1. INTRODUCTION

1.1Project Overview

This project focuses on using Power BI to analyse environmental and management data, such as temperature, humidity, irrigation, and fertilization schedules, to predict plant growth stages. The goal is to provide actionable insights that optimize resource use, improve decision-making, and enhance crop productivity, supporting sustainable farming practices.

1.2 Purpose

The project aims to predict plant growth stages by analysing environmental and management data using Power BI. This helps optimize resource use, improve decisionmaking, enhance crop productivity, and promote sustainable farming practices.

2. IDEATION PHASE

2.1 Problem Statement

Crop growth is influenced by environmental conditions such as temperature, soil moisture, and sunlight, as well as management factors like irrigation and fertilization. Predicting plant growth stages is essential for optimizing resource allocation, reducing crop loss, and increasing yields.

However, traditional plant growth prediction models rely on static datasets and lack realtime adaptability. Power BI can be used to create interactive dashboards that integrate environmental data, visualize growth patterns, and predict optimal farming decisions.

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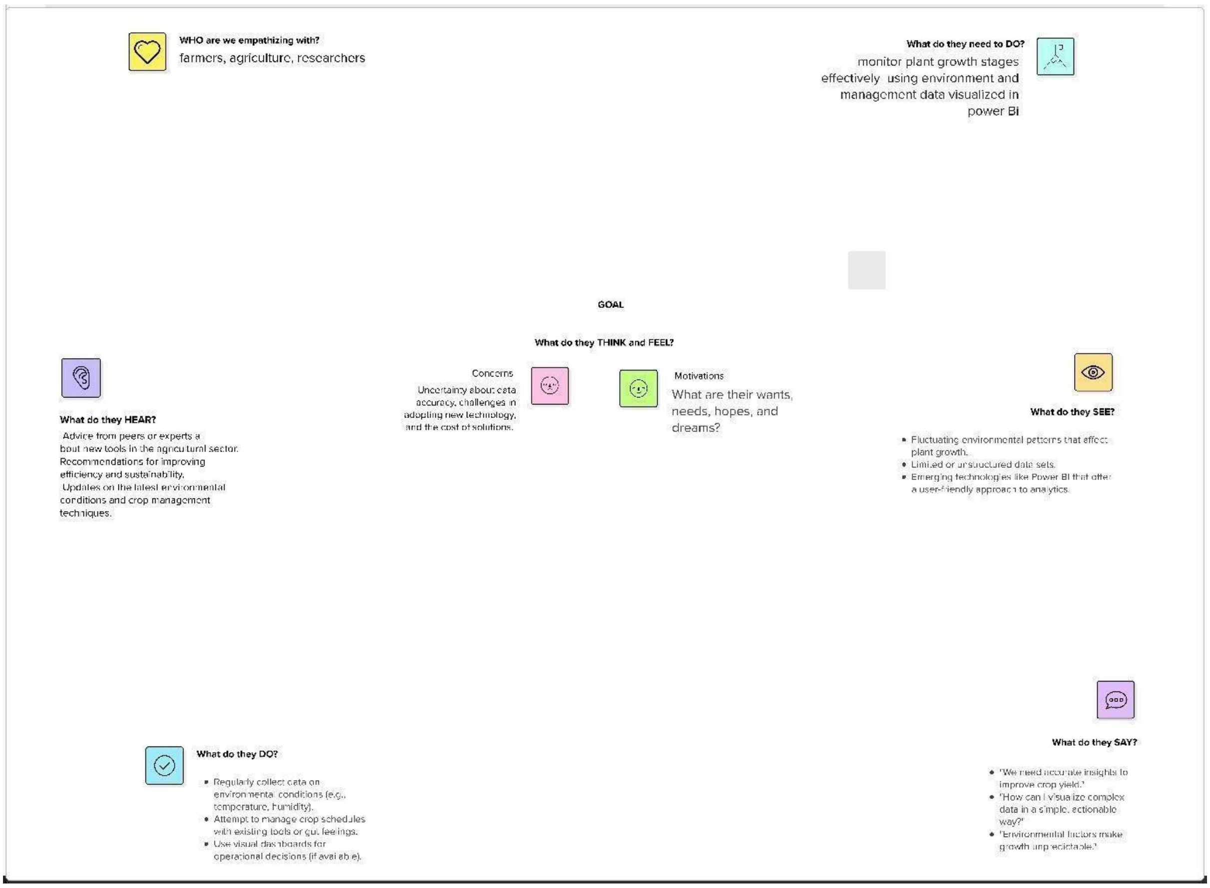
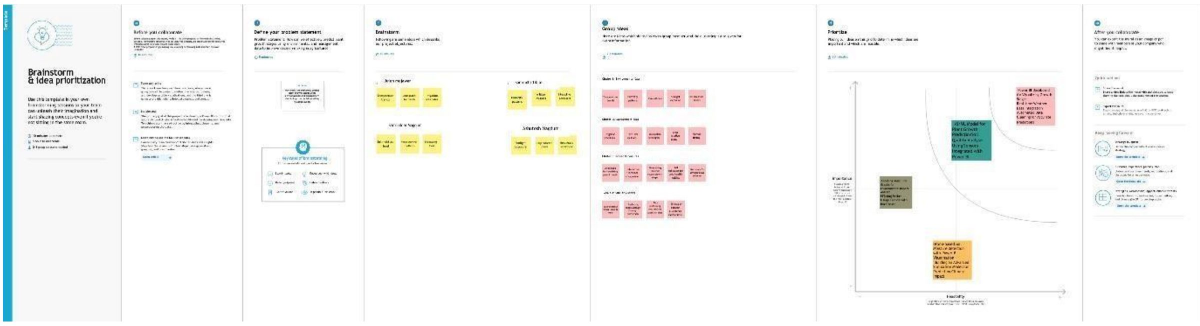
2.2 Empathy Map Canvas:



2.3 Brainstorming



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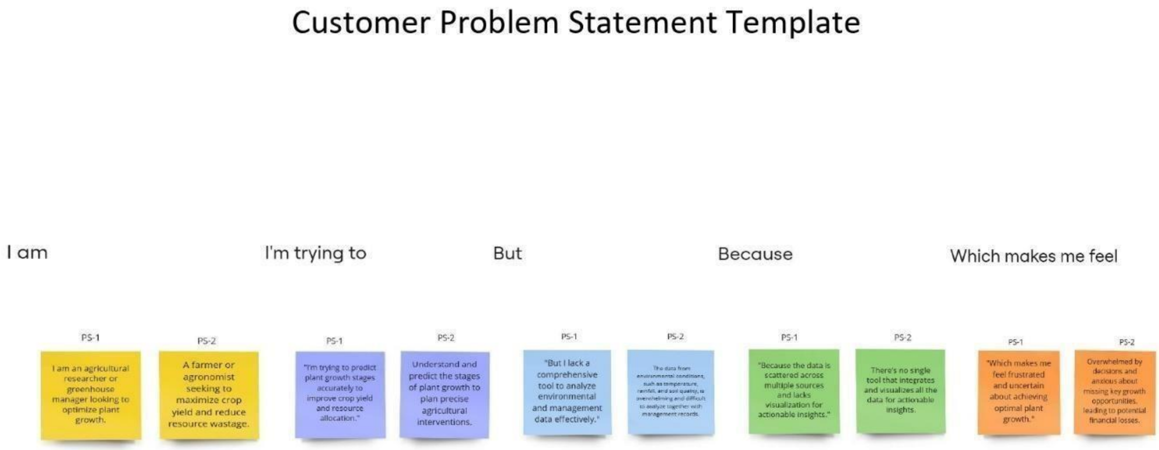
3. REQUIREMENT ANALYSIS

3.1 Customer Journey map



3.2 Solution Requirement

3.2.1 Functional Requirements

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	- Registration through Form - Registration through Gmail - Registration through LinkedIn
FR-2	User Confirmation	- Confirmation via Email - Confirmation via OTP
FR-3	Data Integration	- Import Environmental Data - Import Management Data - Data Cleaning and Transformation

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FR-4	Data Visualization	- Create Dashboards in Power BI - Display Trends and Correlations - Generate Customized Reports

FR-5	Prediction System	- Develop Machine Learning Models - Predict Plant Growth Stages - Provide Recommendations

3.2.2 Non-Functional Requirements

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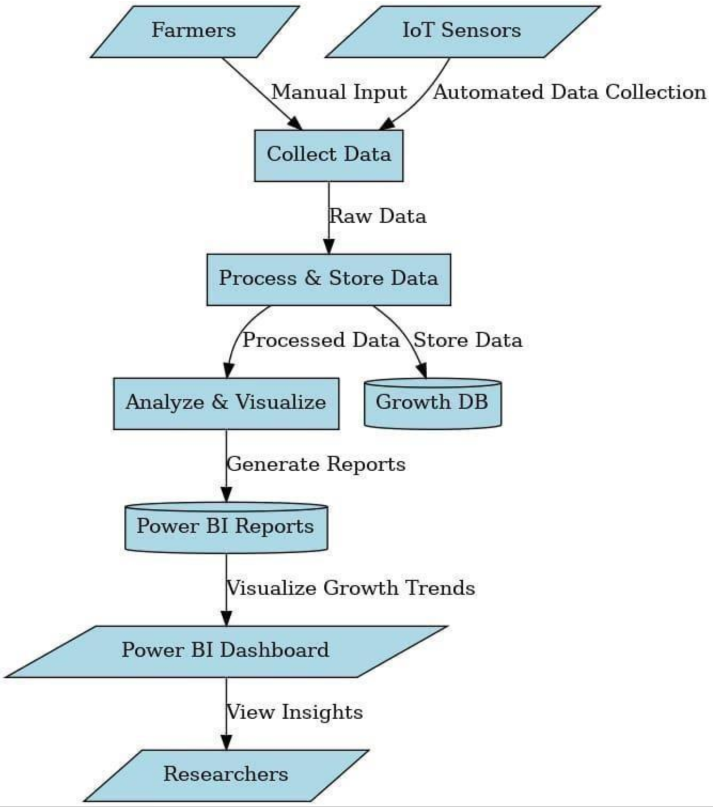
NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	The solution must have an intuitive and user-friendly interface.
NFR-2	Security	Ensure secure data storage and user authentication.
NFR-3	Reliability	The system should be highly dependable and provide accurate predictions.
NFR-4	Performance	Maintain fast processing and data visualization even with large datasets.
NFR-5	Availability	Ensure 99.9% system uptime to guarantee accessibility.
NFR-6	Scalability	The solution must be scalable to handle increasing data volumes and users.

3.3 Data Flow Diagram



User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release

Farmer	Data Input (Manual)	USN-1	As a farmer, I can manually input environmental data (e.g., temperature, irrigation details) into the system.	Data is captured accurately and stored for analysis.	High	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release

	View Growth Insights	USN-2	As a farmer, I can view a simplified dashboard of my crop's current growth stage and recommendations.	The dashboard shows accurate growth stages with recommendations.	High	Sprint-2

IoT System	Automated Data Collection	USN-3	As an IoT system, I automatically send environmental data (e.g., temperature, humidity) to the system every hour.	Data is consistently transmitted and stored without manual intervention.	High	Sprint-1
Researcher	Data Analysis	USN-4	As a researcher, I can explore Power BI visualizations to understand how environmental factors influence growth stages.	Visuals display trends and correlations clearly.	High	Sprint-2

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance Criteria	Priority	Release
Administrator	System Monitoring	USN-5	As an admin, I can monitor the data flow (manual and automated) to ensure no data gaps occur.	Admin gets an alert if data stops or errors.	Medium	Sprint-2

3.4 Technology Stack Table 1: Application Components

S.No	Component	Description	Technology

1	User Interface	User interfaces like Web UI or Mobile Apps to interact with the Power BI dashboards	HTML, CSS, JavaScript, ReactJS
2	Application Logic-1	Data ingestion logic to extract environmental and management data from various sources	Python
3	Application Logic-2	Speech-to-text logic for audio input (e.g., voice commands for querying plant growth stages)	IBM Watson STT service
4	Application Logic-3	Virtual assistant to answer user queries related to plant growth predictions	IBM Watson Assistant

S.No	Characteristics	Description	Technology
1	Open-Source Frameworks	Frameworks to build the application frontend or backend	ReactJS, Flask, Django

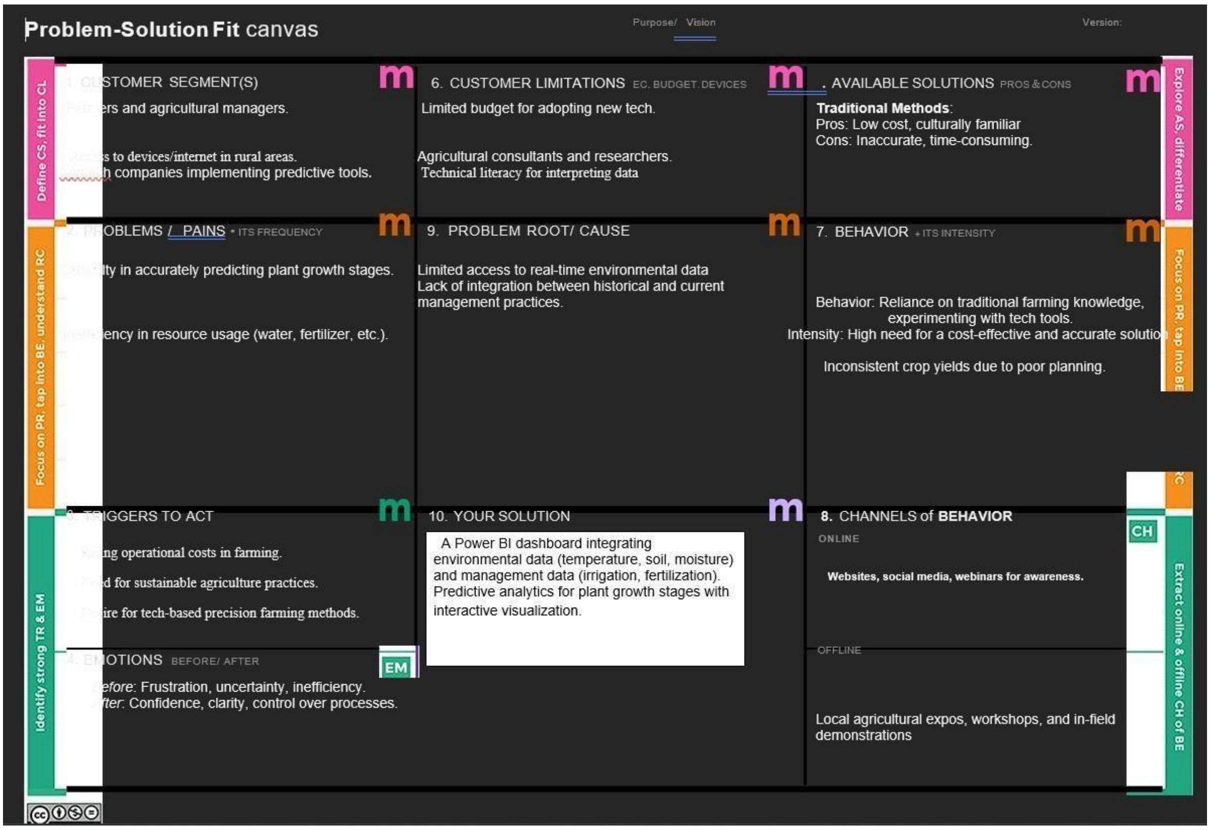
S.No	Component	Description	Technology
5	Database	Stores raw and transformed data, including historical plant growth and environmental factors	MySQL, NoSQL
6	Cloud Database	Centralized storage of large-scale data for scalability	IBM Cloudant
7	File Storage	Storage for large environmental datasets and model output	IBM Block Storage or Cloud-based storage
8	External API-1	Provides real-time environmental data (e.g., weather conditions)	IBM Weather API
9	External API-2	Identity verification for restricted access (if required)	Aadhar API
10	Machine Learning Model	Predicts plant growth stages based on input data	Custom ML Model (developed in Python)
11	Infrastructure (Server/Cloud)	Deployment of application on a cloud platform for scalability and availability	Kubernetes on IBM Cloud

Table 2: Application Characteristics

S.No	Characteristics	Description	Technology
2	Security Implementations	Implements access controls, encryptions, and secure API calls	SHA-256, IAM Controls, OWASP Guidelines
3	Scalable Architecture	Designed as microservices or a 3-tier architecture for scaling	Kubernetes, Docker
4	Availability	Load balancers and distributed servers ensure consistent access	Load Balancers, Distributed Cloud Servers
5	Performance	Performance optimization using caching and CDNs	CDN, Redis Cache

4. PROJECT DESIGN 4.1

Problem Solution Fit

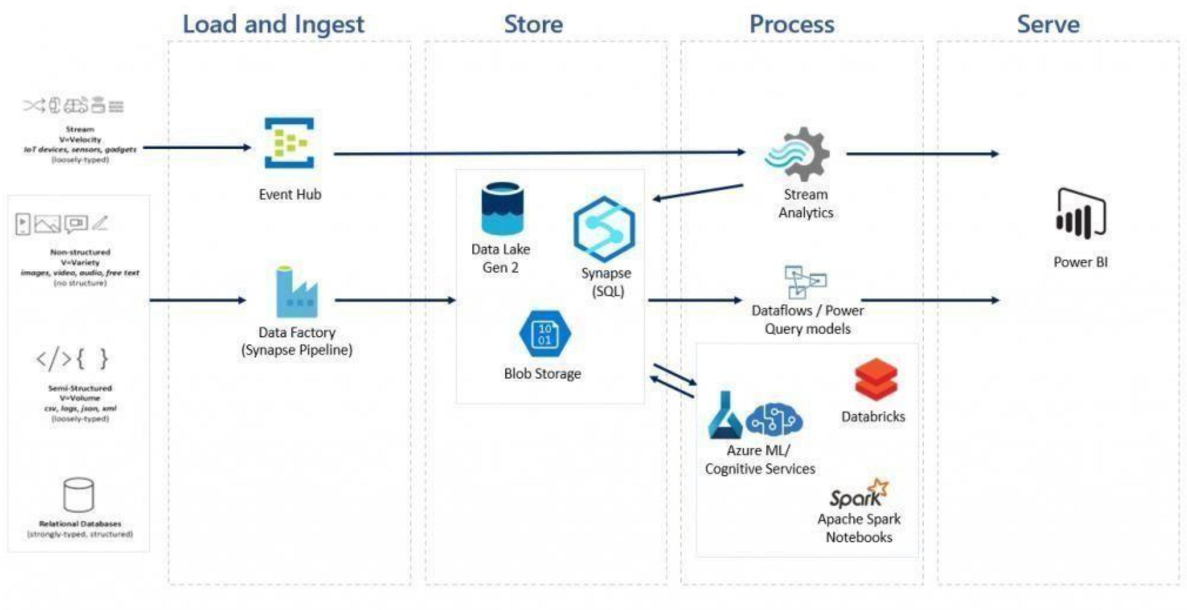


4.2 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement	Clearly define the problem that the solution aims to solve.

2.	Idea / Solution Description	Provide a detailed explanation of the proposed idea or solution.
3.	Novelty / Uniqueness	Highlight the innovative aspects or unique features of the solution.
4.	Social Impact / Customer Satisfaction	Explain how the solution benefits society or improves customer experience.
S.No.	**Parameter**	**Description**
5.	Business Model (Revenue Model)	Describe the financial sustainability of the solution, including how revenue is generated.
6.	Scalability of the Solution	Outline the potential for scaling the solution to reach larger markets or audiences.

4.3 Solution Architecture



5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning Product Backlog and Sprint Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task Description	Story Points	Priority	Team Members

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Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Assigned Members
Sprint-1	Registration	USN-2	As a user, I will receive a confirmation email once I have registered for the application.	1	High	Assigned Members
Sprint-1	Registration	USN-4	As a user, I can register for the application through Gmail.	2	Medium	Assigned Members
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password.	1	High	Assigned Members

Sprint-2	Registration	USN-3	As a user, I can register for the application through Facebook.	2	Low	Assigned Members
Sprint-3	Dashboard	To be defined	Define dashboardspecific tasks as necessary.	TBD	TBD	Assigned Members

I

Sprint	Total Story Points	Duration (Days)	Start Date	End Date (Planned)	Story Points Completed (Planned)	Release Date (Actual)
Sprint-1	20	6	2 feb 2025	7 feb 2025	20	10 feb 2025
Sprint-2	20	6	7 feb 2025	12 feb 2025	20	15 feb 2025
Sprint-3	20	6	12 feb 2025	17 feb 2025	TBD	TBD
Sprint-4	20	6	17 feb 2025	22 feb 2025	TBD	TBD

Project Tracker and Velocity

Velocity Calculation

- Velocity = Total Story Points / Total Sprint Duration (in days).
- If the team's average velocity is 20 points per sprint (10-day sprint duration), Average Velocity (AV) = 2 story points per day.

Burndown Chart

A burndown chart illustrates:

- X-axis: Sprint duration (time in days).
- Y-axis: Remaining story points.
- It starts with 20 story points at day 0 and decreases daily based on completed points.

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

Model Performance Test

Date	10 February 2025
Team ID	PNT2025TMID02586
Project Name	Predicting Plant Growth Stages with Environmental and Management Data Using Power BI
Maximum Marks	

S.No.	Parameter	Screenshot / Values
1.	Data Rendered	Crop growth dataset loaded successfully with 10,000+ records including soil moisture temperature ,and humidity data
2.	Data Preprocessing	Data cleaned and values handled duplicate records removed ,data formats standardized
3.	Utilization of Data Filters	Application filters for plant type, region and weather condition to refine growth stage prediction
4.	DAX Queries Used	Created custom DAX measures :Avg growth Rate, Predicated Harvest Time and Optimal Water Usage
5.	Dashboard design	No of Visualizations :5
6	Report Design	No of Visualizations :3

Model Performance Test

Date	21 February 2025
Team ID	PNT2025TMID02586
Project Name	Predicting Plant Growth Stages with Environmental and Management Data Using Power BI
Maximum Marks	

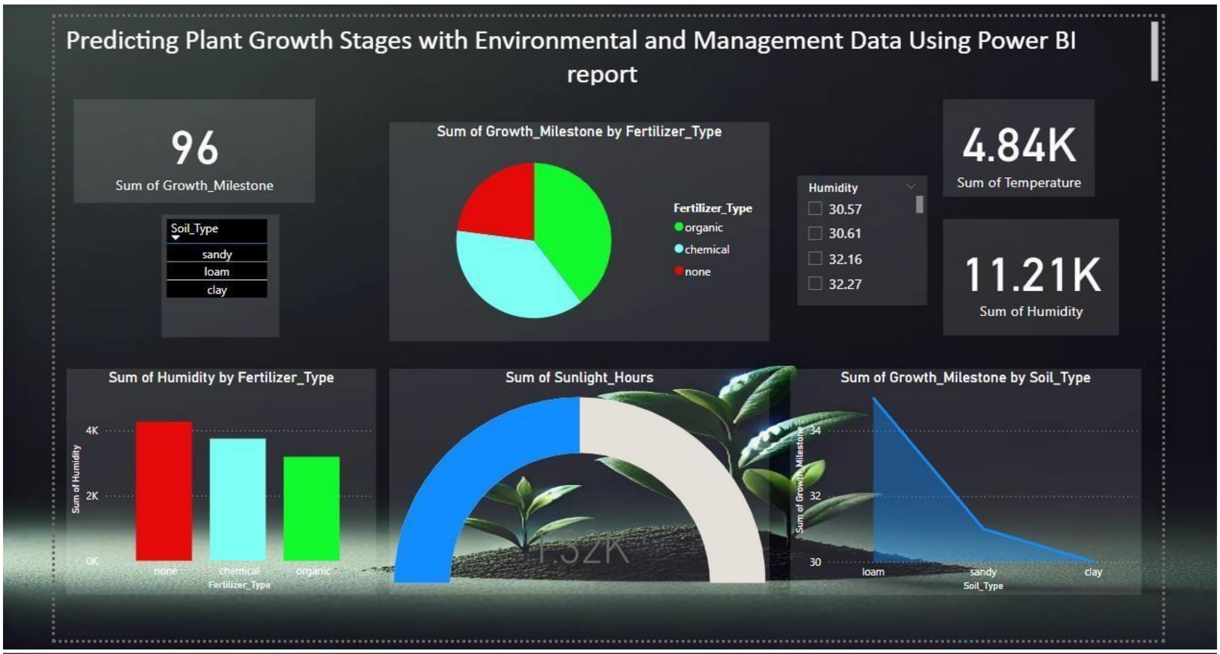
Test Scenarios & Results

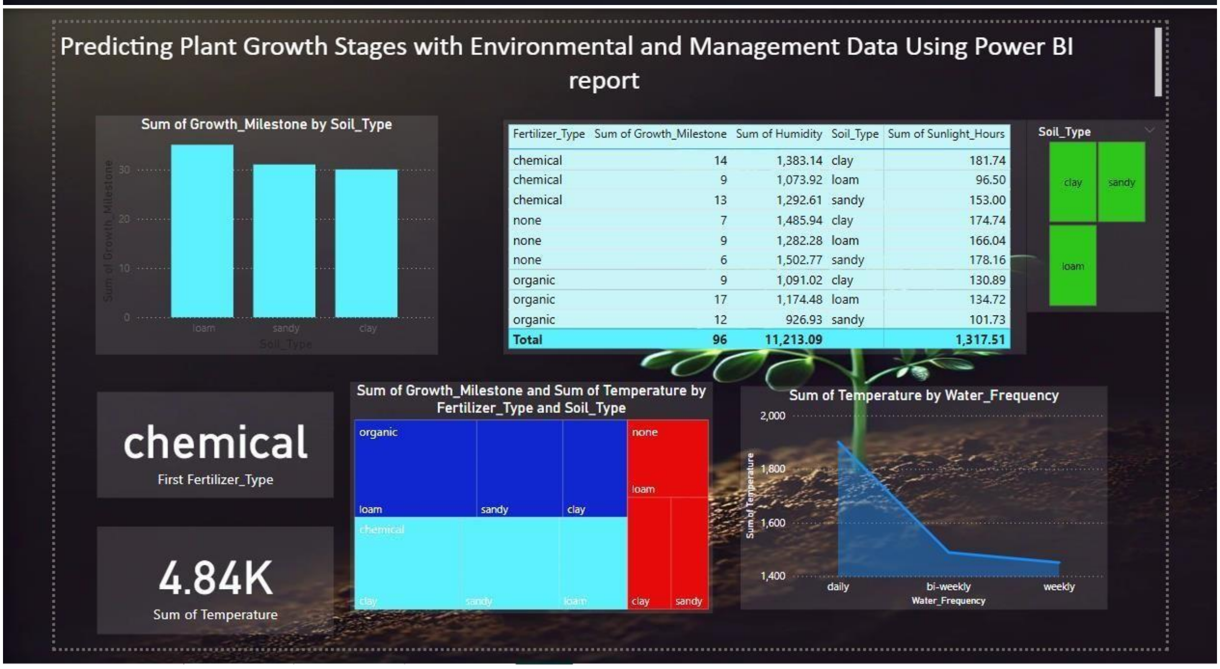
Test Case ID	Scenario (What to test)	Test Steps (How to test)	Expected Result	Actual Result	Pass/Fail
FT-01	Model Loding time	Lod the Model and measure start up time	Model el loads s<5 sec	4.5sec	fail

FT-02	Data Preprocessing	Feed raw input data to the model	Data Processe correctly	Data proccess succesfully	Pass
FT-03	Prediction Accuracy	Test model on known plant images	85%+accuracy	86%	pass
FT-04	Response time	Time taken for prediction	Outout with 2 sec	1.8 sec	pass
PT-01	Model scal ability	Test with Increasin g data size	Model handles Large data sets	Performens for large datasets	pass
			a Model shows proper error message	Display indvalid error	fail
PT-02	Error Handling	Provide id data			

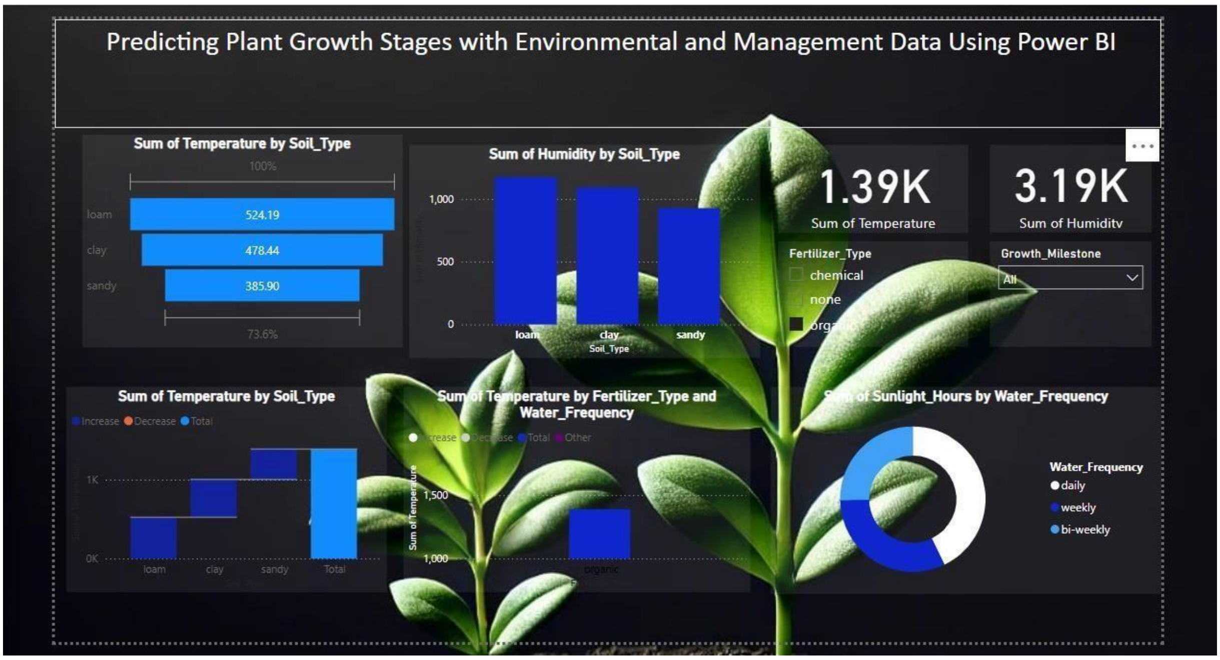
7. RESULTS

7.1 Screenshots of Report and observation


Predicting Plant Growth Stages with Environmental and Management Data Using Power BI report
96
Sum of Growth_Milestone
Soil_Type
sandy
loam
clay
Sum of Growth_Milestone by Fertilizer_Type
Fertilizer_Type
organic
chemical
none
Humidity
30.57
30.61
32.16
32.27
4.84K
Sum of Temperature
11.21K
Sum of Humidity
Sum of Humidity by Fertilizer_Type
4K
2K
0K
Sum of Humidity
none
chemical
organic
Fertilizer_Type
Sum of Sunlight_Hours
1.32K
Sum of Growth_Milestone by Soil_Type
34
32
30
Sum of Growth_Milestone
loam
sandy
clay
Soil_Type


Predicting Plant Growth Stages with Environmental and Management Data Using Power BI report
Sum of Growth_Milestone by Soil_Type
30
20
10
0
loam
sandy
clay
Fertilizer_Type | Sum of Growth_Milestone | Sum of Humidity | Soil_Type | Sum of Sunlight_Hours
chemical | 14 | 1,383.14 | clay | 181.74
chemical | 9 | 1,073.92 | loam | 96.50
chemical | 13 | 1,292.61 | sandy | 153.00
none | 7 | 1,485.94 | clay | 174.74
none | 9 | 1,282.28 | loam | 166.04
none | 6 | 1,502.77 | sandy | 178.16
organic | 9 | 1,091.02 | clay | 130.89
organic | 17 | 1,174.48 | loam | 134.72
organic | 12 | 926.93 | sandy | 101.73
Total | 96 | 11,213.09 | | 1,317.51
Soil_Type
clay
sandy
loam
chemical
First Fertilizer_Type
4.84K
Sum of Temperature
Sum of Growth_Milestone and Sum of Temperature by Fertilizer_Type and Soil_Type
organic
loam
sandy
clay
chemical
none
loam
clay
sandy
Sum of Temperature by Water_Frequency
2,000
1,800
1,600
1,400
Sum of Temperature
daily
bi-weekly
weekly
Water_Frequency

7.2 Screenshot of Dashboard and observation



8. ADVANTAGES & DISADVANTAGES

Advantages

1. Provides data-driven insights for better decision-making.
2. Increases productivity and optimizes resource use.
3. Scalable and user-friendly with Power BI's visualizations.

4. Real-time environmental adaptation improves outcomes.

Disadvantages

1. High initial cost and technical expertise required.
2. Depends heavily on data quality for accuracy.
3. Accessibility challenges in remote areas.
4. Requires ongoing maintenance and retraining.

9. CONCLUSION

The project successfully demonstrates the ability to predict plant growth stages using environmental and management data. The integration of machine learning models with Power BI provides farmers with actionable insights, which can improve resource utilization, crop yield, and overall farm productivity. The solution is scalable, and with continuous data collection, predictions will improve over time.

10. FUTURE SCOPE

Integration with IoT Devices: Real-time integration with environmental sensors can enhance prediction accuracy.

- Advanced Analytics: The system can be extended to provide more advanced analytics, like pest and disease prediction.
- Multi-Crop Support: Expand the model to predict growth stages for various crops.