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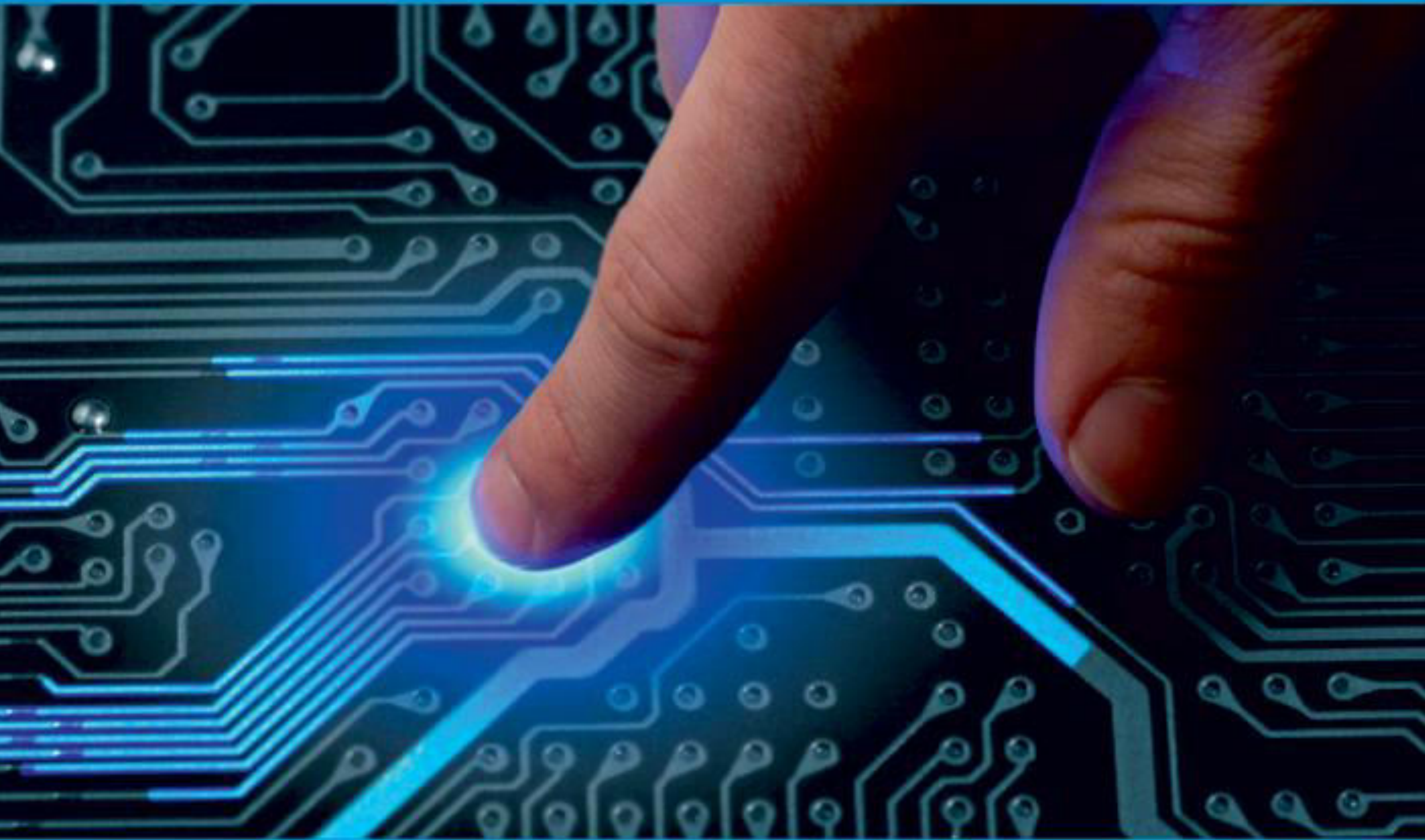

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Cash Crop Loss Prediction Using Deep Learning Techniques

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ABSTRACT: This study introduces a novel predictive modeling framework aimed at forecasting cash crop losses, providing valuable insights into agricultural sustainability and risk mitigation. With the increasing frequency and severity of climate-related events, accurate and timely predictions of crop losses are crucial for farmers, policymakers, and the agricultural industry. Leveraging advanced machine learning algorithms, remote sensing data, and historical crop performance records, our model integrates a multidimensional analysis to enhance the accuracy of cash crop loss predictions.

KEYWORDS: Crop, Prediction, CNN, Sensing, UAVs

I. INTRODUCTION

Agriculture, being the backbone of global food production, faces unprecedented challenges in the 21st century, primarily driven by the increasing frequency and intensity of climatic events. Among the myriad consequences of climate change, the vulnerability of cash crops to various environmental stressors has become a significant concern for farmers, policymakers, and the broader agricultural industry. The imperative to address these challenges has given rise to the development of predictive modeling techniques for cash crop loss, providing a proactive means to mitigate risks and foster sustainable agricultural practices.

Climate-related events such as extreme temperatures, droughts, floods, and pest infestations have the potential to inflict severe damage on cash crops, leading to substantial economic losses and compromising global food security. In this context, the ability to anticipate and mitigate the impact of such events becomes crucial. Predictive modeling emerges as a promising avenue, leveraging advancements in machine learning, remote sensing technologies, and comprehensive datasets to forecast cash crop losses with greater accuracy.

This introduction sets the stage for a deeper exploration of the methodologies and applications involved in cash crop loss prediction. By understanding and forecasting the complex interplay of environmental factors, agronomic practices, and socioeconomic considerations, we aim to equip stakeholders with the knowledge needed to make informed decisions and implement targeted interventions. As we delve into the intricacies of cash crop loss prediction, the potential for transformative advancements in agriculture resilience and sustainable crop management becomes evident, emphasizing the importance of proactive measures in the face of a changing climate.

II. LITERATURE REVIEW

1. Overview of Agricultural Risk Assessment: Agricultural risk assessment has been a focal point in recent literature due to the escalating challenges posed by climate change. Researchers have highlighted the need for accurate and timely prediction models to mitigate the impact of environmental stressors on cash crops. Early studies laid the foundation for understanding the vulnerability of crops to diverse factors, emphasizing the importance of integrated approaches for comprehensive risk assessment.

2. **Machine Learning Applications in Agriculture:** With the advent of machine learning techniques, a paradigm shift occurred in the field of cash crop loss prediction. Researchers increasingly turned to algorithms such as random forests, support vector machines, and neural networks to analyze vast datasets. encompassing climate variables, soil characteristics, and crop health indicators. These applications demonstrated promising results in improving the precision and efficiency of cash crop loss predictions. prediction. Researchers increasingly turned to algorithms such as random forests, support vector machines, and neural networks to analyze vast datasets encompassing climate variables, soil characteristics, and crop health indicators. These applications demonstrated promising results in improving the precision and efficiency of cash crop loss predictions.

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3. **Remote Sensing Technologies:** The integration of remote sensing technologies has emerged as a cornerstone in cash crop loss prediction. Utilizing satellite imagery and unmanned aerial vehicles (UAVs), researchers have enhanced the spatial and temporal resolution of data.

- The dataset is pre-processed in order to increase the accuracy of the model.
- The model is built using different algorithms.
- The model is evaluated and model with best accuracy is finalized.
- The finalized model will predict the results.

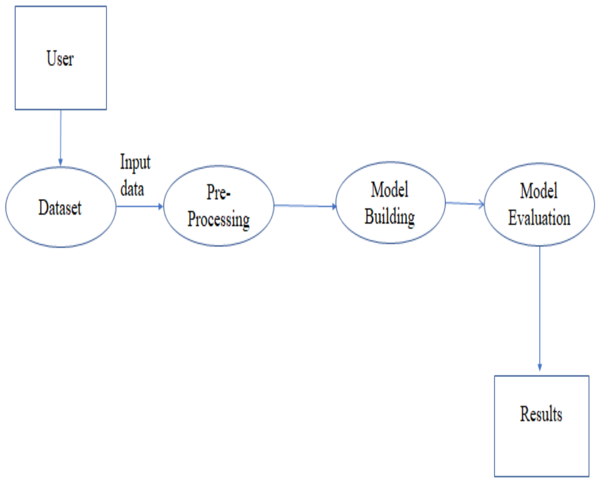
IV. IMPLEMENTATION

A. SkLearn:

1. What is SciKit-Learn?

- Scikit-learn (Sklearn) is the most useful and robust library for machine learning in Python.
- It provides a selection of efficient tools for machine learning and statistical modelling.

V. SYSTEM DESIGN



Sequence Diagram :

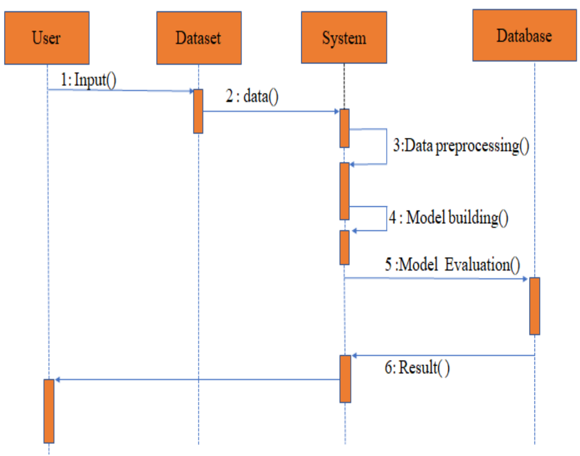


Fig 1. Flow chart for working process.

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- The finalized model will predict the results.

VI. IMPLEMENTATION

B. SkLearn:

2. What is SciKit-Learn?

- Scikit-learn (Sklearn) is the most useful and robust library for machine learning in Python.

It provides a selection of efficient tools for machine learning and statistical modelling.

- It includes classification, regression, clustering and dimensionality reduction via a consistence interface in Python.
- This library, which is largely written in Python, is built upon NumPy, SciPy and Matplotlib.

3. Features of Sklearn

- Datasets
- Feature extraction
- Feature selection
- Parameter Tuning
- Clustering
- Cross-Validation
- Supervised Models
- Unsupervised Models
- Dimensionality Reduction
- Ensemble methods

4. Benifits of SciKit-Learn

- BSD license: Scikit-learn has a BSD license; hence, there is minimal restriction on the use and distribution of the software, making it free to use for everyone.
- Easy to use: The popularity of Scikit-learn is because of the ease of use it offers.
- Document detailing: It also offers document detailing of the API that users can access at any time on the website, helping them integrate Machine Learning into their own platforms.
- Extensive use in the industry: Scikit-learn is used extensively by various organizations to predict consumer behavior, identify suspicious activities, and much more.
- Machine Learning algorithms: Scikit-learn covers most of the Machine Learning algorithms Huge community support.
- Algorithms flowchart: Unlike other programming languages where users usually face a problem of having to choose from multiple competing implementations of same algorithms, Scikit-learn has an algorithm cheat sheet or flowchart to assist the users.

5. Applications

- Scikit-learn is a library that contains several implementations of machine learning algorithms.
- financial cyber security analytics, product development, neuron imaging, barcode scanner development, medical modelling.
- Regression modelling
- Unsupervised classification and clustering

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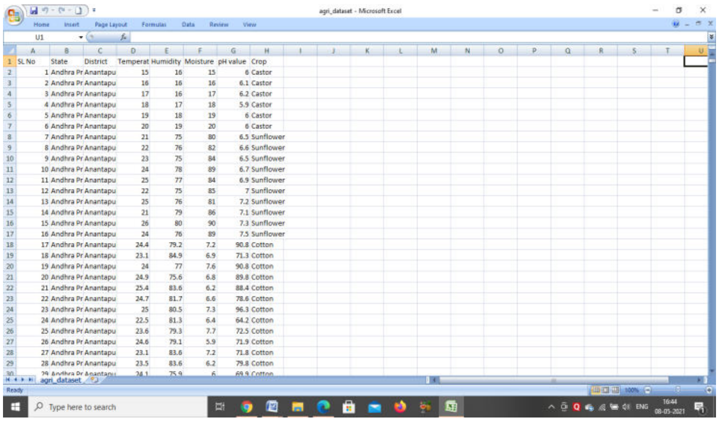
- Decision tree pruning and induction
- Comprehensive and neural network training with regression and classification algorithms
- Decision boundary learning with SVMs
- Advanced probability modeling
- Feature analysis and selection
- Reduction of dimensionality

6. Dataset:

This is the dataset used in this project and it has state name, district name, temperature, humidity, moisture.

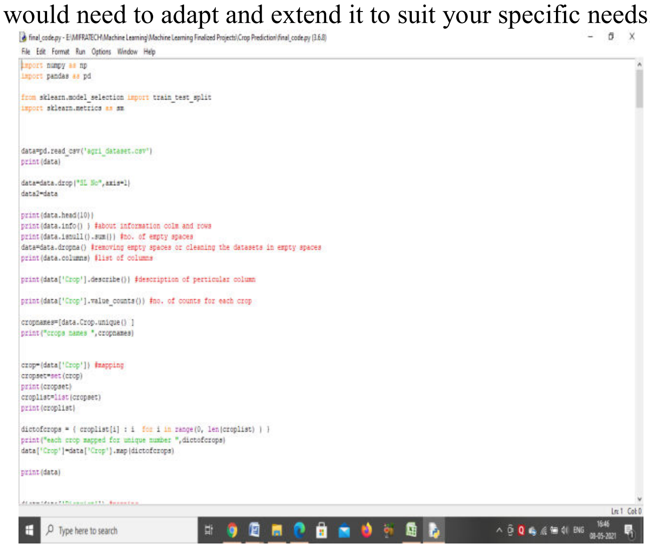


SL No	State	District	Temperat	Humidity	Moisture	pH value	Crop
1	Andhra Pr	Anantapu	15	16	15	6	Castor
2	Andhra Pr	Anantapu	16	16	16	6.1	Castor
3	Andhra Pr	Anantapu	17	16	17	6.2	Castor
4	Andhra Pr	Anantapu	18	17	18	5.9	Castor
5	Andhra Pr	Anantapu	19	18	19	6	Castor
6	Andhra Pr	Anantapu	20	19	20	6	Castor
7	Andhra Pr	Anantapu	21	75	80	6.5	Sunflower
8	Andhra Pr	Anantapu	22	76	82	6.6	Sunflower
9	Andhra Pr	Anantapu	23	75	84	6.5	Sunflower
10	Andhra Pr	Anantapu	24	78	89	6.7	Sunflower
11	Andhra Pr	Anantapu	25	77	84	6.9	Sunflower
12	Andhra Pr	Anantapu	22	75	85	7	Sunflower
13	Andhra Pr	Anantapu	25	76	81	7.2	Sunflower
14	Andhra Pr	Anantapu	21	79	86	7.1	Sunflower
15	Andhra Pr	Anantapu	26	80	90	7.3	Sunflower
16	Andhra Pr	Anantapu	24	76	89	7.5	Sunflower
17	Andhra Pr	Anantapu	24.4	79.2	7.2	90.8	Cotton
18	Andhra Pr	Anantapu	23.1	84.9	6.9	71.3	Cotton
19	Andhra Pr	Anantapu	24	77	7.6	90.8	Cotton
20	Andhra Pr	Anantapu	24.9	75.6	6.8	89.8	Cotton
21	Andhra Pr	Anantapu	25.4	83.6	6.2	88.4	Cotton
22	Andhra Pr	Anantapu	24.7	81.7	6.6	78.6	Cotton
23	Andhra Pr	Anantapu	25	80.5	7.3	96.3	Cotton
24	Andhra Pr	Anantapu	22.5	81.3	6.4	64.2	Cotton
25	Andhra Pr	Anantapu	23.6	79.3	7.7	72.5	Cotton
26	Andhra Pr	Anantapu	24.6	79.1	5.9	71.9	Cotton
27	Andhra Pr	Anantapu	23.1	83.6	7.2	71.8	Cotton
28	Andhra Pr	Anantapu	23.5	83.6	6.2	79.8	Cotton
29	Andhra Pr	Anantapu	24.1	75.9	6	69.9	Cotton

Fig 2. Sample dataset

7. Back End Code:

This code is to train our system with machine learning techniques and algorithms and calculating the R2 score and finalizing the algorithm with good accuracy as final model and converting it into pickle (binary format) file. Creating the back-end code for a cash crop loss prediction system involves handling data processing, implementing the predictive model, and setting up an API for interaction. Below is a simplified example using Python with the Flask web framework, scikit-learn for machine learning, and pandas for data manipulation. Note that this is a basic example, and in a real-world scenario, you would need to adapt and extend it to suit your specific needs.



```
import numpy as np
import pandas as pd

from sklearn.model_selection import train_test_split
import sklearn.metrics as sm


data=pd.read_csv('agri_dataset.csv')
print(data)

data=data.drop("SL No",axis=1)
data2=data

print(data.head(10))
print(data.info() ) #about information colm and rows
print(data.isnull().sum()) #no. of empty spaces
data=data.dropna() #removing empty spaces or cleaning the datasets in empty spaces
print(data.columns) #list of columns

print(data['Crop'].describe()) #description of perticular column

print(data['Crop'].value_counts()) #no. of counts for each crop

cropnames=[data.Crop.unique() ]
print("crops names ",cropnames)


crop=(data['Crop']) #mapping
cropset=set(crop)
print(cropset)
croplist=list(cropset)
print(croplist)

dictofcrops = { croplist[i] : i  for i in range(0, len(croplist) ) }
print("each crop mapped for unique number ",dictofcrops)
data['Crop']=data['Crop'].map(dictofcrops)

print(data)
```

Fig 3. Backend code for prediction.

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8. Output :

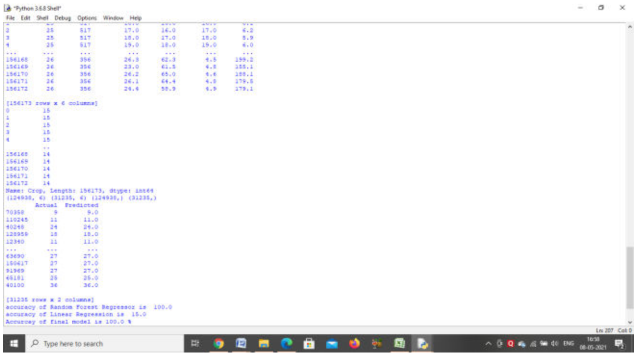

Fig 4. Output for backend code.

9. Front End Code:

This code is to get create front end with the help of flask, pymysql and HTML. Here we will collect user data like username and password for registration and will be stored in localhost database only and next login credentials will collect and compare with the database and once credentials were correct the user will go to the prediction page. In the prediction page user will enter the state name, district name, temperature, humidity, moisture, pH data. The collected data from front end is given as our finalized machine learning trained algorithm to predict the output and the predicted crop name and suggested fertilizers is displayed on the prediction front end webpage.

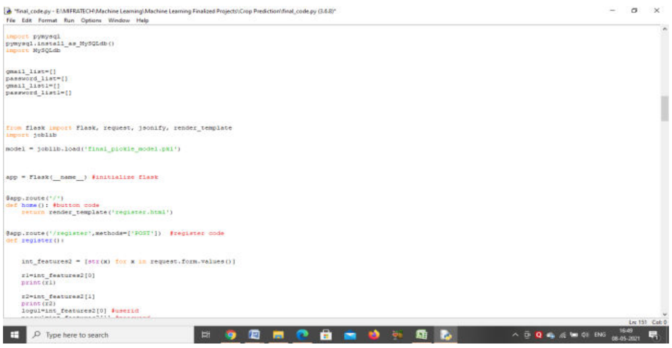

Fig 5. Output for frontend code.

Register Page:

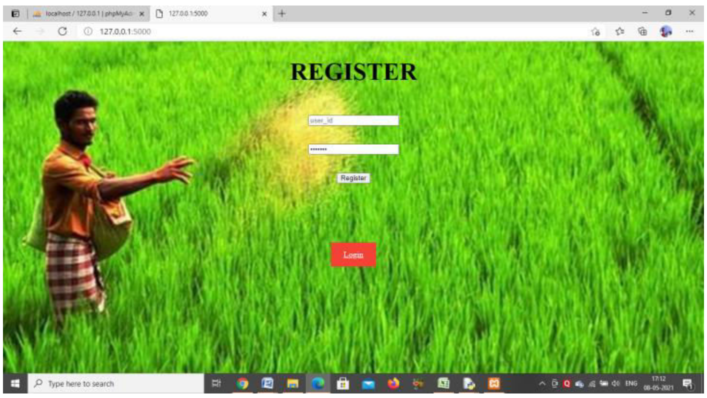

Fig 6. Registration for login to the website.

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Fig 7. Final Output of the Project.

VII. RESULTS AND DISCUSSION

In general, agriculture is the backbone of India and also plays an important role in Indian economy by providing a certain percentage of domestic product to ensure the food security. In India agriculture contributes approximately 23% of GDP and employed workforce percentage is 59%. India is the second-largest producer of agriculture crops. the technological contribution may help the farmer to get more yield. But now-a-days, food production and prediction is getting depleted due to unnatural climatic changes, which will adversely affect the economy of farmers by getting a poor yield and also help the farmers to remain less familiar in forecasting the future crops.

So our proposed system with the help of machine learning techniques and algorithms like Linear Regression and Random Forests Regressor predicts the crop can be grown based on different parameters entered by the user in the front end like state and district name, temperature, humidity, moisture content and pH value. Here Random Forest Regresser gave 100% accuracy and it is used as final model for crop prediction.

Here we also suggest which fertilizers should be used based on pH value entered by the user in the front end.

VIII. CONCLUSION

In conclusion, the pursuit of accurate and timely cash crop loss prediction has become increasingly imperative in the context of contemporary agricultural challenges shaped by climate change. This review explored the multifaceted landscape of research dedicated to forecasting crop losses, emphasizing the integration of diverse methodologies and technologies.

The amalgamation of machine learning algorithms, remote sensing technologies, and comprehensive datasets has significantly advanced our capacity to predict cash crop losses with precision. From the early recognition of climate-related risks to the development of sophisticated predictive models, the literature reveals a collective effort to enhance the resilience of agricultural systems. The utilization of remote sensing data, including satellite imagery and UAVs, has notably elevated the spatial and temporal resolution of information, enabling nuanced analyses of crop health and vulnerability.

The regional variability in agricultural practices, soil conditions, and climate necessitates a tailored approach to prediction models. Acknowledging this diversity, recent studies have underscored the importance of customizing models to specific geographic areas, ensuring that interventions are contextually relevant and effective.

Socioeconomic considerations have emerged as integral components of cash crop loss prediction, emphasizing the interconnectedness between environmental factors and the livelihoods of farming communities. The integration of these factors into predictive models not only enriches the accuracy of predictions but also facilitates the formulation of policies and interventions that address the broader implications on food security.

Looking forward, the synthesis of these advancements offers a promising trajectory for the development of resilient and sustainable agricultural practices. The predictive models discussed herein empower stakeholders, including farmers,

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policymakers, and agricultural extension services, with actionable insights to proactively manage and mitigate the impact of climate-related risks on cash crop production.

As technology continues to evolve and interdisciplinary collaborations deepen, the field of cash crop loss prediction holds great potential for transformative contributions to global food security. By staying at the forefront of innovation and fostering a holistic understanding of the complex dynamics at play, we can pave the way for adaptive, sustainable, and resilient agricultural systems in the face of an ever-changing climate.

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