IBM Hack Challenge - 2021

Project Report on AI-Assisted Farming for Crop Recommendation & Farm Yield Prediction Application

Team Name: AgriOracle

Team Member:

1. **Pavan Pandya**
2. **Rutvik Kachhadiya**
3. **Teerth Sankesara**
4. **Nisarg Shah**

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FIELD IS FUTURE

1 - INTRODUCTION:

1.1 Overview:

Agriculture is very crucial to India's Market. Around 60 percent of the total land in the country is used for agriculture to meet the needs of 1.2 billion people, so improving crop production is therefore seen as a significant aspect of agriculture.[1]

Farmers have been utilizing age-old ways to anticipate the best planting date for generations. Typically, they would sow in early June to take advantage of the monsoon season, which ran from June to August. However, changing weather patterns have resulted in unpredictable monsoons in the last decade, resulting in low crop yields.

Thus, the sowing date becomes crucial in ensuring that farmers harvest a good crop. And if it fails, it results in a loss because a lot of money is spent on seeds and fertilizer applications. Due to atmospheric circumstances and soil changeability, farmers should use the data to generate new insights to make basic cultivating decisions.

Nowadays machine learning algorithms are efficiently used in the agriculture field for various purposes. The main aim of machine learning is to train the machine to behave like humans. The ML has the capability to perform different calculations and predictions very effectively with minimum time [2].

1.2 Purpose:

The purpose of this project is to provide a solution to the farmers so that they can cultivate the best profitable crop in their soil and get every insights of that crop making it one stop solution for the farmer.

2 - LITERATURE SURVEY:

2.1 Existing Problem:

The majority of agricultural land in India is not irrigated. As a result, the monsoon continues to be essential for agriculture's overall growth. The rural economy's reliance on monsoon cannot be overstated in such circumstances. The variation in the monsoon season completely directs the pattern in area sown, as a bad monsoon directly impacts the cost of cultivation and makes sowing large areas unprofitable for farmers. The production and yield of Kharif crops, which are rain-fed in most agricultural states, are also impacted by similar issues and Due to such problems, the supply-demand chain is hindered by increasing prices and thereby affects the economy of the nation.

Literature Review :

[3] S. Pudumalar, E. Ramanujam, R. H. Rajashree, C. Kavya, T. Kiruthika and J. Nisha, "Crop recommendation system for precision agriculture"

Factors like pH, depth, erosion, permeability, texture, drainage and soil color were taken into consideration when predicting the crop. Ensembling was the strategy used, which merged the power of

two or more separate models for better prediction. The Majority Voting Technique was used to build the model.

2.2 Proposed Solution:

A. Acquisition of training dataset:

The number of parameters used and the extent of the correctness of the dataset might affect the accuracy of a machine learning model [4].

As features, our crop recommendation dataset includes the N, P, K, and pH values of several types of soils, as well as labels for the crops that can be cultivated on those soils. We have trained the dataset to forecast the most suited crop that can be grown given the input parameters by applying an effective machine learning method.

Our crop yield dataset includes state name, district name, crop year, crop, area, and production. We have trained the dataset to predict the production of the crop based on given input parameters and using crop production we then predicted crop yield. Our crop price dataset includes rainfall, month, year, WPI price. We have to train the dataset to predict the price for up to 12 months.

B. Data pre processing:

For Crop Yield Prediction, we removed the missing value as the ratio of missing value was very less compared to number of rows present in the dataset. For converting categorical features into numerical features we used Label Encoder.

C. Trained model:

We plotted several algorithm with their respective accuracy score and also, looked into confusion matrix and classification report to find the best performing algorithm

Crop Recommendation:

We tried several machine learning algorithms such as Logistic Regression, Naive Byes, Neural Network and Random Forest. The best performing algorithm was Random Forest.

Crop Yield Prediction:

We tried several machine learning algorithms such as Linear Regression, Logistic Regression, Decision Tree and Random Forest. The best performing algorithm was Random Forest.

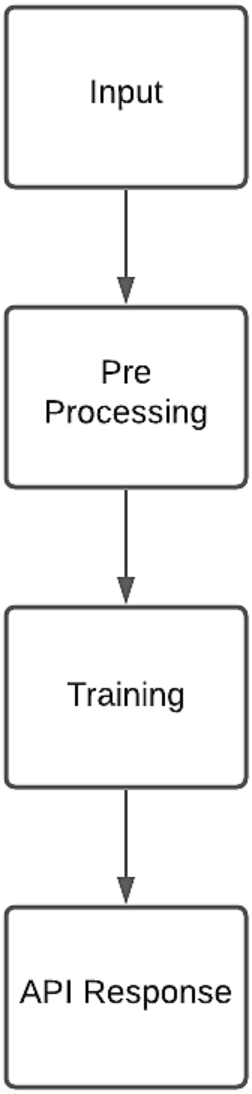
Crop Price Prediction:

We tried several machine learning algorithms such as Arima model, Decision Tree Regressor and Random Forest. The best performing algorithm was Decision Tree Regressor.

Also, we build one **model for specific data (Personal Model)**. User have provide the dataset based on the guid-lines given on the web application. Thus, using that dataset, user can predict best profitable crop, crop yield and price using their own model. And can monitor the crop to get insights about it.

3 - THEORETICAL ANALYSIS:

3.1 Block Diagram:



3.2 Hardware / Software Designing:

Hardware Requirements:

- Microsoft Windows XP Professional SP3/Vista

SP1/Windows 7 Professional:
Processor: 800MHz Intel Pentium III or equivalent,i3
Memory: 512 MB
Disk space: 750 MB of free disk space

- Ubuntu 9.10:
  Processor: 800MHz Intel Pentium III or equivalent
  Memory: 512 MB
  Disk space: 650 MB of free disk space

Software Requirements:

- **OPERATING SYSTEM**: Windows 7/ XP/8 and above.
- **FRONT END**: Html, CSS, Javascript, ReactJS
- **BACKEND**: Flask RESTFUL-API
- **DATABASE**: Postgres
- Watson Studio Desktop

4 - EXPERIMENTAL INVESTIGATIONS:

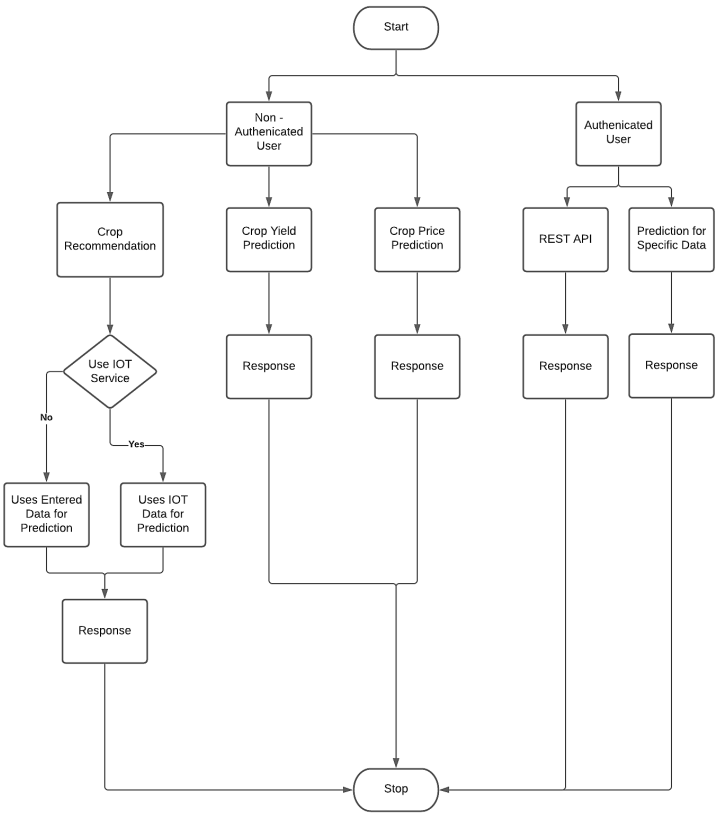
Firstly, we started by searching for the datasets. Getting the proper dataset was a bit challenging. Then, we decided the input parameters to be taken by the farmer and accordingly collect the weather data through Open Weather API integrated with our project.

We cleaned the dataset and preprocessed the data wherever required and applied several machine learning algorithms to get an idea of which algorithm is performing the best. Then, we did some Hyper-Parameter tuning to increase the model accuracy.

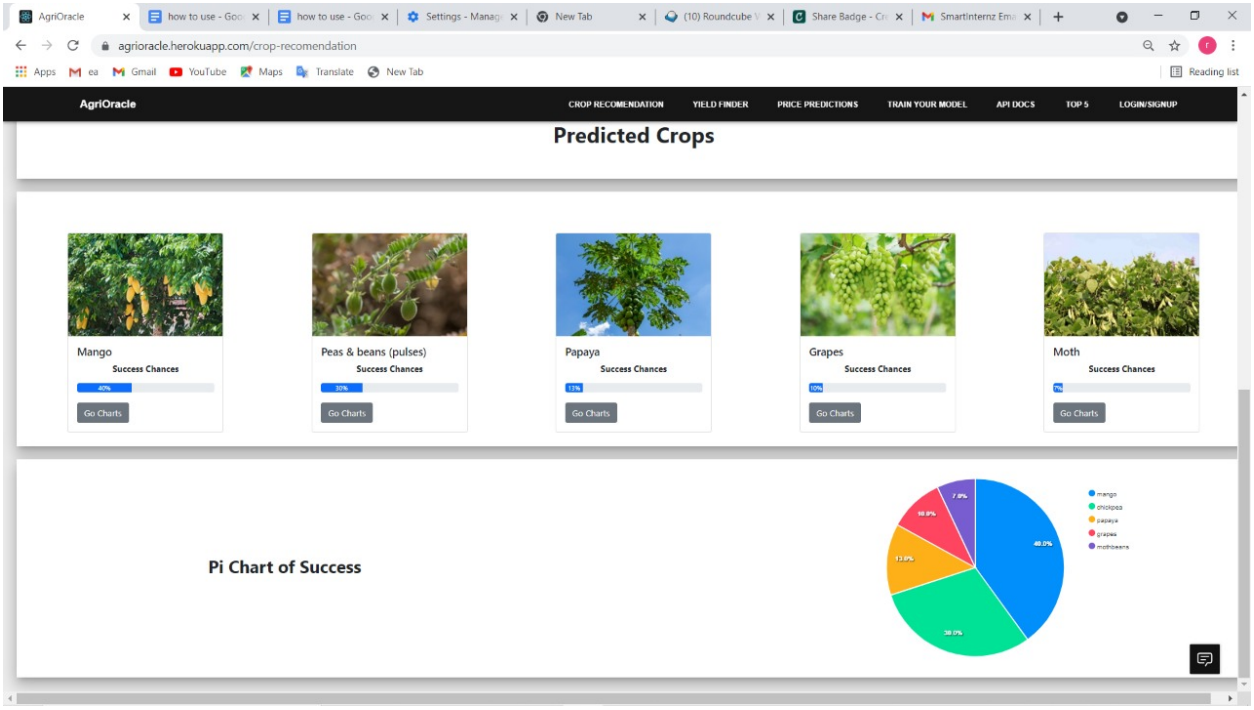
The Second task was to predict the Crop Yield. We analyzed what crop yield is and how is it calculated? After getting the answers, we started working on the dataset and created the model to predict the crop yield.

The Third task was to predict the Crop Price. We got to know about the Gov. API named Mandli. Also, we got introduced with the terms called WPI value i.e Wholesale Price Index and MSP i.e Minimum Support Price declared by the Gov. Thus, we predicted MSP for 12 Months and gave information about Crop Demand through WPI value.

5 - FLOWCHART -



6 - RESULT -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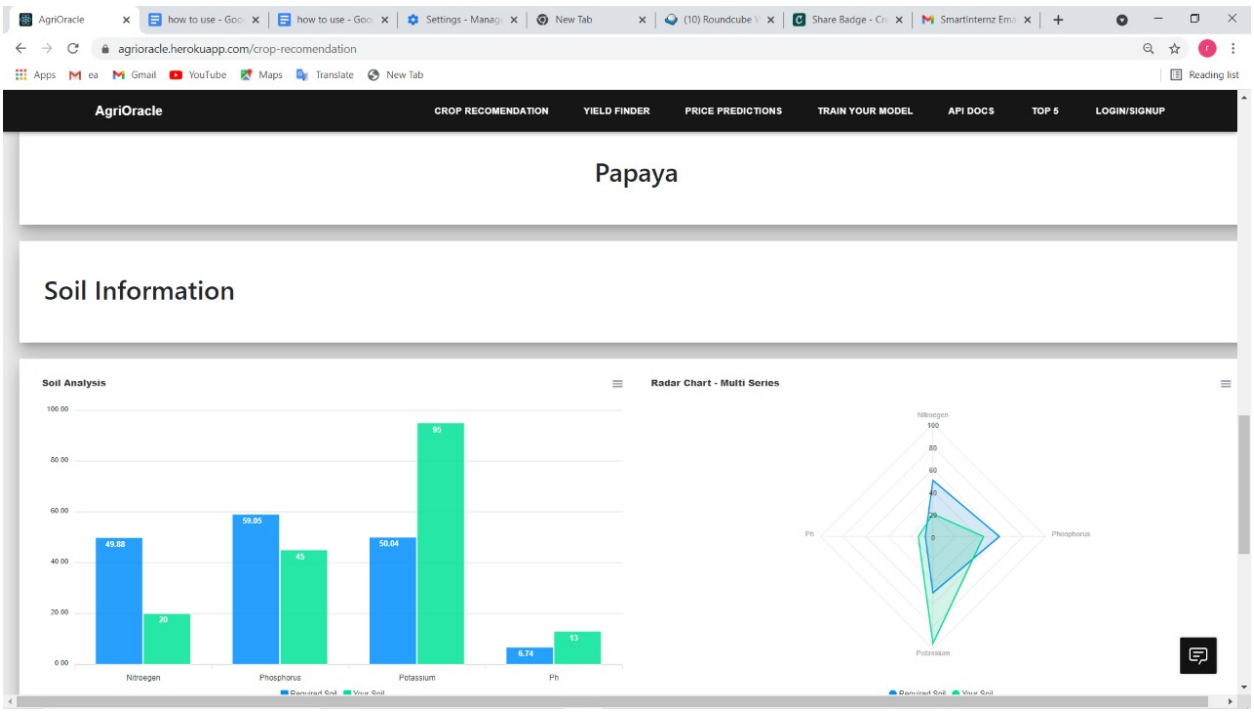
agrioracle.herokuapp.com/crop-recomendation
CROP RECOMENDATION
YIELD FINDER
PRICE PREDICTIONS
TRAIN YOUR MODEL
API DOCS
TOP 5
LOGIN/SIGNUP
Predicted Crops
Mango
Success Chances
Go Charts
Peas & beans (pulses)
Success Chances
Go Charts
Papaya
Success Chances
Go Charts
Grapes
Success Chances
Go Charts
Moth
Success Chances
Go Charts
Pi Chart of Success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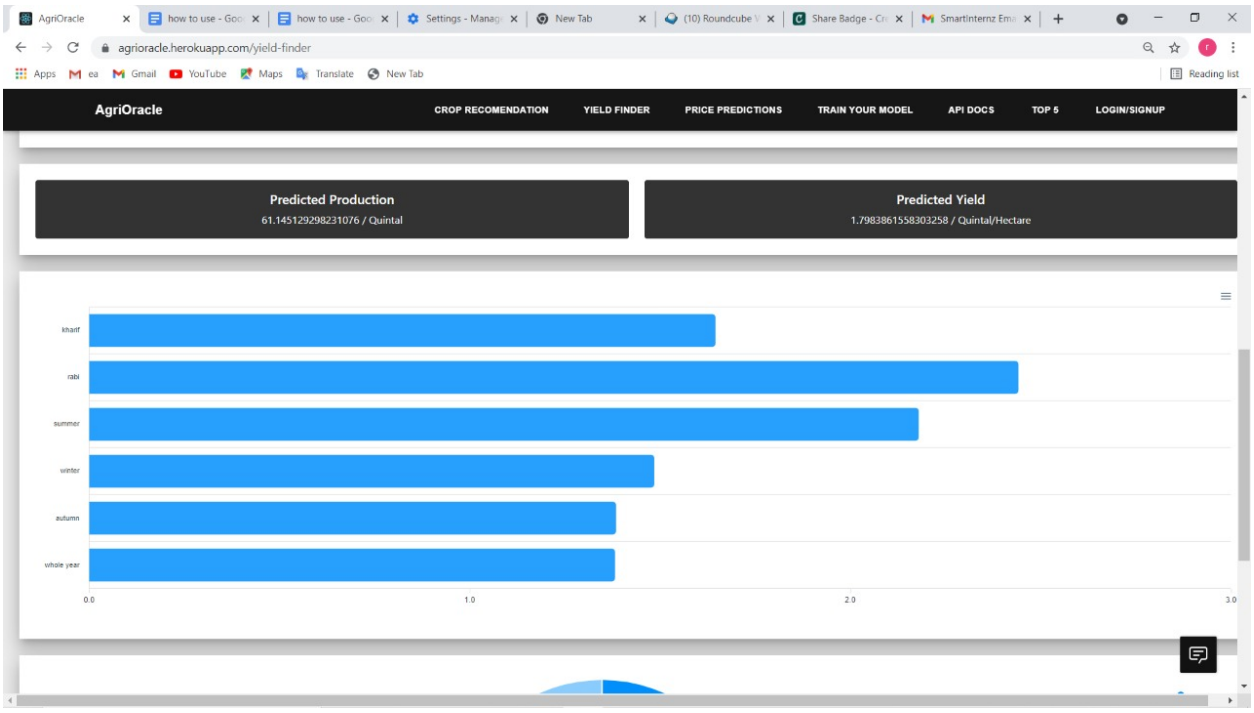
API DOCS
TOP 5
LOGIN/SIGNUP
Papaya
Soil Information
Soil Analysis
Nitroegen
Phosphorus
Potassium
Ph
Radar Chart - Multi Series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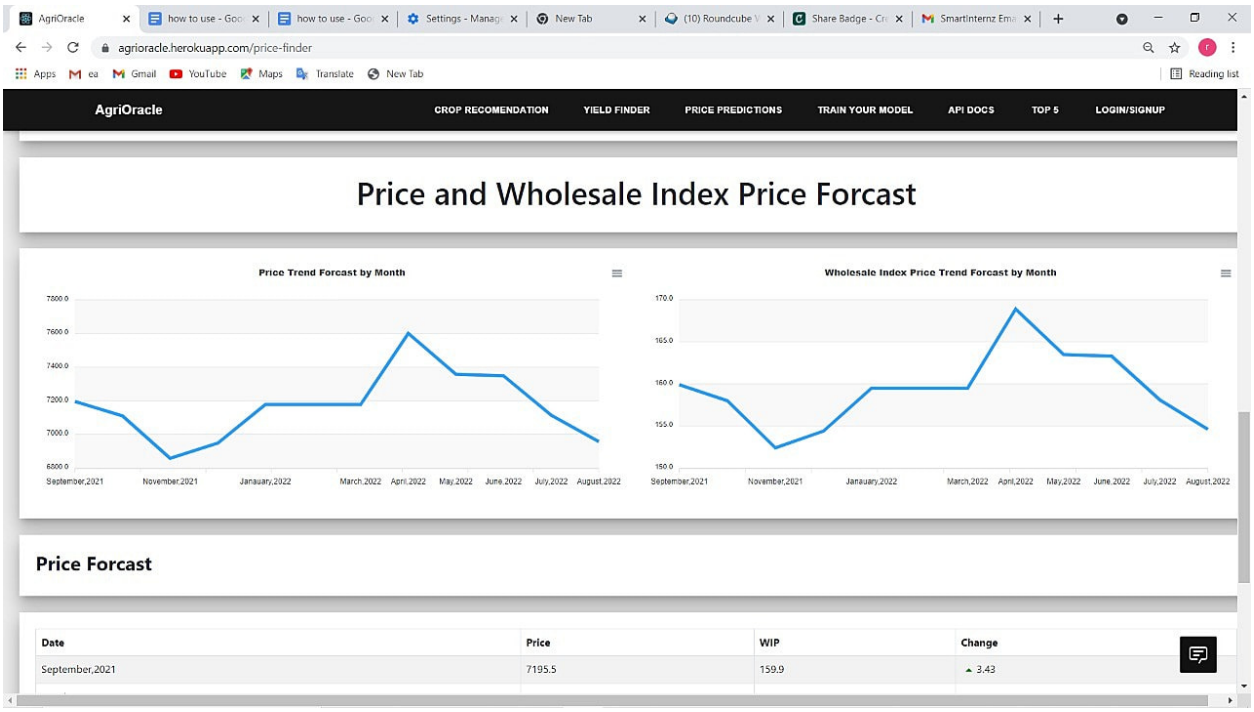
CROP RECOMENDATION
YIELD FINDER
PRICE PREDICTIONS
TRAIN YOUR MODEL
API DOCS
TOP 5
LOGIN/SIGNUP
Predicted Production
61.145129298231076 / Quintal
Predicted Yield
1.7983861558303258 / Quintal/Hectare
kharif
rabi
summer
winter
autumn
whole year
0.0
1.0
2.0
3.0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API DOCS
TOP 5
LOGIN/SIGNUP
Price and Wholesale Index Price Forcast
Price Trend Forcast by Month
Wholesale Index Price Trend Forcast by Month
Price Forcast
Date
Price
WIP
Change
September,2021
7195.5
159.9
3.43

7 - ADVANTAGES AND DISADVANTAGES:

Advantages:

- Using the proposed solution, farmers no longer have to spend their time experimenting on several things. Thereby saving their time, money, and resources.
- Our solution provides accurate results to the farmer and helps in maximizing their profits.
- It's an easy-to-use interface and can be accessed across the world.
- We also provide 3rd party Rest-API Services that you can use or integrate into your solution.
- Last but not the least, we also provide the functionality of Crop monitoring based on the satellite images.

Disadvantages:

- In our model, we have used predicted weather parameters, and sometimes due to sudden climate change, you may get inaccurate output.
- Difficult for farmers who are not aware about how to use a web application.

8 - APPLICATIONS:

- The major application of the proposed solution is in the Agriculture sector. With just a few clicks and some input data, farmers can get the best profitable crop to be cultivated.
- Crop Price can be predicted.
- Crop Production can be estimated

- Crop monitoring can be done using satellite images (remote sensing data) which provide insights about crop health, soil moisture, and weather forecast.

9 - CONCLUSION:

The proposed solution considers N, P, K, and pH values of the soil to determine the best productive crops that can be grown in those conditions. The approach assists the farmer in selecting which crop to cultivate in their area by listing all available crops, the maximum yield that can be produced, and the predicted price. This method thus enables the farmer in determining the most profitable crop.

10 - FUTURE SCOPE:

This approach can be optimized by including IoT to obtain real-time soil values. Sensors can be installed on the farm to collect information about current soil conditions, allowing the systems to improve the precision and correctness of the findings. Not only that, one system can be designed that shares everything from soil preparation to crop cultivation to the registered farmers through the medium of Multimedia/SMS. As a result, farming may be done efficiently.

11 - BIBLIOGRAPHY:

1. Kevin Tom Thomas, Varsha S, Merin Mary Saji, Lisha Varghese, Er. Jinu Thomas, “Crop Prediction Using Machine Learning”, International Journal of Future Generation Communication and Networking - Vol. 13, No. 3, (2020), pp. 1896–1901.
2. Marcio Moreno, Vítor Lourenço, Sandro Fiorini, Polyana Costa, Rafael Brandão, Daniel Civitarese, Renato Cerqueira, "Managing Machine Learning Workflow Components", Semantic Computing (ICSC 2020 IEEE 14th International Conference on, pp. 25-30, 2020.
3. S. Pudumalar, E. Ramanujam, R. H. Rajashree, C. Kavya, T. Kiruthika and J. Nisha, "Crop recommendation system for precision agriculture," 2016 Eighth International Conference on Advanced Computing (ICoAC), Chennai, 2017, pp. 32-36. doi: 10.1109/ICoAC.2017.7951740.
4. Z. Doshi, S. Nadkarni, R. Agrawal and N. Shah, "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), Pune, India, 2018, pp. 1-6. doi: 10.1109/ICCUBEA.2018.8697349
5. For Report - Kevin Tom Thomas, Varsha S, Merin Mary Saji, Lisha Varghese, Er. Jinu Thomas, “Crop Prediction Using Machine Learning”, International Journal of Future Generation Communication and Networking Vol. 13, No. 3, (2020), pp. 1896–1901.
6. https://www.apnikheti.com/en/pn/home
7. Dataset - https://www.kaggle.com/siddharthss/crop-recommendation-dataset,

https://www.kaggle.com/abhinand05/crop-production-in-india, We have taken MSP of 22 Crops given by Government according to yearly.

8. Reference for Model - https://github.com/rahuldkjain/Crop_Prediction
9. Boot camps - https://youtu.be/qcf6a9QzkhI , https://youtu.be/1VXO8p8yX9Y , https://youtu.be/WRxa1JczBeQ , https://youtu.be/nlK0t_9V8kE

APPENDIX:

Code Sample:

```
model_para = [model_n, model_p, model_k, model_temp, model_humidity, model_ph, model_rainfall]

        ## model testing and get output
        # NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
        API_KEY = "6Pe2pNaBxpPB0eN7oyIPBQgDZ6d_ujIp8h4W1ik-pyk5"
        token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey": API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
        mltoken = token_response.json()["access_token"]

        header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}

        # NOTE: manually define and pass the array(s) of values to be scored in the next line
        payload_scoring = {"input_data": [
            {"field": ['N', 'P', 'K', 'temperature', 'humidity', 'ph', 'rainfall', 'label'], "values": [model_para]}]}

```

```
        response_scoring = requests.post(
'https://us-south.ml.cloud.ibm.com/ml/v4/deployments/91bf6a6b-7d60-4e50-b75b-bc99fd76d42a/predictions?version=2021-07-08',
            json=payload_scoring, headers={'Authorization': 'Bearer ' + mltoken})

        response_score = response_scoring.json()
```

Source Code Link:

https://github.com/smartinternz02/SBSPS-Challenge-5238-AI-Assisted-Farming-for-Crop-Recommendation-Farm-Yield-Prediction-Application

Demonstration Link:

https://youtu.be/6rIo71cWkII