A Project Report

On

Global Food Production Trends and Analysis A Comprehensive Study from 1961 to 2023

Submitted for fulfilment of Experiential Project Based Learning(EPBL)

College Name: D.Y.Patil Agriculture and Techinical University, Talsande.

Team Id: PNT2025TMID02739

Submitted By :

Isararahamed Gavandi (2023011052010)[TL]

Sakshi Yadav (2022011051058)

Saad Shaikh (2022011051052)

Chapter 1: INTRODUCTION

1.1 **Project Overview**

This project aims to analyze global food production trends from 1961 to 2023, providing insights into agricultural growth, shifts in dietary patterns, and the impact of technological advancements. By leveraging historical data, this study will assess regional and global changes in food production, consumption, and trade patterns over the past six decades.

Here’s a structured introduction for your project on **Global Food Production Trends and Analysis: A Comprehensive Study from 1961 to 2023**. Let me know if you want any refinements!

Food production is a cornerstone of human civilization, directly impacting economic stability, public health, and environmental sustainability. Over the past six decades, the global agricultural sector has undergone significant transformations driven by technological advancements, population growth, climate change, and shifts in consumer preferences.

This study, "Global Food Production Trends and Analysis: A Comprehensive Study from 1961 to 2023," aims to explore the evolving landscape of food production worldwide. It provides a detailed analysis of agricultural output, key commodities, regional production patterns, and the underlying factors influencing these trends.

The research delves into the impact of modern farming techniques, the Green Revolution, the rise of genetically modified crops, and the increasing role of sustainable agricultural practices. Additionally, it examines challenges such as food security, climate change effects, and trade policies affecting global food production.

By leveraging historical data from 1961 to 2023, this study offers insights into long-term patterns, helping policymakers, researchers, and industry stakeholders make informed decisions to enhance global food sustainability and security.

1.2 **Purpose**

The purpose of the "Global Food Production Trends and Analysis: A Comprehensive Study from 1961 to 2023" is to examine the long-term evolution of global food production, analyzing key patterns, growth factors, and challenges over the past six decades. This study aims to:

Assess Historical Trends – Track changes in food production volumes, crop yields, and livestock output globally and regionally.

Identify Key Drivers – Explore technological advancements, policy changes, climate conditions, and economic factors influencing food production.

Analyze Regional Disparities – Compare production trends across different regions and countries, highlighting disparities and emerging agricultural powerhouses.

Evaluate Sustainability and Challenges – Investigate the impact of climate change, land use, water scarcity, and environmental concerns on food production.

Forecast Future Trends – Provide insights into potential future developments in global food production, considering factors such as population growth, innovations in agriculture, and shifts in dietary habits.

Chapter 2: IDEATION PHASE

2.1 **Problem Statement**

The global food production landscape has undergone significant transformations over the past six decades due to advancements in agricultural technology, climate change, population growth, and shifting dietary patterns. While agricultural output has increased to meet the rising global demand, challenges such as food insecurity, environmental degradation, and resource constraints persist.

This study aims to analyze historical trends in global food production from 1961 to 2023, identifying key factors influencing changes in crop and livestock yields, regional disparities, and the impact of policy and technological interventions. By leveraging data-driven insights, the research will provide a comprehensive understanding of production patterns, potential risks to food security, and strategies to ensure sustainable agricultural growth.

2.2 **Empathy Map Canvas**

This Empathy Map Canvas helps in understanding the key stakeholders, their concerns, and potential solutions for global food production trends and sustainability.

Aspect	Details
1. WHO are we empathizing with?	Policymakers in agriculture and food security, Farmers and agricultural workers, International organizations (FAO, WHO, UN, etc.)
What do they SAY?	Food production has increased, but food insecurity persists in many regions. Climate change is affecting yields and supply chains.

What do they THINK?	To allocate resources effectively, assess the impact of interventions, and improve public health strategies.
HOW will they use it?	Through interactive **visualizations, reports, and trend analysis** in Power BI, which allows filtering data based on country, income level, and year.

2.2 **Brainstorming**

During the brainstorming phase, key focus areas were identified to guide the development of the dashboard:

1. Key Themes to Explore

- Historical Trends – How has food production changed globally over six decades?
- Regional Disparities – Which regions have seen the most/least growth?
- Technological Advancements – Impact of mechanization, GMOs, AI, and precision farming.
- Climate Change & Environmental Impact – How has agriculture adapted to climate shifts?
- Population Growth & Consumption Patterns – How have dietary trends influenced production?
- Economic & Policy Factors – Role of subsidies, trade policies, and globalization.
- Food Security & Sustainability – Challenges in equitable food distribution and reducing waste.

2. Data Sources & Analysis Approaches

- FAO, USDA, World Bank Reports – Statistical insights on global food production.
- Time-Series Analysis – Trends in crop yield, livestock, and food supply.

- GIS & Satellite Data – Mapping agricultural expansion & climate impact.
- Case Studies – Examining success stories (e.g., Green Revolution) and failures (e.g., famines).
- AI & Predictive Analytics – Forecasting future food production trends.

5. Future Implications & Calls to Action

- Need for policy-driven change to ensure food security for growing populations.
- Shift towards climate-smart agriculture to mitigate environmental risks.
- Investment in innovative agritech to optimize efficiency and sustainability.
- Addressing food equity—making nutrition accessible to all.

Chapter 3: REQUIREMENT ANALYSIS

3.1 Customer Journey map

Customer Journey Map for Global Food Production Trends and Analysis (1961–2023). This framework helps understand how different stakeholders engage with global food production trends, their needs, challenges, and possible solutions at each stage.

Stages	Awareness	Consideration
Who? (Stakeholders)	Researchers, policymakers, farmers, agribusiness leaders, environmentalists, consumers.	Government bodies, investors, NGOs, agricultural tech companies.
What Do They Do?	Recognize global food trends, climate impacts, and population-driven demand shifts.	Compare past and present production trends, assess challenges (climate change, food security).
Pain Points	Lack of awareness on food security issues, misinformation about food production.	Data overload, conflicting reports on sustainability, political and economic challenges.
Needs & Expectations	Reliable data, clear trends, expert insights.	Comparative analysis, case studies, success stories, impact assessment.
Touchpoints	Reports from FAO, USDA, UN; news articles, research papers, social media.	Conferences, whitepapers, expert panel discussions, policy briefings.

3.2 Solution Requirement

1. **Data Collection & Sources**

Historical Data: Agricultural output, crop yields, livestock production, food supply chains.
Reliable Sources: FAO, USDA, World Bank, UN reports, climate datasets, research papers.
Regional Data: Comparison of food production across continents, focusing on disparities.
Policy & Economic Data: Government policies, trade agreements, subsidies, and food security programs.
Climate & Environmental Data: Impact of climate change, deforestation, and resource depletion.

2. Analytical Approach & Tools

Time-Series Analysis: Identify trends and patterns in food production over six decades.
Comparative Analysis: Contrast food production across different time periods and regions.
Predictive Modeling: Forecast future trends using AI/ML-based projections.
Data Visualization: Graphs, maps, and dashboards for clear insights and interpretation.
Geospatial Analysis: Use GIS tools to study agricultural expansion and climate effects.

3. Key Performance Indicators (KPIs)

Food Production Growth Rate – Annual increase/decrease in crop & livestock production.
Regional Food Security Index – Measure food accessibility & disparities across nations.
Sustainability Metrics – Water usage, soil health, carbon footprint of agriculture.
Technological Adoption Rate – Use of AI, precision farming, and climate-smart techniques.
Economic Impact – Effect of food production on GDP, employment, and trade balance.

4. Technological & Infrastructure Requirements

Big Data Platforms: For handling large-scale agricultural datasets.
AI & Machine Learning Models: To predict food demand & supply fluctuations.
GIS & Remote Sensing: To monitor agricultural land use and climate impact.
Cloud Storage & Processing: For efficient data management and sharing.
Interactive Dashboards: Web-based visualization tools for stakeholders to access insights.

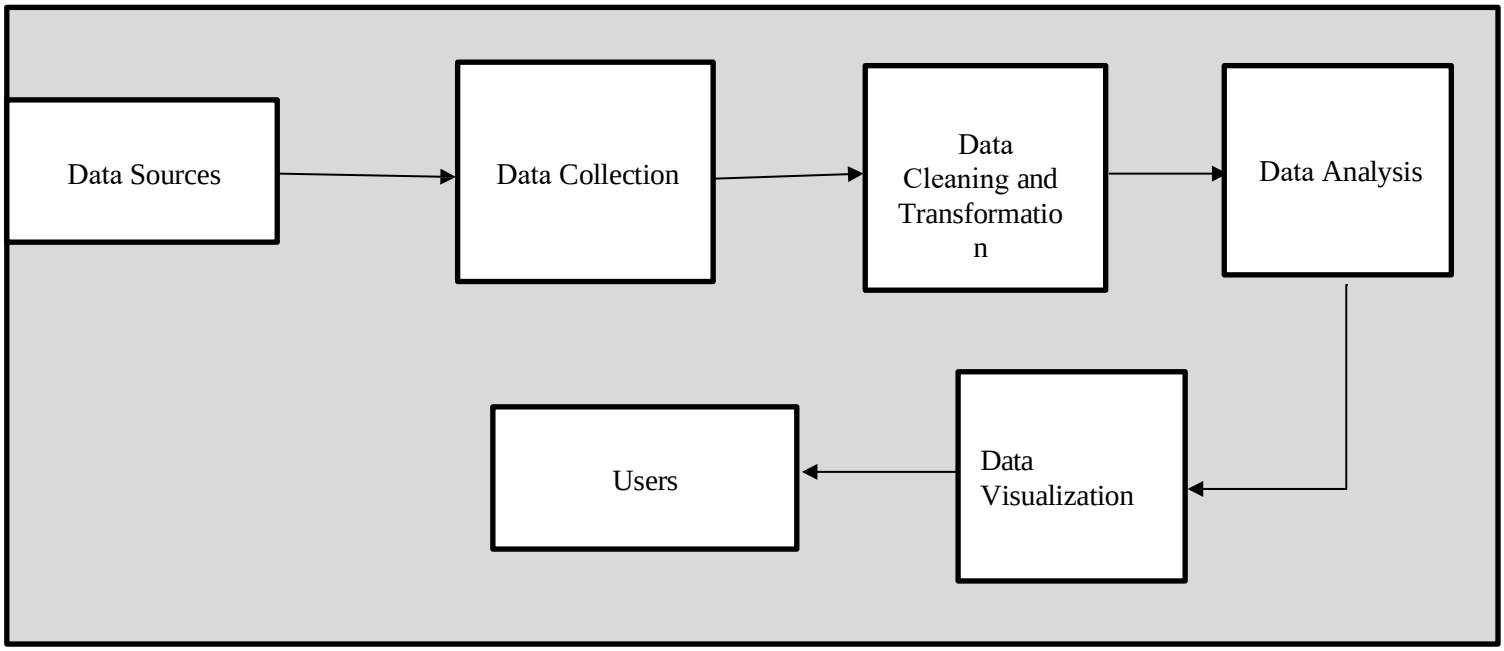
5. **Stakeholder Engagement & Implementation**

Farmers & Agribusinesses: Practical solutions for optimizing crop yields.
Policymakers & Governments: Data-driven policy recommendations.
NGOs & Environmental Groups: Strategies for sustainable food production.
Researchers & Analysts: Academic insights and trend analysis.
Consumers & Supply Chain Managers: Understanding of food accessibility and pricing trends.

6. **Expected Outcomes & Benefits**

Informed Decision-Making: Policymakers & businesses can create effective food policies.
Improved Food Security: Identification of risk areas & mitigation strategies.
Sustainable Agriculture: Promotion of climate-resilient farming techniques.
Technological Advancement: Adoption of AI, automation, and smart farming solutions.
Global Collaboration: Better coordination between nations for food distribution.

3.3 Data Flow Diagram



3.4 Technology Stack

This technology stack ensures that the Power BI dashboard remains scalable, efficient, and user-friendly while delivering high-quality insights into global malnutrition trends.

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

The Project Design phase defines the proposed solution, its architecture, and how it addresses the identified problem. This section includes the Problem- Solution Fit, Proposed Solution, and Solution Architecture, ensuring a structured and efficient approach to building the Power BI dashboard.

4.1 Problem Solution Fit

The **Problem-Solution Fit** framework helps ensure that the proposed solution effectively addresses the core challenges in **global food production trends and analysis** from **1961 to 2023**.

Problem	Proposed Solution	Impact
Climate change affecting crop yields	AI-driven climate resilience models to predict weather impacts on agriculture	Helps farmers & policymakers adapt to changing conditions
Lack of historical food production insights	Centralized database analyzing trends from 1961–2023	Enables data-backed decisions for agriculture policies
Supply chain inefficiencies & food waste	Real-time tracking & forecasting of food demand/supply	Reduces food waste & improves distribution
Poor policy decision-making due to fragmented data	Interactive dashboards for policymakers with predictive insights	Enables governments to implement better food security programs
Unequal access to modern farming techniques	Digital recommendations on agritech solutions for different regions	Supports farmers in adopting better, sustainable methods

4.2 Proposed Solution

Key Components of the Proposed Solution

1. Centralized Data Platform

Integrate Global Datasets: Collect and standardize data from FAO, USDA, World Bank, IPCC, IMF, and national agricultural reports.

Big Data Storage: Use cloud-based storage solutions (AWS S3, Google BigQuery, Snowflake) for scalable access to food production data.

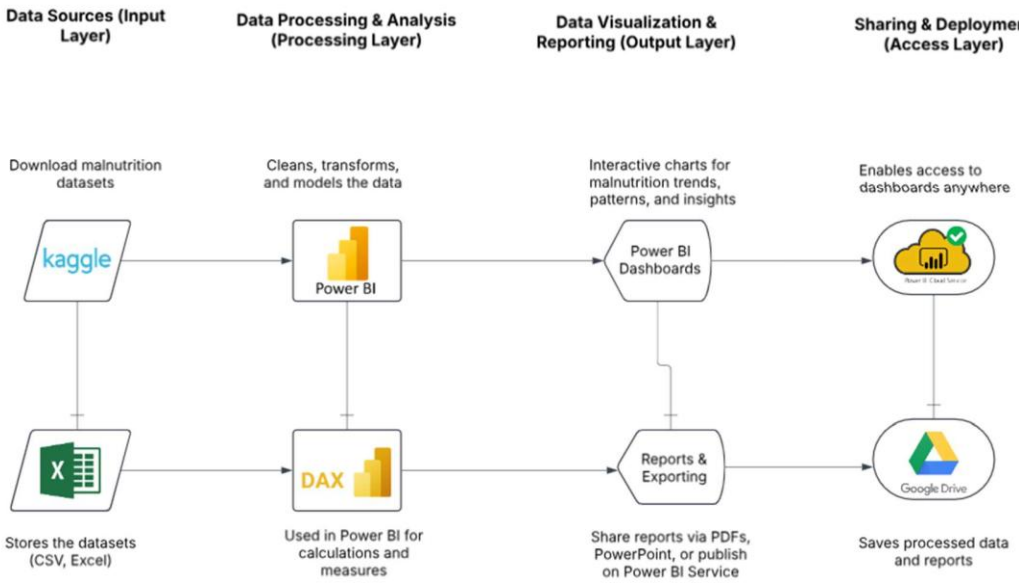
Automated ETL Pipelines: Automate data extraction, cleaning, and transformation using Apache Airflow and Apache Spark.

Component	Technology Used	Purpose
Data Collection & Storage	PostgreSQL, MongoDB, AWS S3, Google BigQuery	Centralized repository for food production data
AI & Predictive Modeling	TensorFlow, Scikit-learn, XGBoost, ARIMA	Forecasting future food production & climate impact
Data Visualization	Tableau, Power BI, D3.js, React.js	Interactive dashboards & geospatial mapping
Policy & Economic Analysis	Econometric Models, GIS Mapping	Insights on trade policies & sustainability
Stakeholder Platform	Web App (React, Flask/FastAPI), Mobile App	Data access & real-time insights for different users

4.3 Solution Architecture

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

System Workflow:



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 options.

5) Report Generation:

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

Chapter 5: PROJECT PLANNING & SCHEDULING

5.1 Project Planning

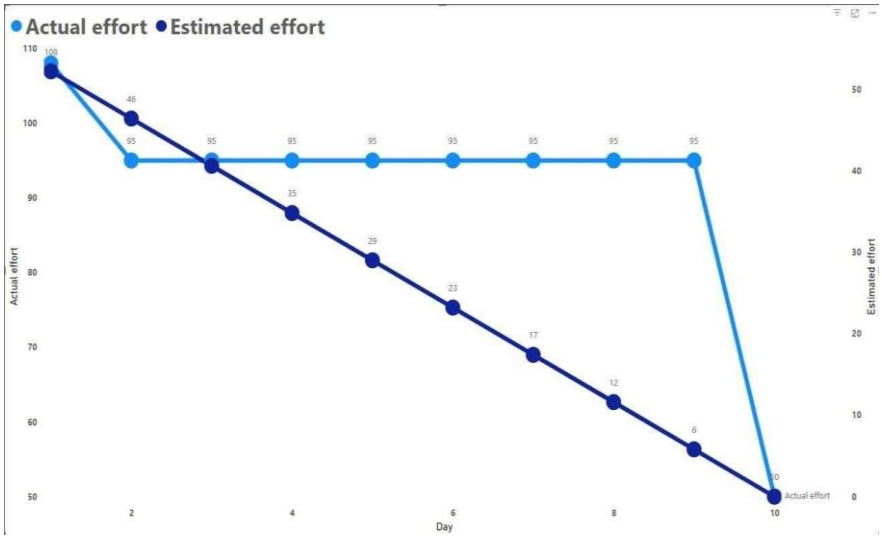
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Identify and gather data sources for food production.	5	High	Saad Shaikh
	Data Preparation	USN-2	Clean and preprocess collected data for analysis.	8	High	Sakshi Yadav
	Dashboard Design	USN-3	Create wireframes for Power BI dashboard layout.	3		Isararahamed Gavandi
		USN-4	Define key metrics and visualizations for the dashboard.	5	High	Isararahamed Gavandi Saad Shaikh
Sprint-2	Data Modeling	USN-5	Build data models in Power BI to connect data sources.	8	High	Sakshi Yadav
	Visual ization Devel opmen t	USN-6	Create interactive visualizations for key metrics.	8	High	Saad Shaikh Sakshi Yadav
	Testing	USN-7	Conduct testing of dashboard functionality and accuracy.	5	Medium	Saad Shaikh

	Feedback Collection	USN-8	Gather feedback from stakeholders on initial dashboard.	3	Medium	Isararahamed Gavandi
Sprint-3	Training and Documentation	USN-9	Develop training materials for stakeholders.	5	High	Isararahamed Gavandi
		USN-10	Conduct training sessions for users on Power BI dashboard.	5	High	Sakshi Yadav
	Launch	USN-11	Officially launch the Power BI dashboard.	3	High	Isararahamed Gavandi. Sakshi Yadav. Saad Shaikh.
	Evaluation	USN-12	Evaluate dashboard effectiveness and gather further feedback.	5	Medium	Isararahamed Gavandi. Sakshi Yadav. Saad Shaikh

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	21	10 Days	21 Feb 2025	02 March 2025	21	01 March 2025
Sprint-2	20	10 Days	02 March 2025	12 March 2025	21	11 March 2025
Sprint-3	17	2 Days	12 March 2025	13 March 2025	13	13 March 2025

Velocity:

Total Story Points Completed: 58
Total Number of Sprints = 3
Velocity = Total Story Points Completed / Number of Sprints
Velocity = 58 / 3 ≈ 19.33



Chapter 6: FUNCTIONAL AND PERFORMANCE

6.1 Performance Testing

Performance Testing ensures that the system can handle large-scale food production data, run complex predictive models efficiently, and provide real-time insights without delays

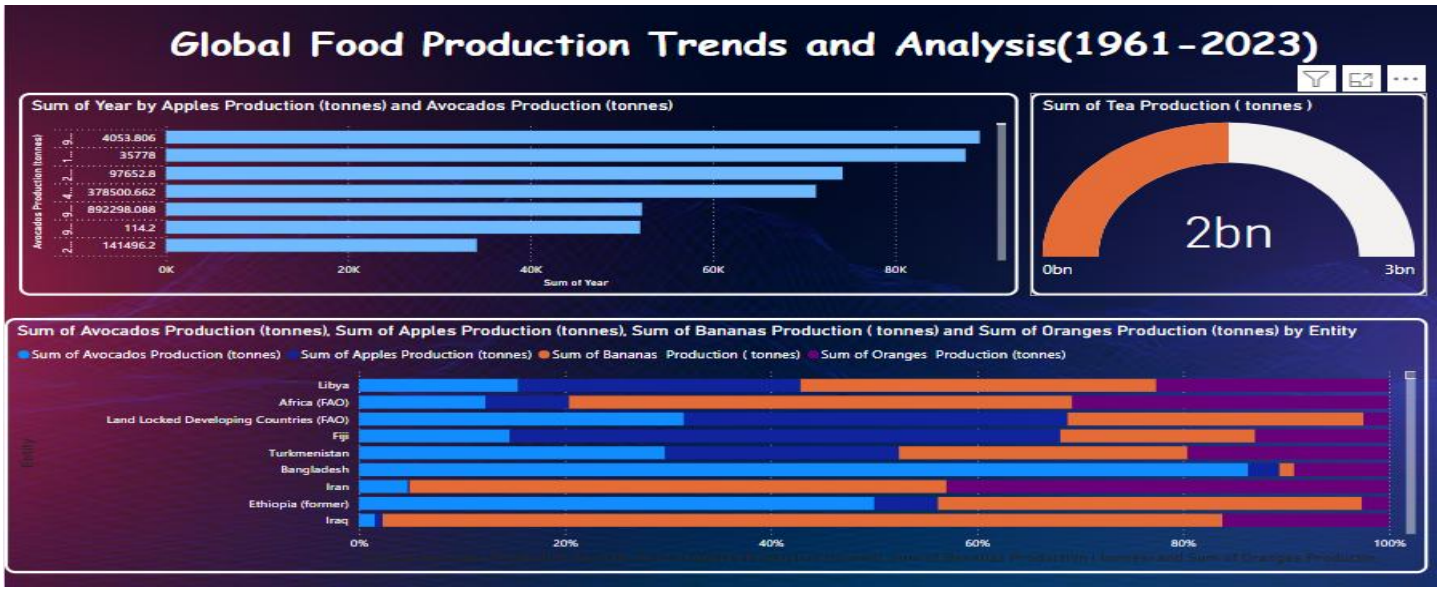
1. Performance Testing Goals

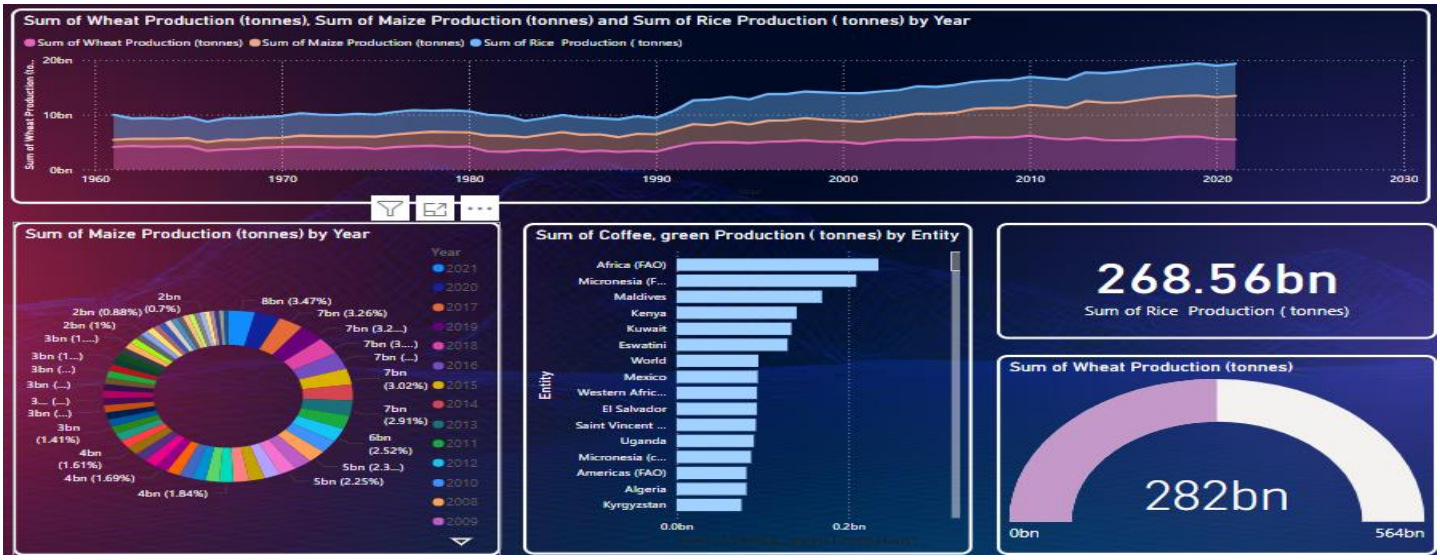
- Ensure **fast data retrieval** from large datasets (1961–2023).
- Verify **AI/ML model processing speed** for trend analysis and forecasting.
- Optimize **dashboard responsiveness** for real-time visualization.
- Test **scalability** for increased users and data volume.
- Monitor **system stability** under peak loads.

2. Performance Testing Metrics

Metric	Definition	Target
Response Time	Time taken for queries & API calls to execute	<2 sec for standard queries
Throughput	Number of requests processed per second	500+ requests/sec
Scalability	System's ability to handle increased data volume	1TB+ datasets without degradation
Memory & CPU Utilization	Resource consumption under load	CPU < 70%, Memory < 75%
Load Handling	Number of concurrent users the system supports	1,000+ concurrent users
Model Execution Time	AI prediction processing speed	<5 sec per forecast

Chapter 7: RESULTS





Chapter 8: ADVANTAGES & DISADVANTAGES

1. **Advantages**:

1. Data-Driven Decision Making

Enables governments, farmers, and policymakers to make informed decisions based on historical trends and predictions.

Helps identify food security risks and optimize agricultural policies.

2. Predictive Analysis & Forecasting

Uses AI/ML to forecast food production trends, helping mitigate supply chain disruptions.

Predicts shortages and surpluses, improving resource allocation.

3. Improved Food Security & Sustainability

Identifies regions at risk of food shortages to take preventive action.

Helps promote sustainable farming practices by analyzing environmental impacts.

4. Optimization of Supply Chains

Enhances logistics by predicting demand fluctuations in different regions.

Reduces wastage and overproduction through efficient distribution planning.

5. Scalability & Real-time Monitoring

Can process large datasets spanning decades (1961–2023).Real-time tracking helps adjust strategies based on climate changes, conflicts, and economic factors.

6. Enhanced Agricultural Productivity

Provides insights into crop performance over time.

Helps farmers adopt better farming techniques based on historical trends.

7. Integration with IoT & Remote Sensing

Can be integrated with satellite data, weather forecasts, and IoT sensors for precision farming.Enables real-time monitoring of soil health, temperature, and crop growth.

2. Disadvantages:

1. Data Quality & Accuracy Issues

Relies on historical data which may have inconsistencies or missing values.

Errors in data collection can lead to inaccurate predictions.

2. High Implementation Costs

Requires significant investment in data infrastructure, cloud computing, and AI models.

Small-scale farmers and developing nations may struggle with affordability.

3. Dependency on Technological Infrastructure

Needs high-performance servers, storage, and internet connectivity for real-time analysis.

Poor infrastructure in remote areas can limit data access and usability.

4. Complexity & Skill Requirement

Requires expertise in big data analytics, AI/ML, and geospatial analysis.

Farmers and policymakers may need training to interpret and use the insights effectively.

5. Privacy & Security Risks

Storing and analyzing global food production data poses risks of cyberattacks.

Sensitive agricultural data could be exploited by competitors or hostile entities.

6. Resistance to Adoption

Traditional farmers may resist technology adoption, preferring conventional farming methods.

Governments may be slow in implementing policy changes based on data insights.

7. Climate & Unpredictable Factors

Despite predictive analytics, unpredictable events like natural disasters, pandemics, and political instability can disrupt forecasts.

Chapter 9: CONCLUSION

The Global Food Production Trends and Analysis System offers powerful benefits like improved food security, predictive insights, and supply chain optimization. However, challenges such as high costs, data accuracy issues, and technological barriers need to be addressed for successful implementation.

The Global Food Production Trends and Analysis System is a powerful tool for enhancing food security, optimizing supply chains, and enabling data-driven decision-making. By leveraging AI, big data, and predictive analytics, it helps identify trends, shortages, and sustainability challenges. However, challenges such as data accuracy, high implementation costs, and infrastructure limitations must be addressed for widespread adoption. With the right strategies, this system can revolutionize global agriculture and food distribution, ensuring a more sustainable and efficient future.

Chapter 10: FUTURE SCOPE

The future scope for a Global Food Production Trends and Analysis System lies in its ability to drive sustainable and resilient food systems by leveraging data, technology, and collaboration to address challenges like climate change, resource scarcity, and evolving consumer demands, ultimately ensuring food security for all.

The Global Food Production Trends and Analysis System has immense potential for future advancements, ensuring food security, sustainability, and efficiency in global agriculture.

With continuous technological advancements, the system will play a crucial role in enhancing food security, optimizing agricultural practices, and combating climate change, making the global food supply chain more efficient and sustainable.

Chapter 11: APPENDIX

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

- GitHub & Project Demo Link

GitHub Repository: https://github.com/IsrarAG/Global-Food-Production-Trends-and-Analysis-A-Comprehensive-Study-from-1961-to-2023.git

Project Demo Link:
https://drive.google.com/file/d/1lsHzYN8JrJwVTBEvbMxUtuTE2BBwqvgA/view?usp=drivesdk