A Project Report On

Global Food Production Trends and Analysis A Comprehensive Study From (1961-2023) Using Power BI

Submitted for fulfilment of Experiential Project Based Learning(EPBL)

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Chapter 1: INTRODUCTION

1.1 **Project Overview:**

This study provides a deep dive into global food production trends from 1961 to 2023 using **Power BI**, a powerful data visualization tool. It aims to analyze the changes in agricultural output, Food production.

Food production is a crucial factor in global sustainability, economic stability, and food security. Over the past six decades, food production patterns have evolved due to technological advancements, climate change, population growth, and shifting dietary preferences. This project aims to analyze global food production trends from 1961 to 2023 using Power BI, providing deep insights into key agricultural sectors, regional contributions, and emerging challenges.

1.2 **Purpose:**

1. Analyze Long-Term Trends – Examine food production patterns across different regions and categories from 1961 to 2023. 2.
2. Identify Leading Producers – Determine the top food-producing countries and their contributions to global supply.
3. Explore Crop and Livestock Growth – Study production changes in major food categories, including cereals, vegetables, fruits, dairy, and meat.
4. Impact Assessment – Assess the impact of climate change, population growth, and policies on food production.
5. Data Visualization – Leverage Power BI to create interactive dashboards for effective data representation and anal

Chapter 2: IDEATION PHASE

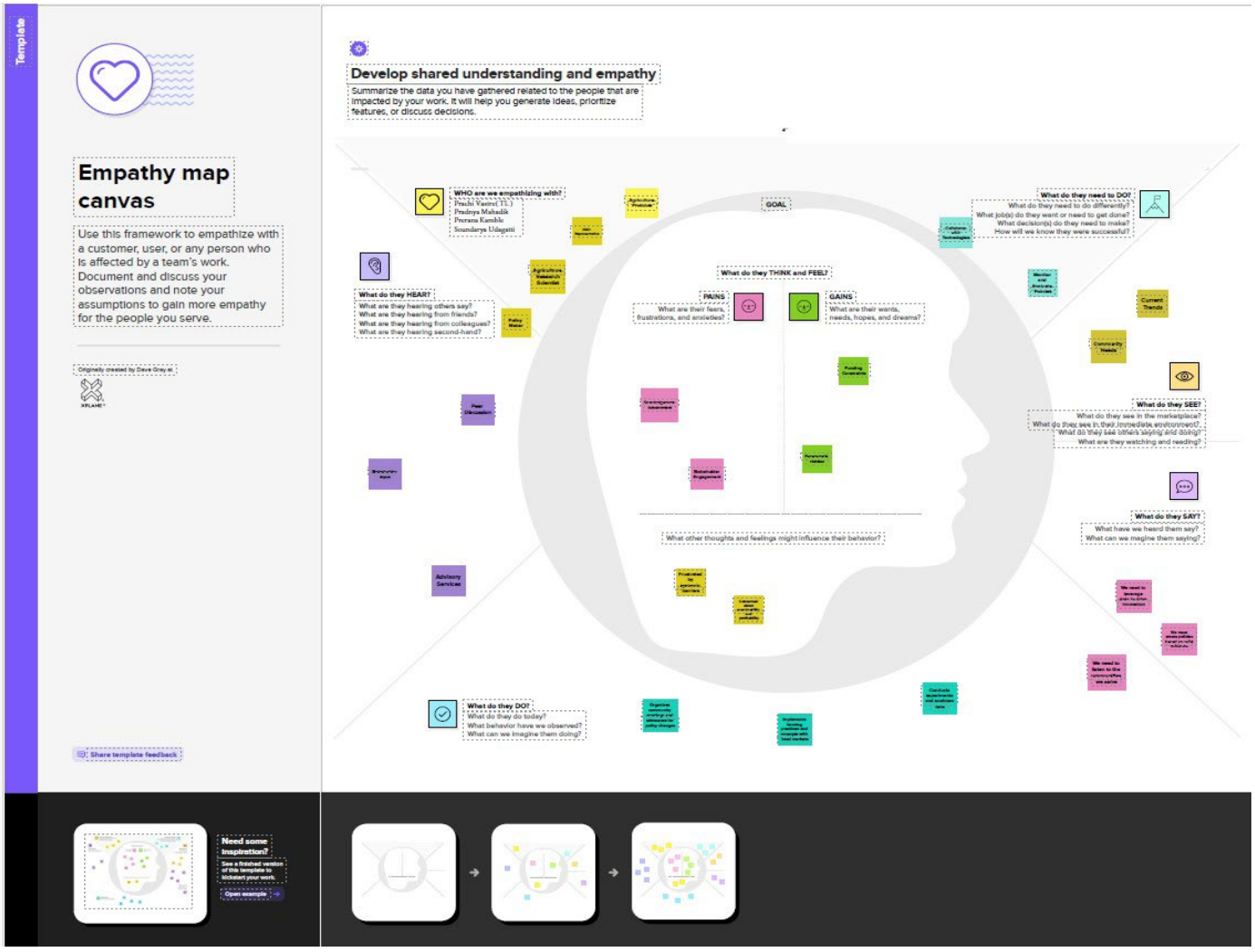
2.1 **Problem Statement:**

Problem Statement (PS)	**I am (Customer)**	**I'm trying to**	**But**	**Because**	**Which makes me feel**
PS-1	A farmer	Increase my crop yield	I lack access to modern agricultural technology	I can't afford expensive machinery	Frustrated and helpless
PS-2	A food company executive	Optimize supply chain efficiency	There are unpredictable fluctuations in food production	Weather conditions and demand vary	Stressed and uncertain
PS-3	A policymaker	Ensure food security in my region	Data on food production trends is scattered	I need reliable insights to make informed decisions	Overwhelmed and concerned
PS-4	A coffee producer	Expand my market globally	I struggle to compete with larger brands	I lack marketing resources and international connections	Disheartened and limited

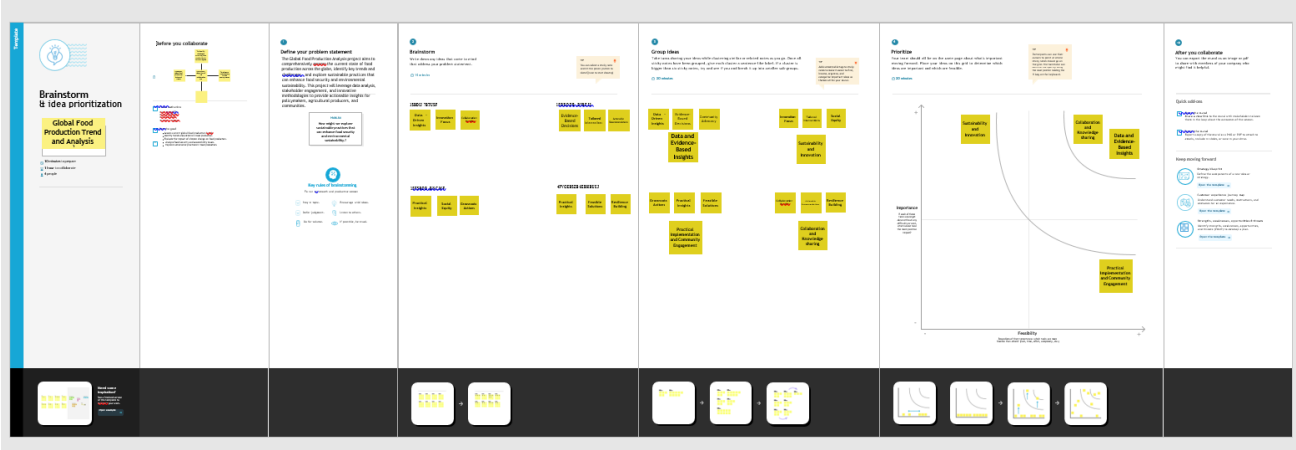
PS-5	A data analyst	Identify key food production trends	The dataset is too large and complex	I need better data visualization tools	Frustrated and inefficient
PS-6	A grocery store owner	Stock the right amount of fresh produce	I can't predict demand accurately	Consumer preferences keep changing	Anxious about losses
PS-7	A consume r	Buy fresh and affordable food	Prices keep increasing	Supply chain disruptions affect availability	Frustrated and worried

2.2 **Empathy Map Canvas:**

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.
It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

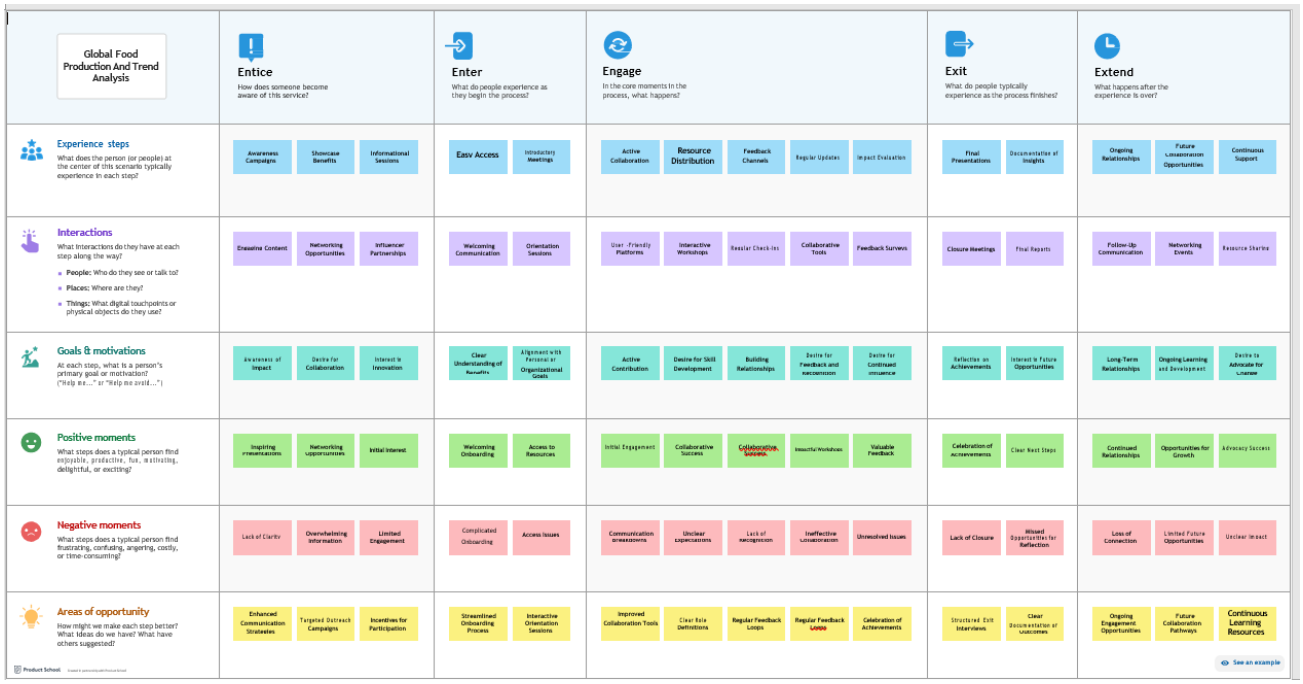


2.3 **Brainstorming:**



Chapter 3: REQUIREMENT ANALYSIS

3.1 Customer Journey Map:



3.2 Solution Requirement:

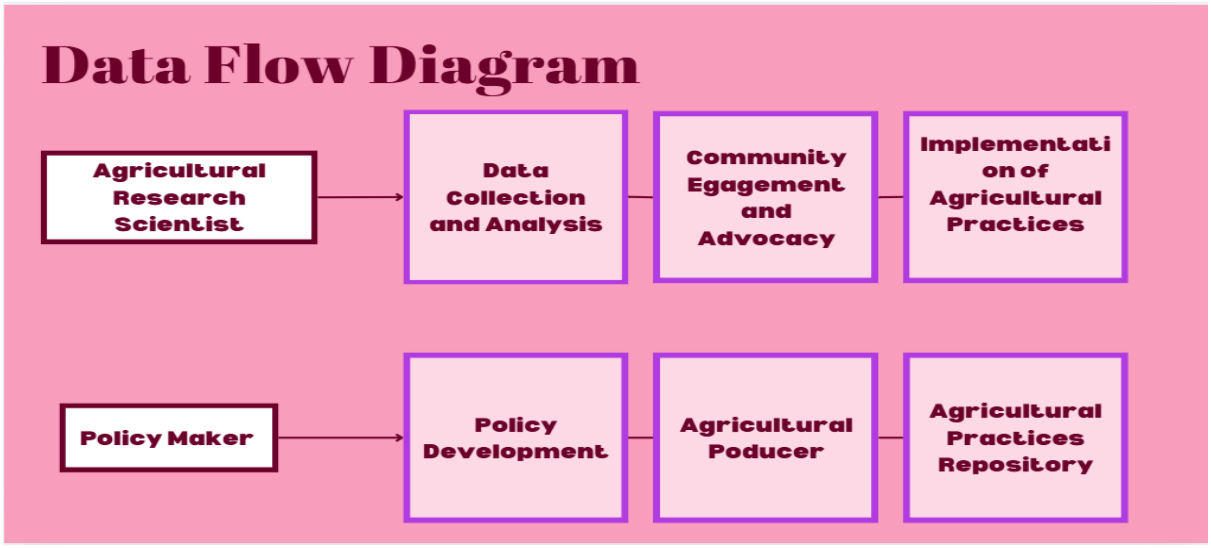
3.2.1 Non-Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Data Collection C Cleaning	Gather historical food production data (1961-2023)
		As a data analyst, I want to integrate global food production data from various sources into power BI.
		Standardize units C formats for analysis
FR-2	Data Processing C Transformation	Aggregate production data by region and crop type
		Calculate yearly growth trends C anomalies
		Prepare dataset for visualization in Power BI
FR-3	Power BI Report Creation	Design interactive dashboards for food production trends
		Create visualizations for staple crops (rice, wheat, maize)
		Develop regional comparison charts for fruit production
FR-4	Insights C Decision Support	Identify key trends in food security C production growth
		Provide data-driven recommendations for stakeholders
		Enable export of reports for business C policy use
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Power BI is a tool that helps people see and understand data using charts, reports, and dashboards. In global food production, it makes decision- making faster, easier, and smarter by showing key information in a clear and interactive way.

NFR-2	Security	keeping this data safe and protected is crucial. Power BI security helps ensure that only the right people can access, view, or change important agricultural data.
NFR-3	Reliability	Reliability in Power BI means that food production data is always accurate, available, and up-to- date so that farmers, researchers, and policymakers can make the right decisions at the right time.
NFR-4	Performance	Power BI reports should load within 5 seconds for optimal user experience, even when handling large datasets.
NFR-5	Availability	The Power BI reports should be accessible 24/7 with minimal downtime, ensuring continuous data availability.
NFR-6	Scalability	The solution should handle growing data volumes and support future integration with additional data sources.

3.3 Data Flow Diagram:

A **Data Flow Diagram (DFD)** is a graphical representation of how data moves through a system. It illustrates how data is processed, stored, and transferred between different components of a system. DFDs are widely used in system analysis and design to visualize the flow of information.



3.4 Technology Stack:

The project leverages a robust technology stack for data handling, analysis, and visualization.

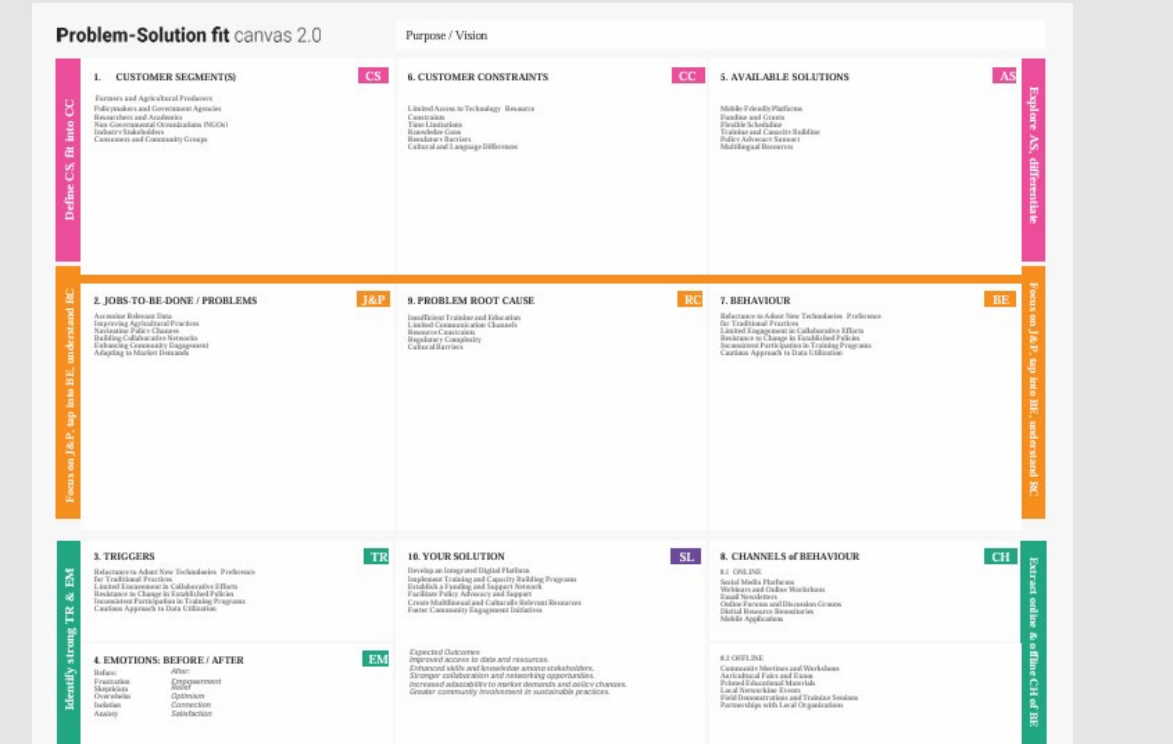
Category	Technology/Tool	Purpose
Data Storage	CSV, Excel, SQL Database	Storing and processing malnutrition data.
Data Processing	Power Query (Power BI)	Data cleaning and transformation.
Data Visualization	Power BI	Dashboard and report generation.
Data Analysis	DAX (Power BI)	Creating calculated fields and measures.
Additional Tools	Python (for preprocessing if needed)	Handling missing values, feature engineering.

Chapter 4: PROJECT DESIGN

4.1Problem-Solution Fit:

Purpose:

- ❑ Solve complex problems in a way that fits the state of your customers.
- ❑ Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.
- ❑ Sharpen your communication and marketing strategy with the right triggers and messaging.
- ❑ Increase touch-points with your company by finding the right problem-behavior fit and building trust by solving frequent annoyances, or urgent or costly problems.
- ❑ Understand the existing situation in order to improve it for your target group.



4.2 Proposed Solution:

Proposed Solution Template:

Project team shall fill the following information in the proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The world needs to produce enough food for a growing population while protecting the environment and ensuring fair access. Challenges like climate change, water shortages, food waste, and inefficient farming make this difficult. We must find better ways to grow, distribute, and consume food sustainably for a healthier future..
2.	Idea / Solution description	Using Power BI, food production data from 1961 to 2023 was analysed, focusing on key commodities such as rice, wheat, maize, coffee, tea, and various fruits like apples, bananas, and grapes. The study provides interactive visualizations to track trends and regional contributions.
3.	Novelty / Uniqueness	In **Power BI**, the uniqueness of improving global food production lies in using **real-time data, AI-driven insights, and predictive analytics** to optimize farming, reduce waste, and improve supply chains. By integrating satellite data, IoT sensors, and market trends, Power BI can help farmers and policymakers make **smart, data-driven decisions** for sustainable food production. This approach enhances efficiency, reduces environmental impact, and ensures better food distribution worldwide
4.	Social Impact / Customer Satisfaction	The analysis benefits agricultural decision-makers, policymakers, and farmers by providing **data-driven insights** that can help improve food security and promote sustainable production practices.
5.	Business Model (Revenue Model)	The business model for global food production generates revenue through smart farming technology, sustainable agriculture products, supply chain services, data-driven insights, and waste management solutions.
6.	Scalability of the Solution	The solution can be scaled by integrating **more agricultural commodities**, real-time data updates.

4.3 Solution Architecture:

The Solution Architecture describes the system's structure, focusing on data processing, storage, and visualization.

System Workflow:

The project leverages Power BI for data visualization and analytics to study global food production trends from 1961 to 2023.

The architecture consists of:

1. Data Sources: o FAO and other global food production datasets (CSV, Excel, SQL databases) o Public APIs for agricultural production statistics o Historical datasets manually processed for trend analysis

2. Data Processing & Transformation: o Data cleaning and transformation using Power Query in Power BI o Creating relationships between various datasets (commodities, regions, years) o Aggregating data for insightful reporting

3. Data Modeling & Storage: o Data is structured and stored in Power BI's in-memory model o Measures and calculated columns created using DAX (Data Analysis Expressions)

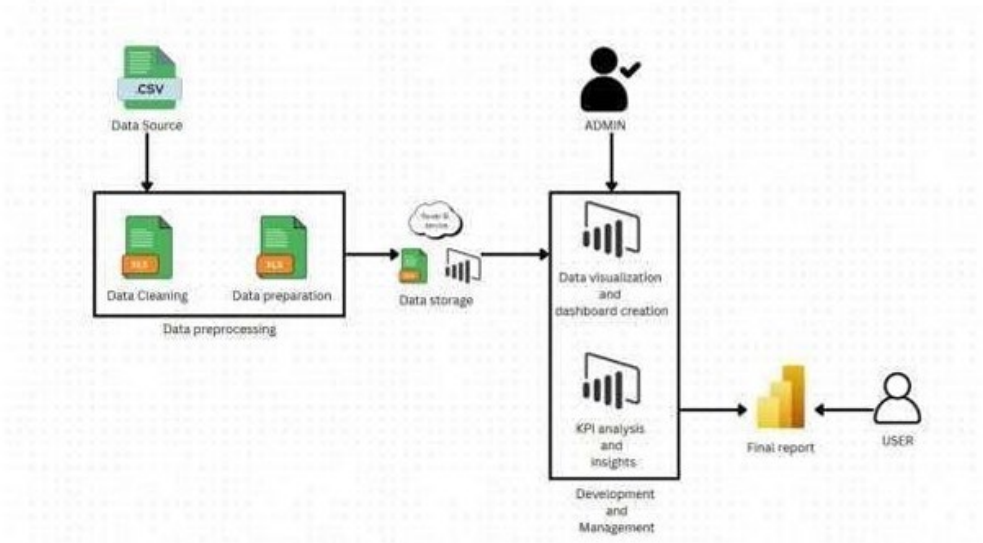
4. Visualization & Reporting Layer:

- Power BI Dashboards & Reports featuring:
  - ♣ Gauge Charts (Tea production analysis)
  - ♣ Bar & Stacked Charts (Fruit & coffee production comparison)
  - ♣ Area Charts (Trends of wheat, maize, and rice over time)
  - ♣ Donut Charts (Maize production distribution)
- Interactive filtering by year, region, and commodity

5. Deployment & Accessibility: o Hosted on Power BI Service for real-time data access o Reports shared via Power BI Embedded & Power BI Mobile for accessibility

6. Scalability & Future Enhancements: o Integration with real-time data sources via APIs o Expansion to include more agricultural commodities and regional insights Example - Solution Architecture Diagram:

Example - Solution Architecture Diagram:



1) Data Source:

- Import datasets from CSV files (WHO, UNICEF, World Bank).

2) Data Cleaning & Processing:

- Handle missing values and normalize data using Power Query in Power BI.
- Create calculated fields (Malnutrition Rate %, Country Rankings).

3) Data Storage:

- Store processed data in Power BI's data model for optimized querying.

4) Visualization & User Interaction:

- Display charts, KPIs, and tables for analysis.
- Allow users to interact via filters, slicers, and drill-down option.

5) Report Generation:

- Export insights in PDF,CSV, or Excel formats for further use

Chapter 5: PROJECT PLANNING & SCHEDULING

The Project Planning & Scheduling phase outlines the sprint-based approach used to develop the Power BI Global Food Production Dashboard. This section is structured according to the Product Backlog, Sprint Planning, and Estimation as specified in the Project Planning Template.

5.1 Project Planning:

The project follows an Agile methodology, dividing tasks into two sprints for efficient execution. Each sprint contains a set of user stories, defining specific tasks with assigned priorities and estimated effort in story points.

Product Backlog & Sprint Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection and Integration	USN-1	As a data analyst, I want to integrate global food production data from various sources into power BI.	4	High	1.PreranaKamble. 2.Prachi Vastre. 3.Soundarya Udagatti. 4.Pradnya Mahadik.
	Data Cleaning and Transformation	USN-2	As a data analyst, I want to clean and transform the raw data into a usable format for power BI.	4	High	
	Data Analysis and Trend Identification	USN-3	As a data analyst, I want to identify trends in global food production.	3	High	
	Report and Dashboard design	USN-4	As a data analyst, I want to create a Power BI	5	High	1.Prerana Kamble. 2.Prachi Vastre. 3.Soundarya Udagatti.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2			dashboard that show the global food production trends by country.			4.Pradnya Mahadik.
	Visualization for Insights	USN-5	As a data analyst, I want to create different visualizations.	4	Medium	
Sprint-3	Forecasting and Predictive Analytics	USN-6	As a data analyst, I want to apply forecasting models in Power BI to predict future trends in food production.	5	Medium	1.Prerana Kamble. 2.Prachi Vastre. 3.Soundarya Udagatti. 4.Pradnya Mahadik.
	Data Aggregation and Drill-through	USN-7	As a data analyst, I want to be able to drill down into the data by country ,region, or crop type to gain deeper insights.	4	Medium	
Sprint-4	Final Report and Stakeholder Review	USN-8	As a data analyst, I want to create a final report summarizing the insights and recommendation for global food production trends.	3	Low	1.Prerana Kamble. 2.Prachi Vastre. 3.Soundarya Udagatti. 4.Pradnya Mahadik.
	Final Adjustment's and feedback integration.	USN-8	As a data analyst, I want to incorporate stakeholder feedback into the Power BI reports and dashboards to improve their usefulness.	3	Low	

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	14	10 Days	15 Feb 2025	20 Feb 2025	14	20 Feb 2025
Sprint-2	9	10 Days	21 Feb 2025	28 Feb 2025	9	28 Feb 2025
Sprint-3	20	6 Days	03 Mar 2025	12 Mar 2025	20	12 Mar 2025
Sprint-4	20	2 Days	13 Mar 2025	14 Mar 2025	20	14 Mar 2025

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Total Story Points Completed: 58

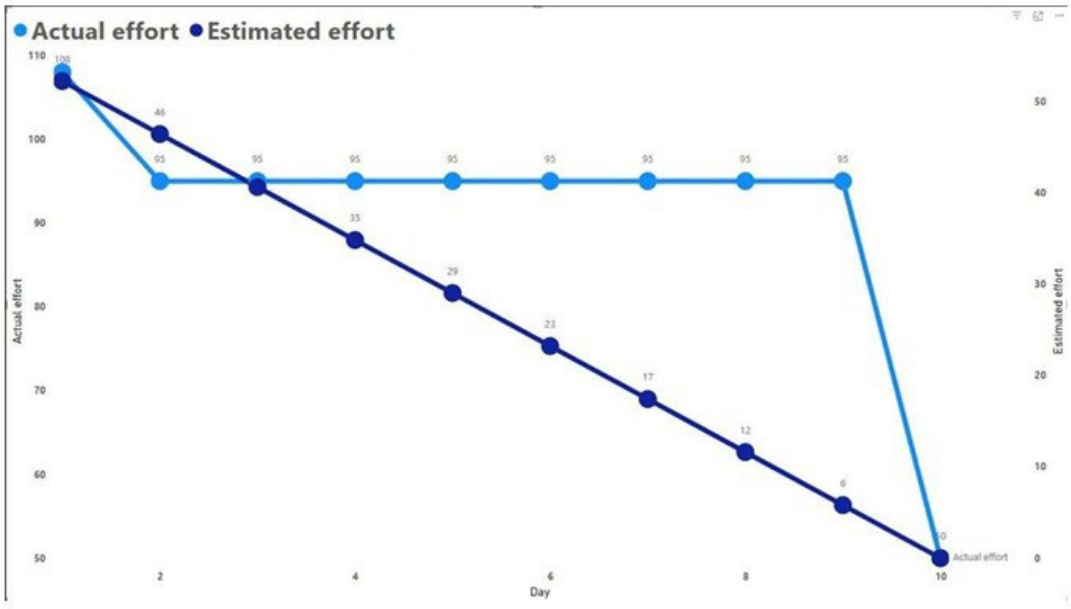
Total Number of Sprints = 4

Velocity = Total Story Points Completed / Number of Sprints Velocity = 58 / 4 ≈ 14.5

Burndown Chart Analysis :

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

Sprint	Day	Total Story Points	Story Points completed	Remaining Story Points
1	1	58	0	58
	2	58	0	58
	3	58	0	58
	4	58	0	58
	5	58	0	58
	6	58	0	58
	7	58	0	58
	8	58	0	58
	9	58	0	58
	10	58	21	37
2	1	58	21	37
	2	58	21	37
	3	58	21	37
	4	58	21	37
	5	58	21	37
	6	58	21	37
	7	58	21	37
	8	58	21	37
	9	58	21	37
	10	58	45	13
3	1	58	45	13
	2	58	58	0



Chapter 6: FUNCTIONAL AND PERFORMANCE TESTING

The Functional and Performance Testing phase ensures that the Power BI Global Food Production Dashboard meets the required performance, accuracy, and usability. This section evaluates the system's ability to handle large datasets, execute DAX queries efficiently, and provide a seamless user experience.

6.1 Performance Testing:

Performance testing was conducted to assess data rendering, preprocessing, filtering, query execution, dashboard responsiveness, and report generation.

Model Performance Testing Summary

S.No.	Parameter	Details
1	Data Rendered	Tables Used: Country-wise-average Table (Columns: 11, Rows: 140) Malnutrition-estimates Table (Columns: 20, Rows: 923)
2	Data Preprocessing	Replaced errors in Survey Sample column with 0. Changed data types for Severe Wasting, Underweight, Overweight, Wasting, Stunting, U5 Population in both tables. Removed null values to improve consistency.
3	Utilization of Data Filters	Filters Used: - Top 10 filter in Line Chart. - Top 5 filter in Clustered Bar Chart.
4	DAX Queries Used	Aggregations & Measures: - Avg_Stunting = AVERAGE('malnutrition-estimates'[Stunting]) - Total_U5_Population = SUM('malnutrition-estimates'[U5

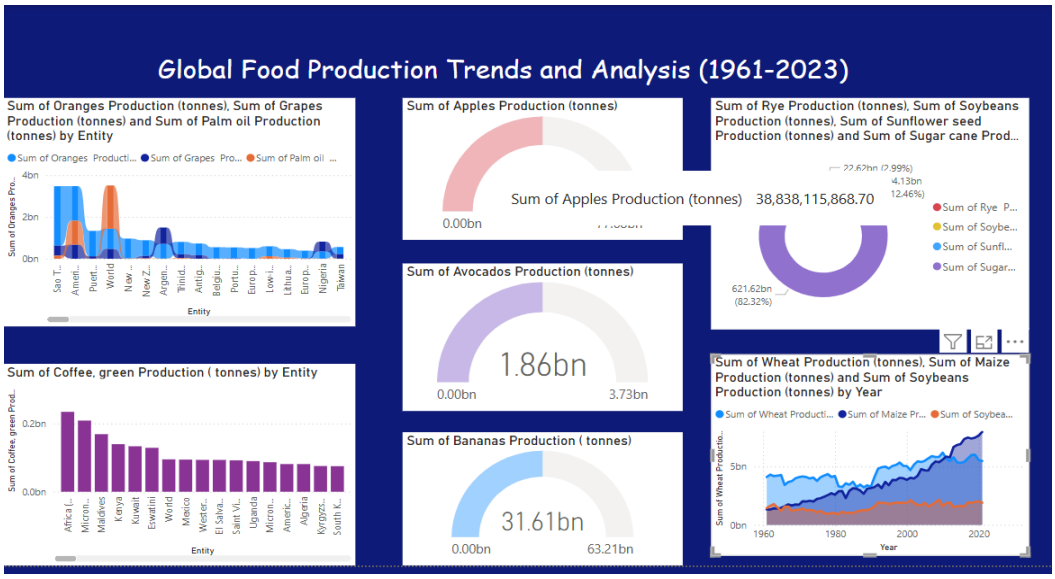
S.No.	Parameter	Details
		Population ('000s)]) - YoY_Stunting_Change = VAR PrevYear = CALCULATE(AVERAGE('malnutrition-estimates'[Stunting]), PREVIOUSYEAR('malnutrition-estimates'[Year])) RETURN AVERAGE('malnutrition-estimates'[Stunting]) - PrevYear - Malnutrition_Severity = IF([Stunting] >= 40, "High", IF([Stunting] >= 20, "Medium", "Low")) - Income_Group = SWITCH([Income Classification], 0, "Low Income", 1, "Lower-Middle Income", 2, "Upper-Middle Income", 3, "High Income")
5	Dashboard Design	No. of Visualizations: - Card – Sum of Overweight - Card – Sum of Stunting - Card – Sum of Underweight - Card – Total_U5_Population - Clustered Bar Chart – Year-wise Stunting Change - Slicer – Year & Country - Line Chart – Top 10 Countries by Average Stunting - Clustered Bar Chart – Stunting, Underweight, and Wasting by Income Classification - Map – World Rate for Malnutrition
6	Report Design	Report includes: - Summary Cards for Key Malnutrition Indicators - Comparison Charts (Year-wise, Country-wise, Income Classification) - Global Malnutrition Map for easy visualization

Performance Optimization Strategies Implemented

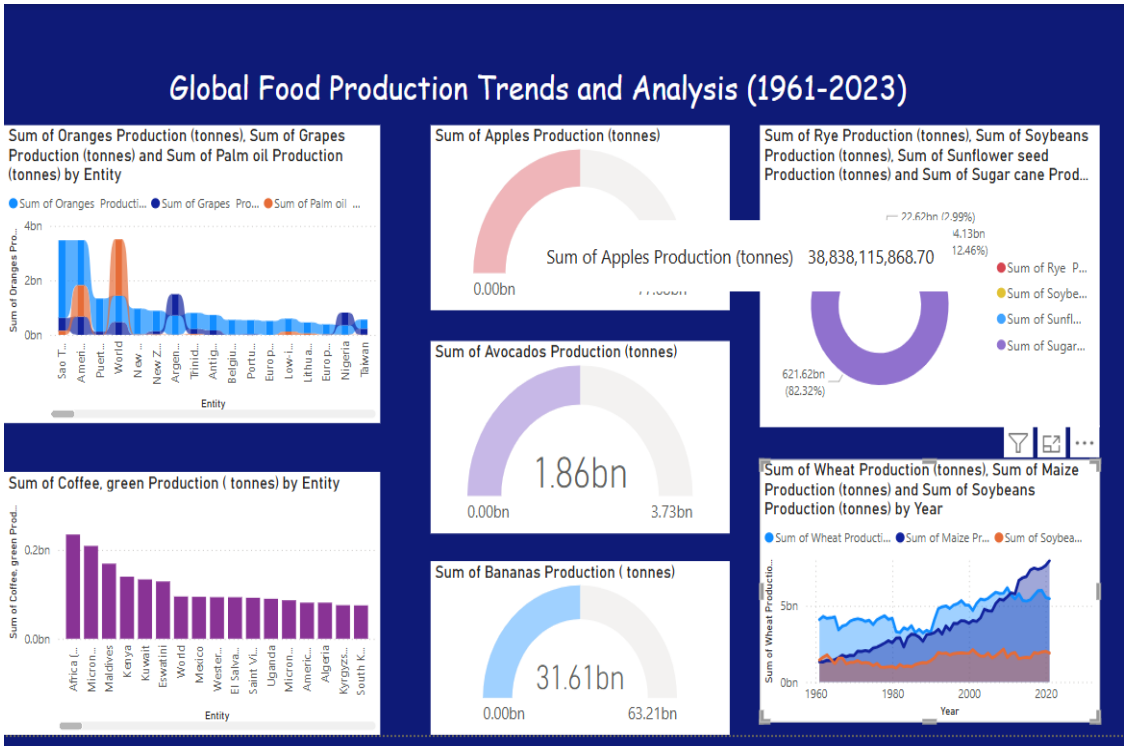
- Data Model Optimization: Removed unnecessary columns, optimized data types.
- DAX Performance Tuning: Used optimized DAX queries to improve calculation speed.
- Filter & Query Optimization: Applied Top N filters for efficient visualization rendering.
- Data Aggregation Techniques: Summarized datasets to improve query execution time.

Chapter 7: RESULTS

7.1 Screenshots of Report and Observations:



7.2 Screenshots of Dashboard and Observations:



Chapter 8: ADVANTAGES & DISADVANTAGES

8.1 **Advantages:**

Advantages:

1. Centralized Data Access**:**

   Provides a single point of access for global food production data, helping stakeholders like governments, NGOs, businesses, and researchers stay informed.

2. Informed Decision-Making**:**

   Facilitates data-driven decisions by offering real-time and historical data. This helps policymakers and businesses plan for food security, resource allocation, and future food production strategies.

3. Tracking Sustainability and Environmental Impact**:**

   Allows users to track the environmental impact of food production, such as greenhouse gas emissions, water usage, and land degradation, promoting more sustainable practices.

4. Identification of Trends**:**

   Helps in identifying global food production trends, such as shifts in crop yields, regional production shifts, and emerging challenges (e.g., climate change effects or pest outbreaks).

5. Early Warning for Food Crises**:**

   Enables early detection of potential food shortages or crises, which could be caused by natural disasters, geopolitical tensions, or other disruptions, allowing for proactive response measures.

6. Improved Resource Management**:**

   Provides insights into how efficiently global resources are being used in food production, helping to optimize agricultural practices and reduce waste.

7. Global Comparisons**:**

   Facilitates cross-country or regional comparisons, enabling policymakers to assess performance and improve food systems globally.

8. Data Transparency**:**

   Improves transparency by providing open access to data about food production, which is crucial for building trust among stakeholders and the public.

8.2 **Disadvantages:**

1. Data Accuracy and Reliability:

   The accuracy and quality of the data presented might be inconsistent, as food production data can vary by region or depend on different reporting standards or systems.

2. Complexity of Interpretation:

   The data can be overwhelming and complex for non-experts to interpret. For effective use, users may need advanced data analytics skills or expert support.

3. Cost and Infrastructure:

   Setting up and maintaining a comprehensive dashboard can be expensive, requiring robust data collection infrastructure and constant updating to keep the data relevant and current.

4. Data Gaps:

   There may be significant data gaps, especially in developing countries where food production data may not be as thoroughly collected or reported. This could skew the global picture.

5. Over-Simplification:

   Aggregated data can sometimes mask critical local issues, such as regional food insecurity or unequal distribution, making it difficult to address specific, localized problems.

Chapter 9: CONCLUSION

A Global Food Production Dashboard is an essential tool for monitoring and analyzing global agricultural trends. Its primary advantages include centralized access to data, informed decision-making, tracking sustainability, and providing early warnings for potential food crises. This allows stakeholders from governments to businesses to respond proactively to emerging challenges in the food production sector.

However, there are notable disadvantages to consider, such as issues related to data accuracy, complexity in interpretation, the cost of infrastructure, and potential data gaps. Additionally, while dashboards provide valuable data, they may not always offer clear, actionable insights, and their effectiveness is highly dependent on the quality of the data and technology available.

Ultimately, a Global Food Production Dashboard can significantly enhance global food systems management, and the ability to transform raw data into meaningful actions.

Chapter 10: FUTURE SCOPE

The future of **Global Food Production Dashboards** is promising, especially with advancements in technology, data analytics, and a growing global focus on food security and sustainability. Here are several areas where the scope of such dashboards can expand:

1. Integration with AI and Machine Learning:

- Future dashboards will likely incorporate artificial intelligence (AI) and machine learning (ML) to enhance data prediction, trend analysis, and early warning systems. This could enable more accurate forecasts of crop yields, pest outbreaks, climate impacts, and other variables, allowing for better planning and resource allocation.

2. Real-time Data and IoT Integration:

- The integration of real-time data from IoT (Internet of Things) sensors in agricultural fields will allow for continuous monitoring of crop health, soil quality, water usage, and weather conditions. This will provide more accurate, granular insights into food production dynamics, especially at a local level.

3. Enhanced Geographic and Regional Customization:

- Dashboards will likely offer better customization for specific regions, considering local agricultural conditions, climate, and socioeconomic factors. This could lead to more actionable and region-specific insights, supporting localized food security strategies and interventions.

4.Blockchain for Transparency and Traceability:

- The integration of blockchain technology could further enhance the transparency and traceability of food production data, ensuring authenticity and reducing fraud. This would benefit food supply chains, allowing consumers and businesses to track the origins and sustainability of their food.

5. Collaboration with Climate and Environmental Data:

- Future dashboards will incorporate more detailed climate and environmental data to understand the broader impacts of climate change on food production. By integrating information like temperature

changes, precipitation patterns, and soil health, dashboards can provide a holistic view of how global food production is being affected by environmental shifts.

6. Personalized and Predictive Alerts:

- Dashboards will evolve to offer more personalized predictive alerts. For instance, farmers could receive region-specific alerts on weather patterns or pest infestations, while governments might get early warnings about potential food shortages in specific areas due to supply chain disruptions or climate impacts.

7. Improved Collaboration Across Sectors:

- The future of these dashboards lies in greater collaboration among governments, private sector organizations, NGOs, and international bodies. This could lead to shared data systems, enabling coordinated responses to global food crises, improved trade and distribution policies, and more efficient global food security efforts.

8. Big Data Analytics and Visualization:

- As data collection expands, dashboards will leverage big data analytics to process vast amounts of information and present it in more intuitive, user-friendly formats. This will make the data more accessible and actionable for a broader range of stakeholders, including policymakers, businesses, and farmers.

9. Addressing Food Waste:

- Future dashboards could focus more on tracking food waste across the supply chain, offering insights on inefficiencies and opportunities for reducing waste. This would be critical in enhancing food security by optimizing the available food supply and minimizing losses.

10. Enhanced Focus on Global Equity and Sustainability:

- There will likely be a stronger emphasis on equity in food production. Future dashboards may include data on global disparities in food access, help identify regions most at risk of food insecurity, and monitor the progress of sustainable agricultural practices globally.

Chapter 11: APPENDIX

Dataset Link :

https://www.kaggle.com/datasets/rafsunahmad/world-food-production

GitHub Link :

https://github.com/PrachiVastre/Global-Food-Producton-Trends-Analysis-A-Comprehensive-Stdy-From-1961-to-2023-Using-Power-BI

Project Demo Link :

https://drive.google.com/file/d/1Mv52CZSWUgo74ICDYm0gIoQyXSjMV0pZ/view