ANALYZING AGRICULTURE IN INDIA AND MAKING STRATEGIC DECISIONS BASED ON IT ACCORDING TO POPULATION

AGROPRED
TECH 2 FARM

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1. INRODUCTION

1.1. ***Overview***

AgroPred is an agricultural data analytics solution that helps farmers improve their decision-making through the utilization of IBM Cognos analytics and machine learning. Insights into crop production across the country are provided by our dashboards that are powered by IBM Cognos analytics. In addition to this, we provide services for crop production forecast, which can assist farmers in increasing their overall yields.

1.2. ***Purpose***

The purpose of the project is to analyze the agricultural sector in India and make strategic decisions based on the findings. The analysis will focus on the Crop production which includes the production of cereals, pulses, oil-seeds, fruits, vegetables, and other crops. The project will be beneficial to India in a number of ways like:

- To improve the productivity of the agricultural sector, which will lead to increased food production.
- To create jobs in the agricultural sector, which will benefit the rural economy. Based on production and crop type employment can be planned to avoid disguised unemployment.
- To reduce poverty in rural areas.
- To improve the food security of India.
- Make better decision in agricultural policies.
- To predict production of various crops for various states in various season.

2. LITERATURE SURVEY

2.1. ***Existing problem***

- **Data availability:** There is a lack of reliable and up-to-date data on the agricultural sector in India. This makes it difficult to conduct accurate analysis and make informed decisions. Lack of real time data pipelines [1].
- **Lack of coordination:** There is a lack of coordination between different government agencies and stakeholders involved in the agricultural sector. This can lead to duplication of efforts and

wasted resources.

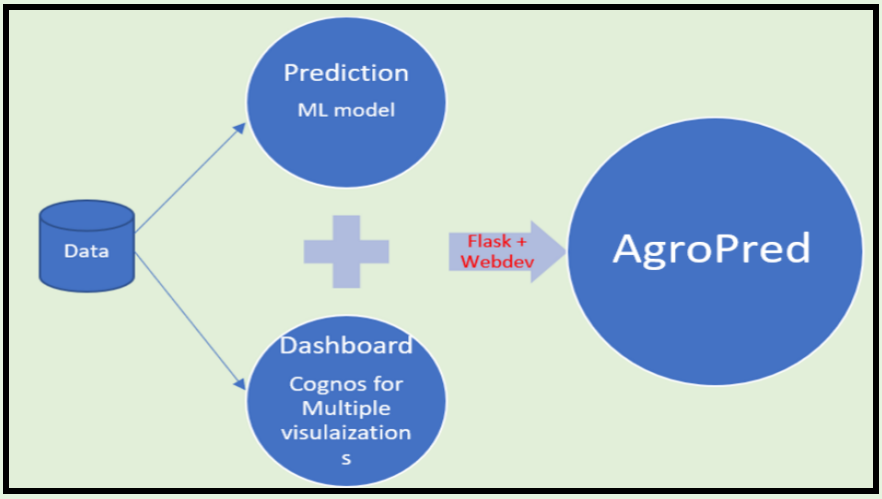
- **Political interference:** The agricultural sector is often subject to political interference. This can make it difficult to implement reforms and make long-term planning [2].
- **Low adoption of technology:** There is a low adoption of modern agricultural technologies among farmers in India. This is due to a number of factors, including lack of awareness, high cost, and lack of access to credit [3].
- **Climate change:** Climate change is a major threat to agriculture in India. The sector is already facing the effects of climate change, such as droughts, floods, and heat waves. These effects are expected to worsen in the future, which will have a negative impact on food production [4].
- **Soil quality:** Extensive usage of fertilizers and pesticides are affecting soil greatly. Planting same crop again and again also leads to depletion of soil nutrients. To tackle this effective alternate crop selection mechanism is needed [5].

2.2. ***Proposed solution***

- AgroPred is an agricultural data analytics website.
- It will help wide range of stakeholders in making better decisions in agricultural matters like crop selection, area of land etc.
- Prominently the solution involves fabrication of three components:
  - Dashboard – Using IBM Cognos Platform. Multiple dashboard based on various feature of the dataset. It has many visualizations that provide useful insights.
  - Machine learning Model – Using scikit-learn, numpy, pandas libraries of python. To predict the production based on State, District, Crop, Season, Area of land.
  - Website – Using HTML, CSS, JavaScript and flask library of python. This website will integrate both the dashboards and prediction part.
- A machine learning regression model to be used for predicting the production. This will be beneficial to farmers for finding crop that will give optimal production and also profit.
- One dashboard will be dedicated for visualizing overall statistics while others will provide options to visualize based on the selected values of feature. This will address both the individuals need and decision makers need.

3. THEORETICAL ANALYSIS

3.1. *Block diagram*



3.2. *Hardware / Software designing*

- **Hardware requirements:**
  - A computer with high-speed internet connection.
- **Software:**
  - Cognos on cloud was used to create dashboards.
  - Google Colaboratory platform was used to pre-process the data. Tested various models and identified the better performing model. Then the model was dumped to a jobfile.
  - Frontend of the webpage was created using HTML, CSS and JavaScript.
  - Dashboards were added to webpage using iframes.
  - Flask library of python was used to link the model with webpage.

4. EXPERIMENTAL INVESTIGATIONS

There were multiple challenges involved in designing of the proposed solution. The following are the innovative ways used to tackle the issues:

- The dataset involved **both string values and numerical values**. Making it difficult to use regressor directly. **Encoding** was done, after removing the blank records.

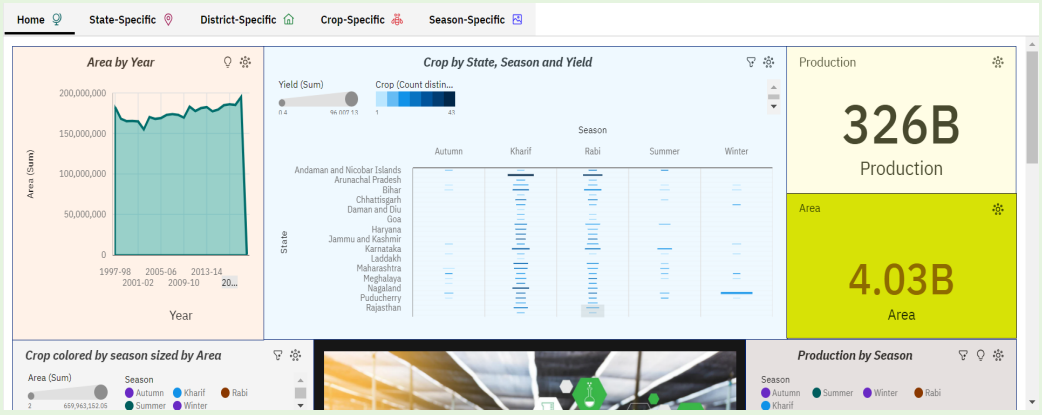
```
{'Andaman and Nicobar Islands': 0, 'Andhra Pradesh': 1, 'Arunachal Pradesh': 2, 'Assam': 3, 'Bihar': 4, 'Chandigarh': 5, 'Chhattisgarh': 6, 'Dadra and Nagar Haveli': 7, 'Daman and Diu'
{'24 PARAGANAS NORTH': 0, '24 PARAGANAS SOUTH': 1, 'ADILABAD': 2, 'AGAR MALWA': 3, 'AGRA': 4, 'AHMADABAD': 5, 'AHMEDNAGAR': 6, 'AIZAWL': 7, 'AJMER': 8, 'AKOLA': 9, 'ALAPPUZHA': 10, 'AL
{'Arecanut': 0, 'Arhar/Tur': 1, 'Bajra': 2, 'Banana': 3, 'Barley': 4, 'Black pepper': 5, 'Cardamom': 6, 'Cashewnut': 7, 'Castor seed': 8, 'Coconut': 9, 'Coriander': 10, 'Cotton(lint)':
{'Autumn': 0, 'Kharif': 1, 'Rabi': 2, 'Summer': 3, 'Whole Year': 4, 'Winter': 5}
```

- As classical regressor didn't perform well, **Random Forest Regressor** was used. It is an **ensemble technique** capable of performing both regression and classification tasks with the use of multiple decision trees and a technique called Bootstrap and Aggregation, commonly known as bagging. The following score was obtained.

```
model = RandomForestRegressor()
model.fit(df[features], df["Production"])
model.score(df[features],df["Production"])
```

```
0.9933216425988927
```

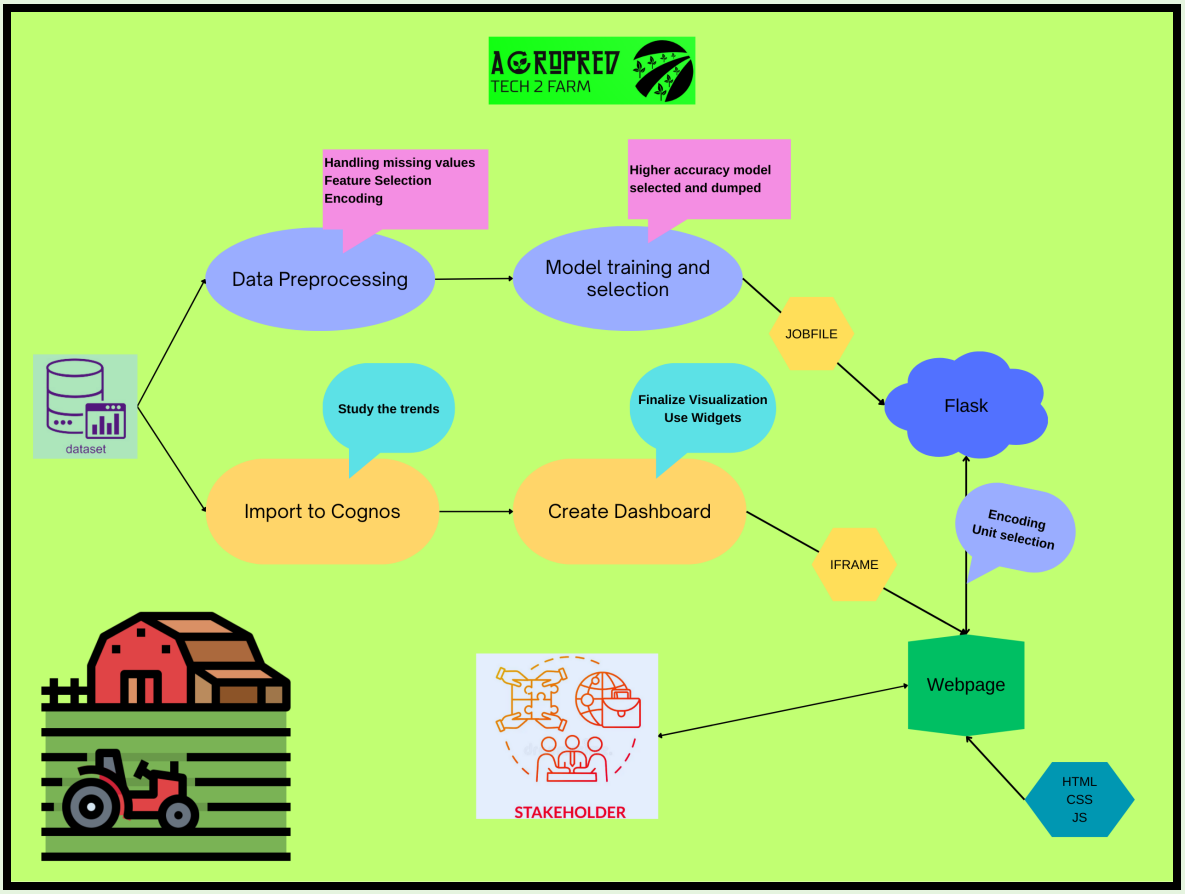
- Initially **pickel5** library of python was used to dump the model as .pkl file that can be used to predict production when linked with flask. It was observed that the .pkl file was **very large and it had more latency**. So this procedure was replaced by using scikit learn library of python. It offers dumping by using **joblib**, which is **smaller in size and faster**.
- Cognos offered **various types of visualizations** identifying appropriate visualization that gave sound insights was very critical. Also to enable visualization based on choice of any one of the important features of dataset, 5 dashboards were created. **Widgets** were used in 4 of the dashboards to select a particular state, district, crop and season respectively.



- Various **colour schemes, images, icons and descriptions** were placed in dashboard to make it more informative, interesting and user friendly.
- **Integration of the two functionalities using flask** had multiple hiccups as we aspired to make the webpage very **clean and perfect**. **JavaScript** was used to create the **dynamic elements** like collapsible sidebar, highlight on hover, etc..
- **Form** for getting values for prediction required special arrangements as **districts were to be dynamically shown based on the state selected**.

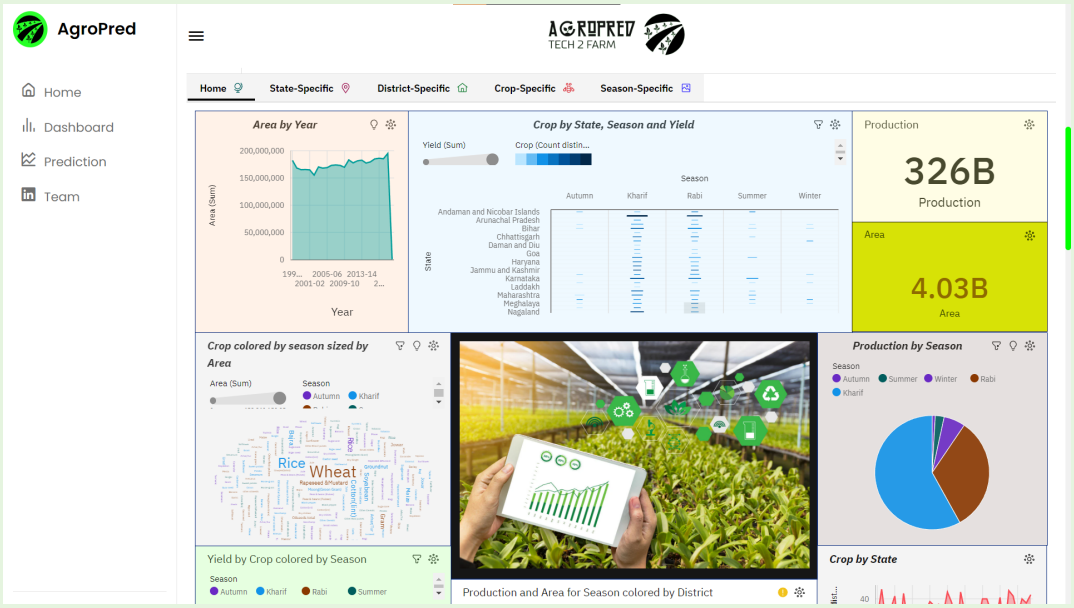
- As the **data was encoded** prior to training of model, the same encoded value was expected to be passed to model through flask. To achieve this, in flask the **input obtained was encoded** using the **same key value pair used in encoding** of train data.
- The dataset had **3 different production units** namely **tonnes, bales and nuts** based on crop. **Based on crop selected the prediction result prompt will have production units**.
- A dynamic **loading element** was included, that will be displayed **until the model returns** the predicted production value with units.
- The system also **supports reset of prediction functionality without complete reloading of page** and **doing another prediction**.
- The **dashboards** were inserted into webpage using the **iframe snippet** obtained from the IBM Cognos platform.

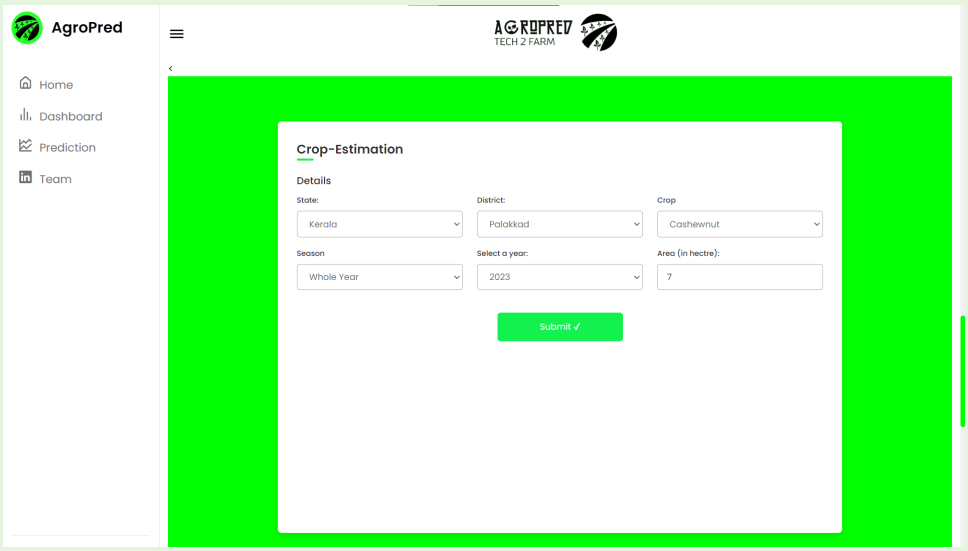
5. FLOWCHART

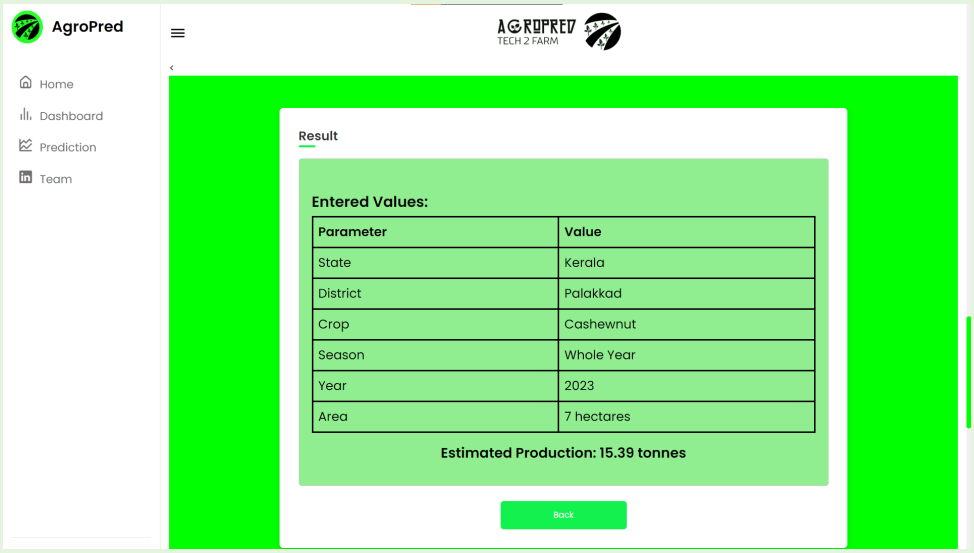


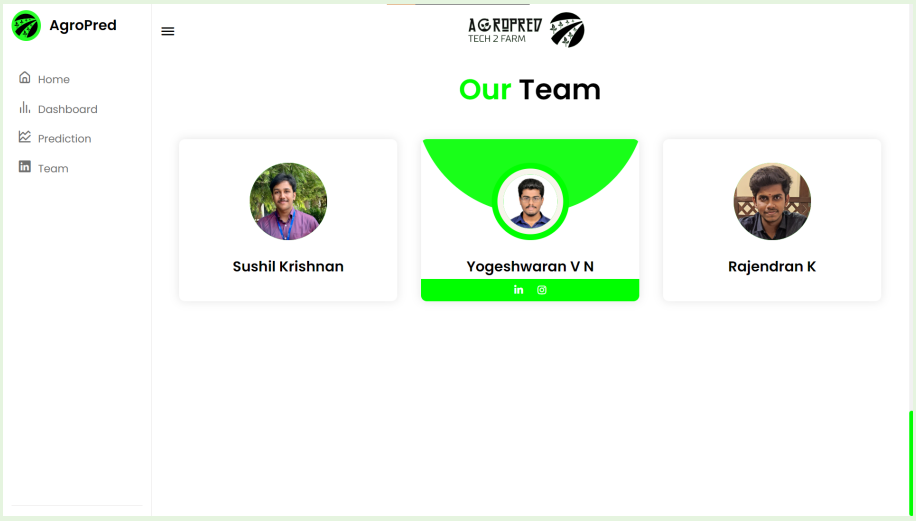
6. RESULT

The solution developed has two perfectly functioning components to cater the needs of various stakeholders like farmers and policymakers. The better performing model was used for prediction. Based on testing and debugging features like correct unit display, loading window, etc were fixed. Dashboard developed using Cognos Analytics on cloud gives many insights. **All the features can be very clearly observed in the demo video.**




AgroPred
Home
Dashboard
Prediction
Team
AGROPRED
TECH 2 FARM
Crop-Estimation
Details
State:
Kerala
District:
Palakkad
Crop
Cashewnut
Season
Whole Year
Select a year:
2023
Area (in hectre):
7
Submit ✓


AgroPred
Home
Dashboard
Prediction
Team
AGROPRED
TECH 2 FARM
Result
Entered Values:
Parameter
Value
State
Kerala
District
Palakkad
Crop
Cashewnut
Season
Whole Year
Year
2023
Area
7 hectares
Estimated Production: 15.39 tonnes
Back


AgroPred
Home
Dashboard
Prediction
Team
AGROPRED
TECH 2 FARM
Our Team
Sushil Krishnan
Yogeshwaran V N
Rajendran K

7. ADVANTAGES AND DISADVANTAGES

- **Pros**
  - Boost agricultural productivity, increasing food output.
  - Boost rural economies by creating agricultural jobs.
  - Lessen rural poverty.
  - Boost Indian food security.
  - Boost sustainable agriculture.
  - Benefit farmers and other agricultural workers.
  - Reduce inflation and crop failure.
  - User friendly and easy to use.
- **Cons**
  - Limited availability of multi-feature data.
  - Doesn't take into consideration of other factors impacting agriculture like soil type, weather, etc.
  - Real time data is not connected.
  - If not planned and implemented, the project may fail.
  - The proposal may not solve all Indian agriculture problems.

8. APPLICATION

- **Improving crop yields:** The research can discover the optimal farming strategies for particular crops and areas. This can boost crop yields and reduce food waste.
- **Promoting sustainable agriculture:** The initiative can identify and promote sustainable agriculture techniques. This can safeguard the environment and support agriculture.
- **Increasing food security:** The initiative can identify India's food security issues and develop solutions.
- **Job creation:** The project can boost rural economies by creating agricultural jobs.
- **Reducing poverty:** The project can reduce rural poverty by enhancing agricultural output and creating jobs.
- **Improving the lives of farmers:** The project can enhance the livelihoods of farmers by giving them with better technologies, information, and markets.
- **Policy making:** Based on trends and forecasted production several welfare policies can be planned. Volume of imports and exports can be optimized.

9. CONCLUSION

It was an exhausting and time-consuming endeavor to analyze agriculture in India and base strategic decisions on that analysis in light of the country's population. However, the project's prospective benefits are very large. The project has the potential to improve the lives of millions of people in India by increasing agricultural output, generating new employment opportunities, decreasing poverty, and bolstering food security. These technological innovations should be made easily accessible to farmers and other stakeholders.

10. FUTURE SCOPE

The population-based agricultural analysis and decision-making project in India has enormous potential. Some potential directions for future study are as follows.

- **The effects of climate change on farming:** Global warming poses a serious threat to India's agricultural sector. This project can be used to learn how climate change is affecting various agricultural sectors and geographic areas, and then react accordingly.
- **Adding more features:** More datasets can be generated encompassing multiple features that have strong correlation with agricultural production.
- **The role of technology in agriculture:** The potential for technological advancement to revolutionize farming in India. Various advanced technologies like IoT, Blockchain can be leveraged to tackle the challenges faced in agricultural sector.
- **The difficulties of rural improvement:** Rural improvement is crucial for the well-being of India's hundreds of millions of people. Challenges to rural development can be examined, and strategies to better people's lives in rural regions can be discovered, with the help of this initiative.
- **The role of women in agriculture:** The initiative can be used to learn more about the contributions women farmers make, and to develop strategies to increase women's participation in agriculture.
- **Agriculture's response to globalization:** Initiative can be used to investigate how globalization affects various agricultural products and geographic areas, and to develop responses to these trends.

11. BIBLIOGRAPHY

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12. APPENDIX

https://github.com/smartinternz02/SBSPS-Challenge-10605-1692034193