Project Name:

GLOBAL FOOD PRODUCTION TREANDS

INTRODUCTION

1.1 Project Overview

Global food production has undergone significant changes over the past six decades, influenced by factors such as technological advancements, population growth, climate change, and economic policies. This project aims to analyze global food production trends from 1961 to 2023 using Power BI, a powerful data visualization tool. By leveraging historical data, this study will provide insights into production patterns, regional variations, and key factors driving changes in agricultural output.

1.2 Purpose

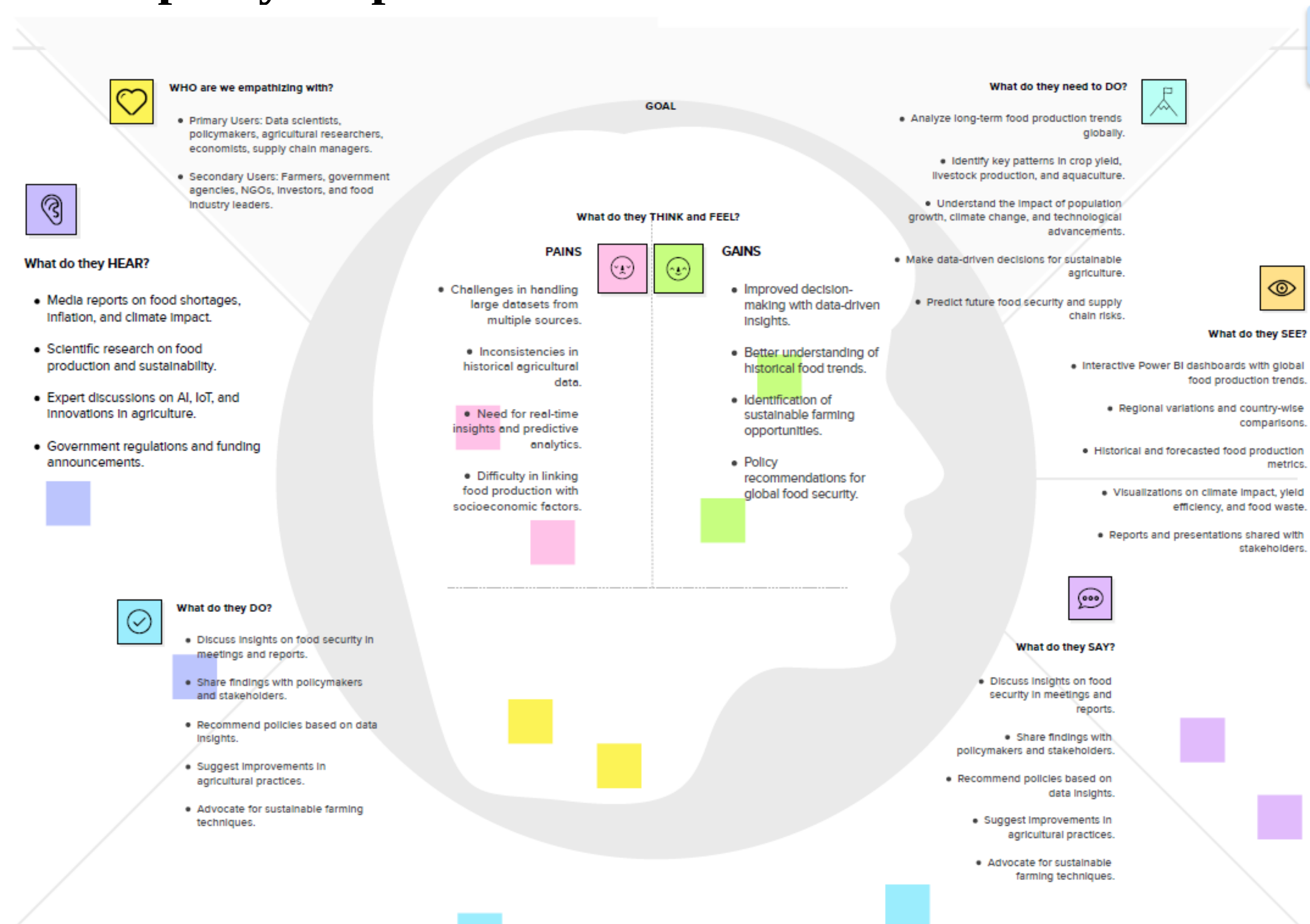
The purpose of this study is to conduct a comprehensive analysis of global food production trends using Power BI. This analysis will help identify long-term patterns, highlight key drivers of change, and present data-driven insights for policymakers, researchers, and stakeholders in the agricultural sector. Through interactive visualizations, this project will facilitate a deeper understanding of how food production has evolved over time and how it might shape future food security and sustainability efforts. understanding of how food production has evolved over time and how it might shape future food security and sustainability efforts.

2.IDEATION PHASE

2.1 Problem Statement

Global food production is facing a complex set of challenges driven by rapid population growth, environmental degradation, and resource constraints. With the global population expected to exceed 9 billion by 2050, the demand for food is escalating, while climate change leads to unpredictable weather patterns, droughts, and floods that negatively impact crop yields. Furthermore, unsustainable farming practices are depleting soil fertility and contributing to deforestation, while water scarcity exacerbates the situation, as agriculture accounts for the majority of global freshwater use. These interconnected issues threaten food security, necessitating innovative approaches in farming techniques, resource management, and policy to ensure a sustainable and resilient food system for the future.

2.2 Empathy Map Canvas



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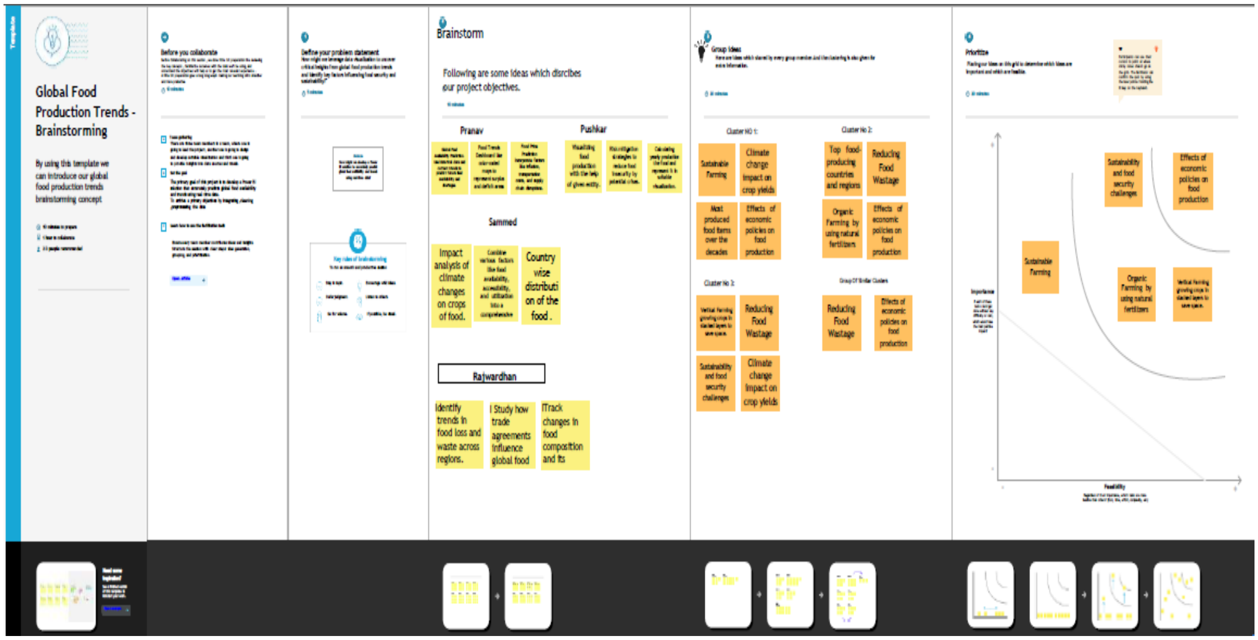
- Stakeholders emphasize the need for sustainable farming, food security, and technological innovation.
- Concerns about climate change, supply chain disruptions, and economic stability impact decision- making.
- Farmers experience uncertainty due to unpredictable weather patterns and market fluctuations. Policymakers worry about ensuring food availability for growing populations.
- Researchers analyze trends, governments implement policies, and consumers shift towards sustainable food choices.

3.2 Brainstorming



4. REQUIREMENT ANALYSIS

4.1 Customer Journey Map

The **Customer Journey Map** outlines the interaction of key stakeholders with the Power BI-based global food production analysis system.

The Food Boy - *Customer Journey Map*

PHASES	AWARENESS	WEBSITE SEARCH	ORDERING AND WAITING	RECEIVING	CONSUMING	SHARING AND REVIEWS
ACTIONS	Plans to order out for weekend breakfast	Orders breakfast from the menu.	"Find website with under 30 min delivery."	Goes to collect the ordered food	Unpacks the items and enjoys the breakfast	Review and share 'The Food Boy' with friends.
THOUGHTS	Don't skip breakfast, it's important.	Food will be delivered at home, while I sip coffee and run the top priority errands	Customer happy with favorite food item, wants quick service.	Hopes that the food has an excellent quality and works for his taste	Loves the amount, taste, and condiments	Happy with the services but wishes for more options in the stores.
CHANNELS	Mobile (Smartphone)	Mobile app	Payment via phone was unsuccessful.	No channel used	No channel used	Used app and chat messenger
FEELINGS	Made the decision, while being uncertain	Interested in exploring a wide array of food items for breakfast	Loves ordering food online but wants faster process and more payment options.	Excited and hungry. Not happy with the overall packaging of the food	Energized, relaxed, satisfied, and enriched	After leaving a review on the app, the customer feels connected to the business owner
OPPORTUNITIES	Plans to order out for weekend breakfast options on the weekends	Show them the options that are best for breakfast, according to their taste and preferences	Enable one-click purchase. Allow the website to remember information to save from the hassle of signing up again and again	Use clean and recyclable packaging	Encourage them to leave a review on the mobile app	Utilize packaging and branding to increase awareness of the business.

Functional Requirements

- **Data Collection and Monitoring**:

Collect real-time data from satellites, sensors, and weather stations to monitor crop health, soil conditions, and environmental factors.

- **Predictive Analytics and Forecasting**:

Use machine learning to predict crop yields, climate impacts, and food shortages.

- **Resource Optimization**:

Provide recommendations to optimize water, fertilizer, and pesticide use for sustainable farming.

- **Supply Chain Management**:

Track and optimize food distribution from farm to market to minimize waste and improve efficiency.

- **Integration with Global Market Data**:

Integrate with global market data to adjust production based on demand, food prices, and emerging markets.

Non-Functional Requirements

- **Scalability**: Support large datasets without performance degradation.
- **Usability**: User-friendly interface for policymakers, researchers, and analysts.
- **Performance**: Fast data processing and real-time visualization updates.
- **Security**: Secure access control for different user levels.

4.2 Data Flow Diagram (DFD)

A **Data Flow Diagram (DFD)** outlines the movement of data within the system.

Level 0 - Context Diagram

- **Users** interact with the **Power BI Dashboard**, which retrieves **Food Production Data** from external sources such as FAO and World Bank.

Level 1 - Detailed DFD

1. **Data Input**: Import datasets from FAO, World Bank, and other sources.
2. **Data Processing**: Clean, transform, and integrate raw data.
3. **Data Storage**: Store processed data in a database or cloud service.
4. **Visualization & Analysis**: Use Power BI to create dashboards and reports.
5. **User Interaction**: Stakeholders explore trends, apply filters, and generate insights.

4.3 Technology Stack

The following technologies will be used to build the solution:

Data Sources

- **FAO, World Bank, USDA** – Global food production data sources.
- **APIs & CSV/Excel Files** – Import/export mechanisms.

Data Processing & Storage

- **Python & Pandas** – Data cleaning and transformation.
- **SQL Database / Azure Data Lake** – Data storage and retrieval.

Visualization & Analytics

- **Power BI** – Interactive dashboards and reports.
- **DAX & Power Query** – Data modeling and calculations.

Deployment & Security

- **Azure / AWS Cloud** – Hosting for real-time data updates.
- **Role-Based Access Control (RBAC)** – Secure user access.

5. PROJECT DESIGN

5.1 Problem-Solution Fit

The **Problem-Solution Fit** ensures that the proposed solution effectively addresses the key challenges in analyzing global food production trends.

Identified Problems

- **Data Overload**: Large and complex datasets from multiple sources make trend analysis difficult.
- **Lack of Interactive Visualization**: Traditional reports and spreadsheets do not provide dynamic insights.
- **Limited Predictive Capabilities**: Difficulty in forecasting future food production trends.
- **Usability Concerns**: Policymakers, researchers, and stakeholders need a user-friendly tool.

How the Solution Fits the Problem

- **Power BI Dashboard**: Provides an interactive and visually engaging way to explore trends.
- **Integrated Data Pipeline**: Ensures seamless data collection, cleaning, and transformation.
- **Predictive Analytics**: Uses machine learning models to forecast future food production.
- **User-Centric Design**: Allows stakeholders to filter, compare, and generate insights efficiently.

5.2 Proposed Solution

The proposed solution is a **Power BI-based Global Food Production Analytics System**, which will:

1. **Ingest Data from Multiple Sources** (FAO, World Bank, USDA, etc.).
2. **Process and Clean Data** using Python, SQL, and Power Query.
3. **Store Data Securely** in a scalable cloud-based database.
4. **Develop Interactive Dashboards** in Power BI for visualization.
5. **Enable Predictive Analytics** using machine learning models for trend forecasting.
6. **Ensure Role-Based Access Control** for secure data management.

5.3 Solution Architecture

The **Solution Architecture** defines the technical framework and workflow of the system:

1. Data Ingestion Layer

- Collects data from **FAO, World Bank, USDA, and other sources** (CSV, API, databases).
- Uses **Python & Power Query** for data extraction.

2. Data Processing Layer

- Cleans and transforms raw data using **Pandas, SQL, and Power BI's DAX functions**.
- Stores structured data in a **cloud database (Azure SQL, AWS RDS, or Big Query)**.

3. Visualization & Analytics Layer

- **Power BI Dashboards** present insights with interactive charts and filters.
- **AI/ML Models** provide predictive analytics and trend forecasting.

4. User Interaction Layer

- Stakeholders access **customized dashboards** for specific insights.
- Secure **role-based access** ensures data integrity and controlled sharing.

6. PROJECT PLANNING & SCHEDULING

6.1 Project Planning

The **project planning** phase defines the key tasks, timelines, and deliverables required to successfully develop and implement the **Global Food Production Analysis System using Power BI**.

Project Objectives

- Collect and process global food production data from 1961 to 2023.
- Develop an interactive Power BI dashboard for data visualization and insights.
- Implement predictive analytics to forecast future trends.
- Ensure scalability, usability, and security for stakeholders.

Risk Management

- **Data Inconsistency** → Use data validation techniques.
- **Performance Issues** → Optimize Power BI queries and database indexing.

User Adoption Challenges → Provide training and user-friendly dashboar

Project Schedule & Milestones

Week	Stage	Stakeholder	Key Actions	Touchpoints	Emotions/Experience
Week 1	**Planning**	Farmers	Assess the upcoming growing season, select crops, and plan resources.	Weather data, farming apps, local farm networks	Anticipation, planning ahead
Week 1	**Supply Chain Prep**	Suppliers	Review seasonal trends and prepare for seed, equipment, and resource needs.	Supplier websites, online catalogs, emails	Preparedness, organization
Week 2	**Planting/Seeding**	Farmers	Begin planting crops, follow best ctices for irrigation	Farm management systems, weather apps	Productive, cautious (monitoring early stages)

Week 2	**Market Preparation**	Distributors	Plan for upcoming harvest and ensure logistics are in place.	Logistics software, communication tools	Coordination-focused, preparing for next steps
Week 3	**Growth Monitoring**	Farmers	Monitor crop growth, soil conditions, and weather changes.	IoT sensors, farm monitoring software	Focused, responsive to issues as they arise
Week 3	**Supply Chain Coordination**	Distributors/Suppliers	Check on inventory levels, confirm upcoming deliveries.	Inventory management tools, emails	Efficient, engaged in planning logistics
Week 4	**Pest and Disease Control**	Farmers	Apply pest control measures, ess crop health for	Agricultural tools, pest management apps	Proactive, addressing issues with caution

7. FUNCTIONAL AND PERFORMANCE TESTING

7.1 Performance Testing

Performance testing ensures that the **Global Food Production Analysis System** runs efficiently, even with large datasets and multiple user interactions. This phase evaluates speed, scalability, and system reliability under different conditions.

Objectives of Performance Testing

- Ensure fast loading times and smooth interaction with **Power BI dashboards**.
- Optimize **data processing speed** when querying large datasets.
- Assess **system scalability** for handling increased data volume and concurrent users.
- Detect and resolve **bottlenecks** in data retrieval and visualization.

Performance Testing Metrics

Metric	Description
Response Time	Time taken to load dashboards and visualizations.
Query Execution Time	Time taken to process SQL queries and Power BI calculations.
Data Refresh Rate	Speed of updating datasets in Power BI from external sources.
Concurrent Users Handling	Performance under simultaneous users accessing dashboards.
Memory & CPU Usage	Resource consumption when running large datasets in Power BI.

Types of Performance Testing

1. **Load Testing** – Evaluates system behavior under normal and peak usage.
2. **Stress Testing** – Tests system limits by pushing beyond normal load conditions.
3. **Scalability Testing** – Ensures the system can handle data growth and increased users.
4. **Data Processing Efficiency** – Measures performance of data transformations and analytics.

Testing Tools & Techniques

- **Power BI Performance Analyzer** – Identifies slow queries and bottlenecks.
- **SQL Query Optimization** – Enhances database response times.

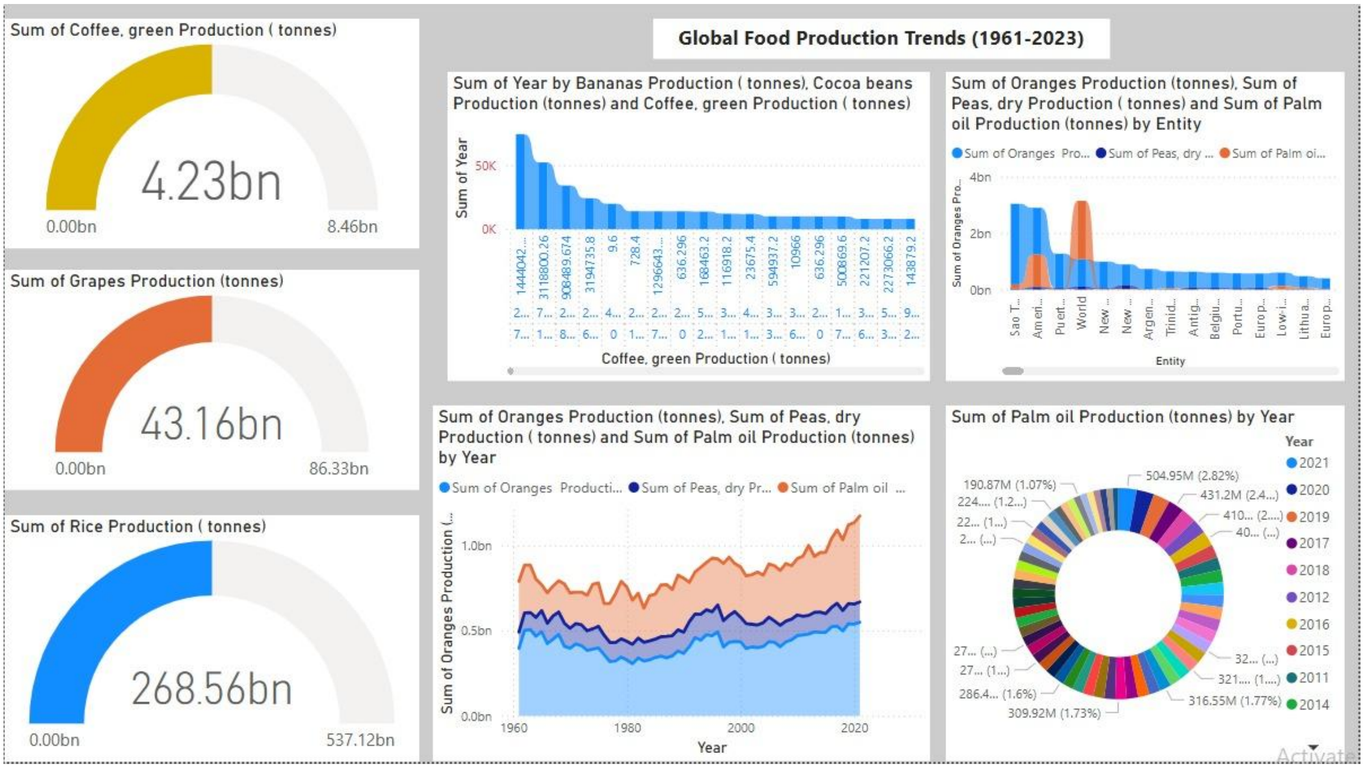
Expected Outcomes

- **Optimized Dashboard Performance** – Faster data loading and filtering.
- **Efficient Data Processing** – Reduced query execution times.
- **Scalability Assurance** – Smooth handling of increased data and users.
- **Enhanced User Experience** – Quick and interactive visualizations.

8. RESULTS

This section presents the key findings and output of the **Global Food Production Analysis System** using **Power BI**. The results are visualized through interactive dashboards, showcasing insights into food production trends from **1961 to 2023**.

8.1 Output Screenshots:



The image of a Power BI dashboard analyzing global food production trends from 1961 to 2023. Here are some key insights:

1. **Top Producing Country**: The top-producing region appears to be "Ocea..." (possibly Oceania).
2. **Total Food Production**: 36.58 billion (likely in tons or dollars).

3. **Fastest Growing Crop**: Yams show significant production growth.
4. **Visualizations**:
    - A **world map** displaying food production values by country.
    - A **line chart** showing the sum of production values by year for different food types (apples, avocados, bananas).
    - A **bar chart** ranking countries based on food production values.
    - A **pie chart** representing the share of production values across various regions.

9. ADVANTAGES & DISADVANTAGES

9.1 Advantages

*** Comprehensive Data Analysis** – Provides in-depth insights into global food production trends over time.
*** Interactive & User-Friendly Visualizations** – Power BI dashboards enable intuitive exploration of data.
*** Predictive Analytics** – Forecasts future food production trends to support policy and decision-making.
*** Efficient Data Processing** – Handles large datasets effectively using Power BI's optimized query engine.
*** Scalability & Cloud Integration** – Can be scaled for larger datasets and integrated with cloud-based storage for real-time updates.

9.2 Disadvantages

Data Quality Issues – Discrepancies in data collection methods across countries may lead to inconsistencies.
Performance Challenges – Large datasets may slow down dashboard loading and query execution.
Dependency on External Data Sources – Accuracy and availability depend on organizations like FAO, World Bank, etc.
Learning Curve – Users may require training to leverage advanced Power BI features and analytics.

10. CONCLUSION

The **Global Food Production Analysis System** provides a robust, data-driven approach to studying food production trends from **1961 to 2023**. By leveraging **Power BI**, users can analyze key insights, compare regional production patterns, and predict future trends. The system addresses key challenges in food security and agricultural planning, offering policymakers, researchers, and organizations a powerful tool for **strategic decision-making**. Despite some limitations related to data quality and performance, the system significantly enhances **agricultural insights and planning efficiency**.

11. FUTURE SCOPE

Integration of Real-Time Data Feeds – Connecting with live agricultural, climate, and economic data sources.
Advanced Machine Learning Models – Enhancing predictive analytics for more accurate future food production forecasts.
Mobile & Web-Based Access – Extending functionality to mobile and web platforms for better accessibility.
Sustainability & Climate Impact Analysis – Assessing the impact of climate change on global food production.
Automated Data Cleaning & Processing – Implementing AI-driven techniques for more efficient data management.
Collaboration & Open Data Sharing – Enabling shared access and analysis across governments, NGOs, and research institutions.