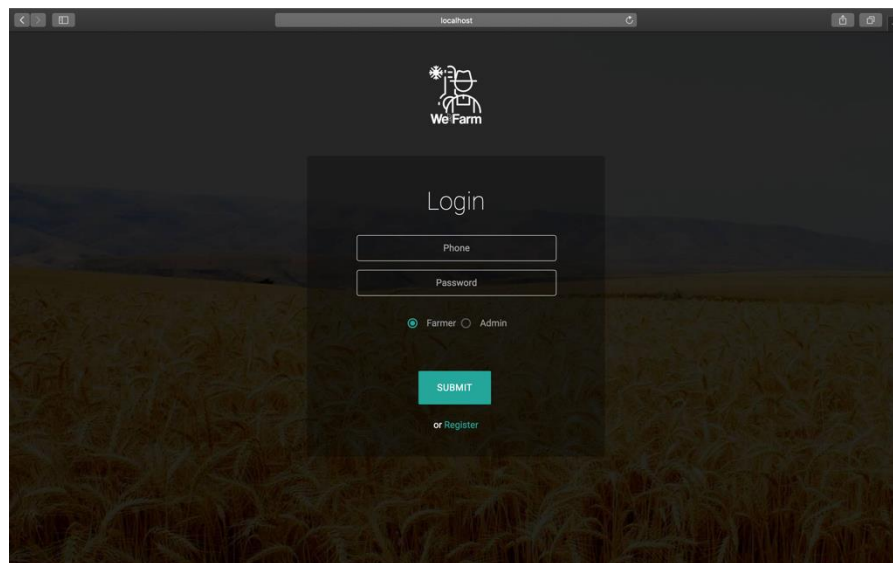
The above described hyper tuned models were combined together in a stacked ensemble models that uses weak learners to make predictions and uses the outcome of these to make the final prediction. Thus it acts like a strong classifier. All the weak classifiers that are stacked together are pretrained and hyper tuned for optimal parameters. When a sample is given to the stacked model to make a prediction, it passes the sample to all the weak classifiers under it and then collects the outcome of all these classifiers. Then using the outcome function, it makes the final prediction. The outcome function can be as simple as the mode function or some complex function that assigns weights to the outcome of the different weak classifiers to make the final outcome.

## IMPLEMENTATION (WEBSITE)

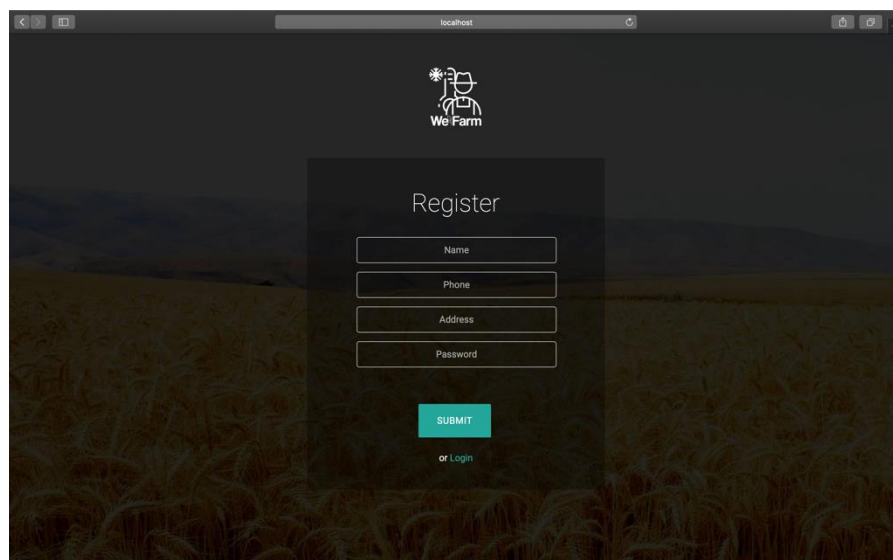
Our website We-Farm is designed using Node.js. It has two portals. One is for the administrator and the other is for the farmers. The home page will help a user in logging in or registering as a new user. Authenticated users can enter their phone number or password as their credential and can opt for suitable login portal.

New users can enter their personal details to create a new account.

### FRONT END DESIGN

A screenshot of a web browser displaying the 'We Farm' login page. The page has a dark background with a faint image of a field. At the top center is the 'We Farm' logo, which consists of a stylized plant icon and the text 'We Farm'. Below the logo is a white rectangular box containing the 'Login' form. The form has two input fields labeled 'Phone' and 'Password'. Below these fields are two radio buttons: 'Farmer' (which is selected) and 'Admin'. At the bottom of the form is a green 'SUBMIT' button. Below the button is a link that says 'or Register'.

*Fig.: The Login Form*

A screenshot of a web browser displaying the 'We Farm' registration page. The page has the same dark background and 'We Farm' logo as the login page. Below the logo is a white rectangular box containing the 'Register' form. The form has four input fields labeled 'Name', 'Phone', 'Address', and 'Password'. At the bottom of the form is a green 'SUBMIT' button. Below the button is a link that says 'or Login'.

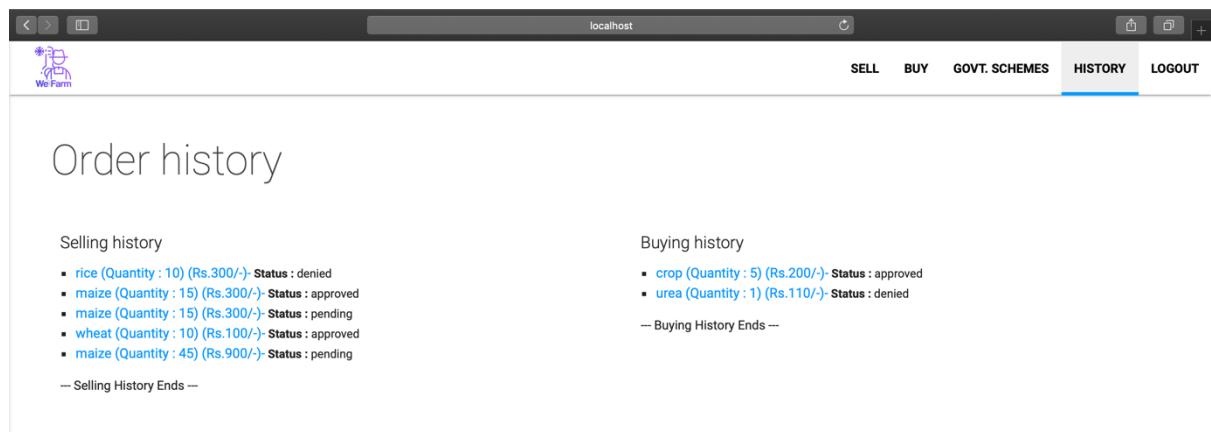
*Fig.: The Registration Form*

## The Admin Portal:

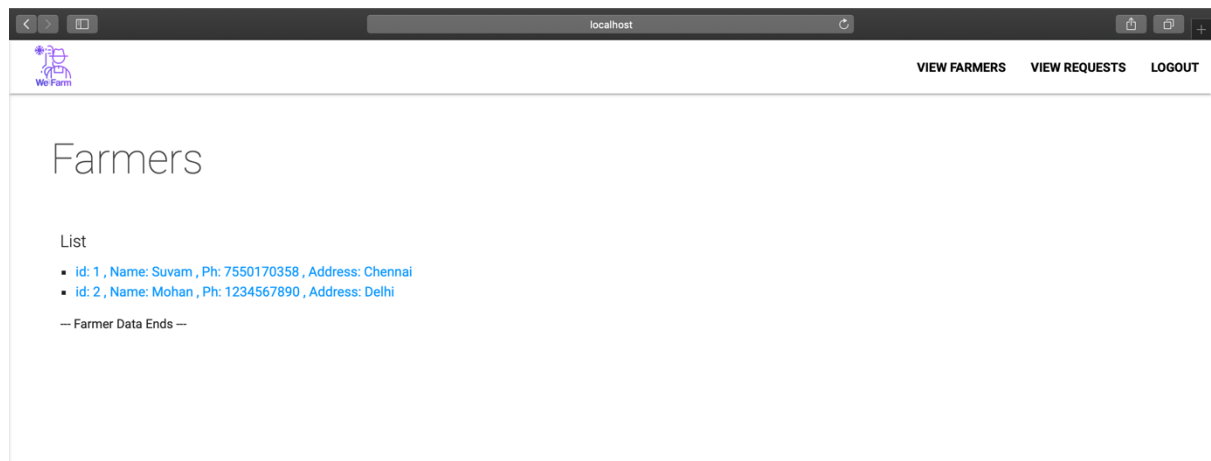
This portal is used to view the details of all the registered farmers. When a farmer makes a request to buy or sell something, the request is directly sent to admin where he can approve or deny the orders.

It can basically displays the details of farmers, displays the pending requests of farmers and also view the order history as a compilation of selling and buying history.

## FRONT END DESIGN



*Fig.: Order History Page of Admin Side*



*Fig.: Farmers view of Admin Side*

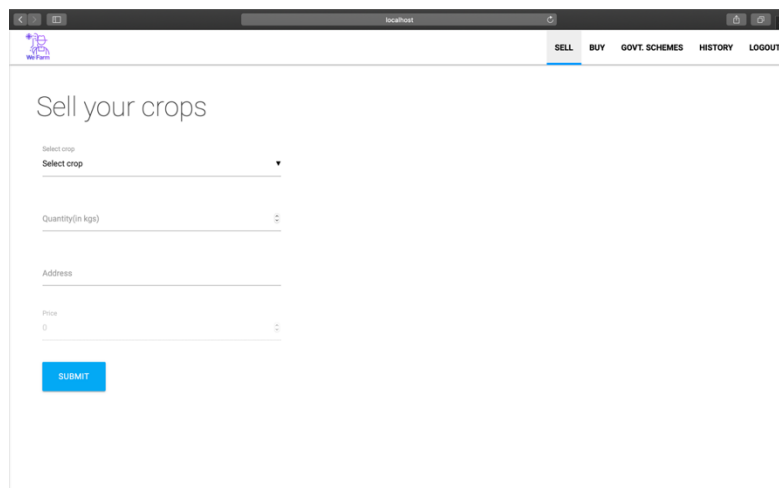
## The User Portal:

This portal let the farmers to sell their produce, buy seeds, view their orders history and see the ongoing Government schemes.

Farmers can use the sell portal to place a request for approval of order. This goes for the page of buying crops too. Once the farmer fills out the form, the request is sent to admin to queue for approval. In the page to view the Government Schemes, the link to the schemes is provided along with an in-depth description.

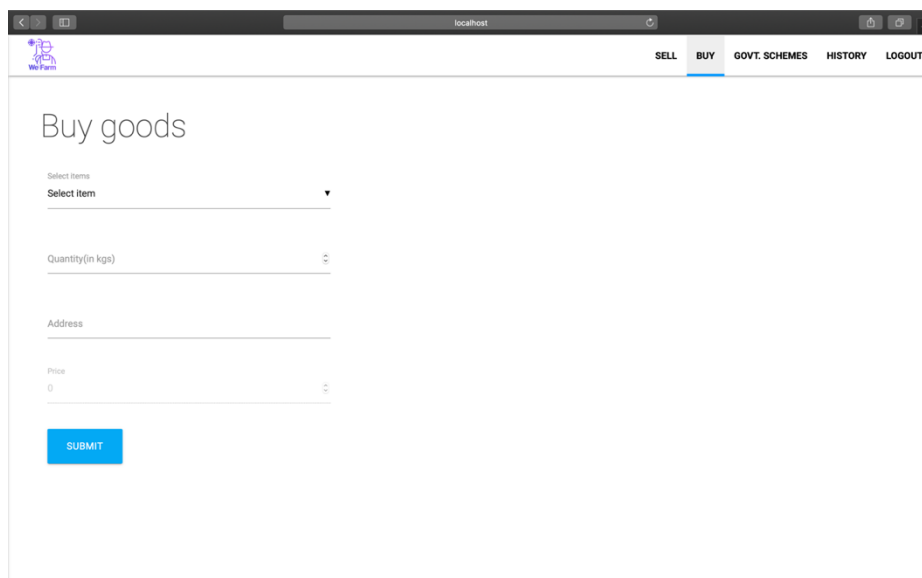
In the Order History portal, the farmer can view their buying and selling history. Each row shows the order details along with status. The status changes from pending once the admin approves or denies the request. Same is for the buying history.

### FRONT END DESIGN



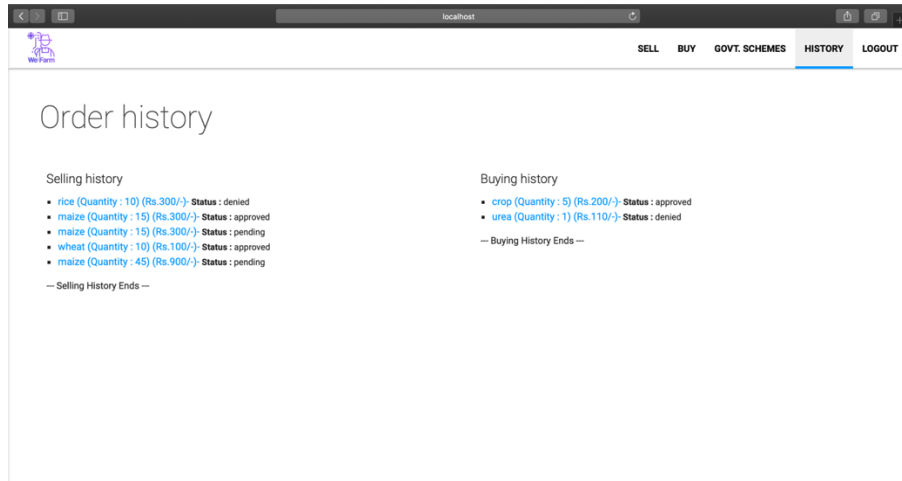
The screenshot shows a web browser window with the URL 'localhost'. The page has a navigation bar with links: 'SELL', 'BUY', 'GOVT. SCHEMES', 'HISTORY', and 'LOGOUT'. The 'SELL' link is highlighted. The main heading is 'Sell your crops'. Below it is a form with the following fields: 'Select crop' (a dropdown menu), 'Quantity(in kgs)' (a text input with a spinner), 'Address' (a text input), and 'Price' (a text input with a spinner). A blue 'SUBMIT' button is at the bottom of the form.

*Fig.: Sell Portal*

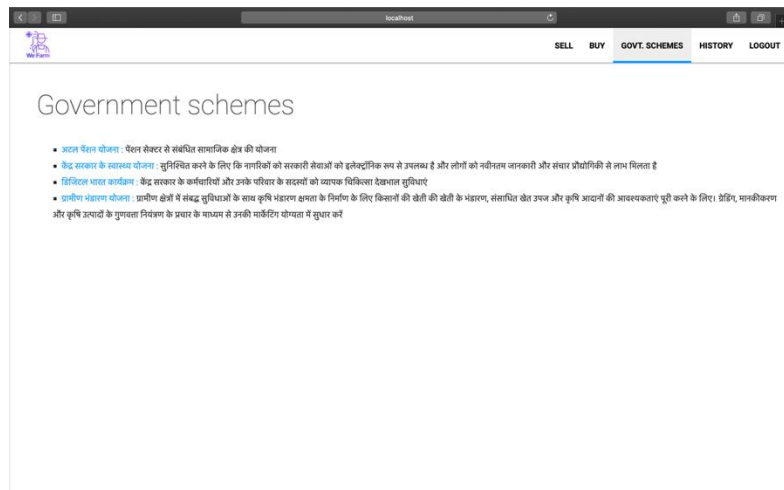


The screenshot shows a web browser window with the URL 'localhost'. The page has a navigation bar with links: 'SELL', 'BUY', 'GOVT. SCHEMES', 'HISTORY', and 'LOGOUT'. The 'BUY' link is highlighted. The main heading is 'Buy goods'. Below it is a form with the following fields: 'Select Item' (a dropdown menu), 'Quantity(in kgs)' (a text input with a spinner), 'Address' (a text input), and 'Price' (a text input with a spinner). A blue 'SUBMIT' button is at the bottom of the form.

*Fig.: Buying Portal*



*Fig.: History Portal*



*Fig.: Scheme Portal*

## WORKING (WEBSITE)

This project encouraged us to use one of the latest technologies as our tech stack for the completion of this project, namely Node.js with its different frameworks like express.js and also view template engines like pug for rendering the HTML web pages.

Data is stored at two different places i.e. Google Firebase console as well as locally in mysql database for faster results. This technique gives our application the flexibility to store the data on the cloud as unstructured data, providing security to database and also giving us the access to many api's available on cloud.

Using firebase helped us in making data available anywhere, at any time and also making our system scalable with some improvements. It is often advised to use mysql as database as relational database structure helps in querying the data quite easily.

We have used express js which itself is a framework of node js which provides an environment for the execution of javascript and making different routes using express framework. Different authentications have been added using morgan validation which is a middleware in node js explicitly used for authentication purposes. We explored many other middlewares like Joi for authentication but found out that morgan actually optimizes the validations.

Form data is updated to firebase in key value pairs which is handled using express-json. Different rest api protocols have been used appropriately in this application including the information of the forms being handled using POST protocols which makes the application more and more secure as well as optimized.

We have also maintained the sessions of the users logged in to avoid any unauthorized access of data.

## **CONCLUSION**

Our proposed solution We-Farm was successfully designed, developed and deployed. We-Farm performs all the desired functions properly. Both parts of We-Farm mobile application as well as website has been implemented and are working properly according to set standards. We-Farm is a novel solution, when taken to market, it is expected to perform beyond its limits and help the farmers grow again and continue contributing to our economy.