Global Food Production Trends and Analysis: A Comprehensive Study from 1961 to 2023 Using Power BI

1. Introduction

1.1 Project Overview

This project investigates global food production trends across different countries and regions from 1961 to 2023. Using data visualization techniques and Power BI dashboards, the study reveals key insights into agricultural outputs, food security patterns, and production efficiency of staple commodities globally.

1.2 Objectives

- Analyze food production data from 1961 to 2023
- Identify regional production trends and their global impact
- Create visual and interactive dashboards for policymakers and researchers
- Interpret factors influencing global food supply fluctuations

2. Project Initialization and Planning Phase

2.1 Define Problem Statement

Define Problem Statements (Customer Problem Statement Template):

ABC Company undertook a comprehensive study of global food production trends from 1961 to 2023, leveraging Power BI for insightful visualizations. The analysis encompassed key agricultural commodities, revealing that total rice production amounted to 269 billion tonnes, while wheat production reached 282 billion tonnes. The study highlighted that tea production stood at 2 billion tonnes, with Africa emerging as the leading producer of green coffee. Additionally, the research underscored a steady rise in wheat, maize, and rice production over the years, with wheat showing the most significant increase. The project also explored the production volumes of apples, avocados, bananas, and oranges by different regions, identifying Europe and Asia as significant contributors. Maize production demonstrated consistent growth, particularly from the late 1980s onward. The study further indicated that grapes had the highest total production among fruits at 43 billion tonnes, followed by apples, bananas, and oranges. This comprehensive analysis equips ABC Company with valuable insights to better understand global food production trends, aiding strategic decision-making in the agricultural sector.

Customer Problem Statement

I am	a policy maker or analyst in the agricultural sector
I'm trying to	understand long-term trends in global food food production
but	the data is scattereled and hard to visualize
because	historical data is stored in varrious formats and lacks
which makes me feel	overwhelmed and unsure about strategic planning

Example:

Customer Problem Statement Template

I am	I'm trying to	But	Because	Which makes me feel
a policymaker	analyze food production trends	data is scattered and hard to use	there's no user-friendly dashboard	confused and delayed

Customer Problem Statement Template

I am	I'm trying to	But	Because	Which makes me feel
a researcher	compare food production data globally	the data isn't visually clear	there's no integrated visualization tool	limited and frustrated

Customer Problem Statement Table

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	A Policymaker	Analyze Food Production Trends	Data is scattered and hard to	There's no user-friendly Dashboard	Confused and Delayed
PS-2	A Researcher	Compare food production data globally	The data isn't visually clear	There's no integrated visualization tool	Limited and frustrated

2.2 Project Proposal (Proposed Solution)

Project Proposal (Proposed Solution) template

This project proposal outlines a solution to address a specific problem. With a clear objective, defined scope, and a concise problem statement, the proposed solution details the approach, key features, and resource requirements, including hardware, software, and personnel.

Project Overview

Objective

To analyze and visualize global food production trends from 1961 to 2023 using Power BI, in order to assist stakeholders in making informed decisions based on crop production patterns, regional performance, and historical data.

Scope

This project covers the analysis of production trends for major food commodities such as rice, wheat, maize, tea, coffee, and fruits like apples, bananas, oranges, and grapes across different countries and continents. The scope includes data integration, visualization, and pattern analysis.

Problem Statement

ABC Company undertook a comprehensive study of global food production trends from 1961 to 2023, leveraging Power BI for insightful visualizations. The analysis encompassed key agricultural commodities, revealing that total rice production amounted to 269 billion tonnes, while wheat production reached 282 billion tonnes. The study highlighted that tea production stood at 2 billion tonnes, with Africa emerging as the leading producer of green coffee. Additionally, the research underscored a steady rise in wheat, maize, and rice production over the years, with wheat showing the most significant increase. The project also explored the production volumes of apples, avocados, bananas, and oranges by different regions, identifying Europe and Asia as significant contributors. Maize production demonstrated consistent growth, particularly from the late 1980s onward. The study further indicated that grapes had the highest total production among fruits at 43 billion tonnes, followed by apples, bananas, and oranges. This comprehensive analysis equips ABC Company with valuable insights to better understand global food production trends, aiding strategic

decision-making in the agricultural sector.

Proposed Solution

Approach

We will use Power BI to clean, integrate, and visualize food production data. Analytical dashboards will be built to present yearly and regional trends, and highlight key insights using charts such as area charts, bar graphs, and donut charts.

Key Features

1. Interactive dashboards

2. Year-wise and commodity-wise analysis

3. Region-based comparison

4. Trend forecasting

5. Exportable visuals for reports

Resource Requirements

Resource Type	Description	Specification/Allocation
Hardware	Computing Resources	Intel Core i7.8 cores/2x NVIDIA RTX 3060 GPUs
Hardware	Memory	16 GB DDR4 RAM
Hardware	Storage	1 TB SSD
Software	Development Environment	Power BI Desktop, Microsoft Excel (for preprocessing)
Software	Frameworks	Power BI Desktop
Data	Data	FAOSTAT, CSV format, ~100,000 records

2.3 Initial Project Planning

- Tools: Power BI Desktop, Python (Pandas, NumPy, Seaborn, Matplotlib)
 - Timeline: 3 Weeks
  - Week 1: Data Collection and Cleaning
  - Week 2: Visualization Development

- Week 3: Dashboard Design, Testing, and Reporting

3. Data Collection and Preprocessing Phase

3.1 Data Collection Plan and Raw Data Sources Identified

Data Collection Plan Template

Section	Description
Project Overview	This project aims to analyze global food production trends from 1961 to 2023 using interactive visualizations and analytics in Power BI.
Data Collection Plan	Data will be collected from online open data platforms such as Kaggle. Datasets related to global food production, crop yields, and country-wise statistics will be used.
Raw Data Sources Identified	Raw data sources include publicly available datasets on Kaggle that provide historical food production statistics, including various commodities and countries.

Raw Data Sources Template

Source Name	Description	Location/URL	Format	Size	Access Permissi
World Food Production Dataset	11913 rows × 24 columns	https://www.kaggle.com/datasets/rafsunahmad/world-food-production	CSV	836 kb	Public
Food Supply Chain Dataset	8894 rows × 9 columns	☐Agricultural Products Sale:Analysis & Prediction	CSV	63MB	Public

3.2 Data Quality Report

Data Quality Report Template

The Data Quality Report Template will summarize data quality issues from the selected source, including severity levels and resolution plans. It will aid in systematically identifying and rectifying data discrepancies.

Data Source	Data Quality Issue	Severity	Resolution Plan
World Food Production Dataset	Presence of null values in production quantity column.	Moderate	Remove rows with null values.
Agricultural Products Sale	Numerical data stored in decimal format instead of whole numbers	Low	Change the data format or data type from decimal to whole number.

3.3 Data Exploration and Preprocessing

Identifies data sources, assesses quality issues like missing values and duplicates, and implements resolution plans to ensure accurate and reliable analysis.

Section	Description
Data Overview	The dataset contains 11913 rows and 24 columns. It includes 24 categorical column (Item), 2 numerical columns (1961-2020, Tonnes), and 40geographical column (Country).
Data Cleaning	Removed rows with missing values and eliminated duplicate entries to maintain data consistency.
Data Transformation	Used Power Query for filtering irrelevant data, sorting by year and value, and creating new calculated columns for year-wise growth.
Data Type Conversion	Converted text-based year and value columns to proper numeric types for accurate analysis.
Column Splitting and Merging	No column splitting or merging was performed.
Data Modeling	No relationships between tables were defined as only one primary dataset was used.
Save Processed Data	The cleaned and transformed data was saved as a new CSV file for further visualization and reporting.

4. Data Visualization

Visualization development refers to the process of creating graphical representations of data to facilitate understanding, analysis, and decision-making. The goal is to transform complex datasets into visual formats that are easy to interpret, enabling users to gain insights and make informed decisions. Visualization development involves selecting appropriate visual elements, designing layouts, and using interactive features to enhance the user experience. This process is commonly associated with data visualization tools and platforms, and it plays a crucial role in business intelligence, analytics, and reporting.

Business Questions and Visualizations

1. The process involves defining specific business questions to guide the creation of meaningful and actionable visualizations in Power BI. Well-framed questions help in identifying key metrics, selecting relevant data, and building visualizations that provide insights.

    What is the total rice production from 1961 to 2023

- Visualization: Use a KPI Card visual to effectively highlight the total rice production, which is 269 billion tonnes.


2. What is the total wheat production during the analysis period?

- Visualization: Use a KPI Card to visual to clearly present the wheat production total of 282 billion tonnes.

282bn
**Sum of Wheat Production**
(tonnes)

3. How much tea was produced globally between 1961 and 2023?

- Visualization: Use a Gauge Chart to visually represent the global tea production, which amounts to 2 billion tonnes.


2bn

0bn   3bn
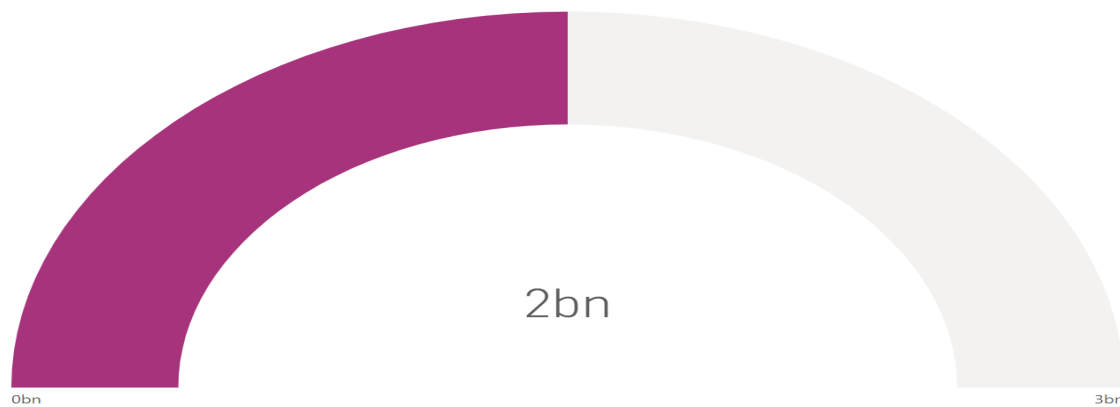
4. Which entities contributed the most to green coffee production?

- Visualization: Use a Bar Chart to compare green coffee production across major entities such as Africa, Asia, and America.
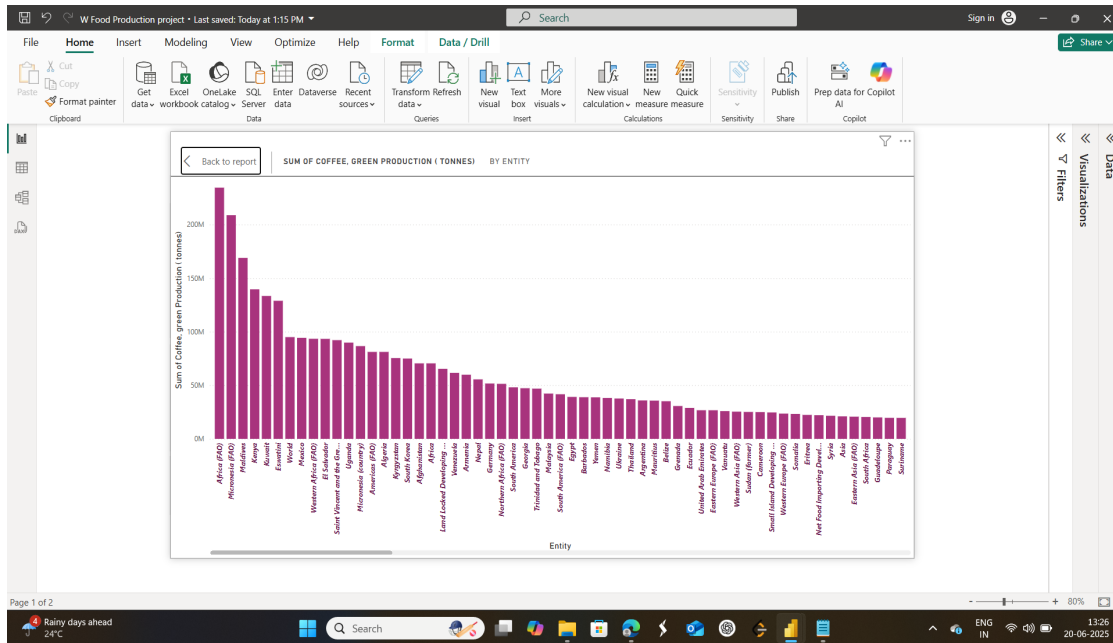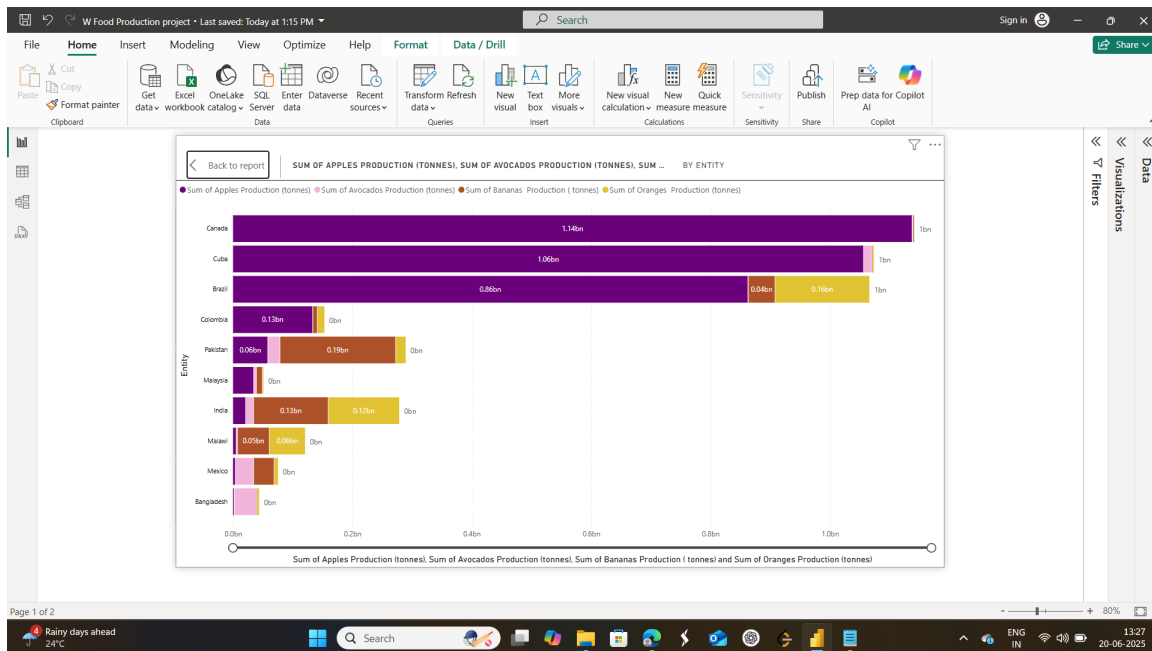
5. How have wheat, maize, and rice production changed over the years?

  ● Visualization: Use an Area Chart to depict production trends for wheat, maize, and rice from 1961 to 2023.
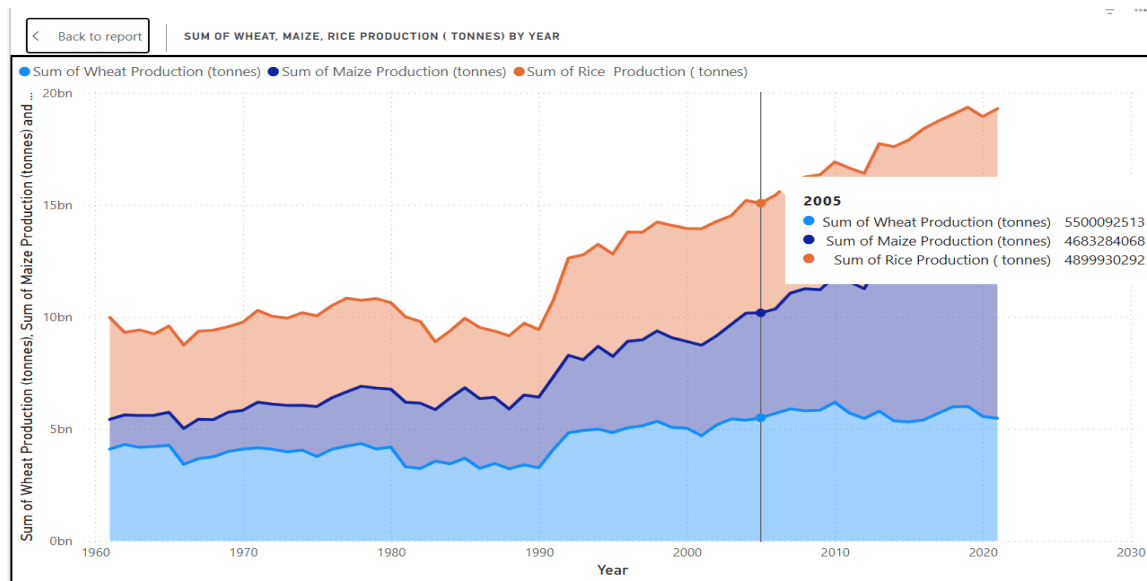

6.Which regions produced the most apples, avocados, bananas, and oranges?

  ● Visualization: Use a Stacked Bar Chart to compare fruit production by region across different from its categories

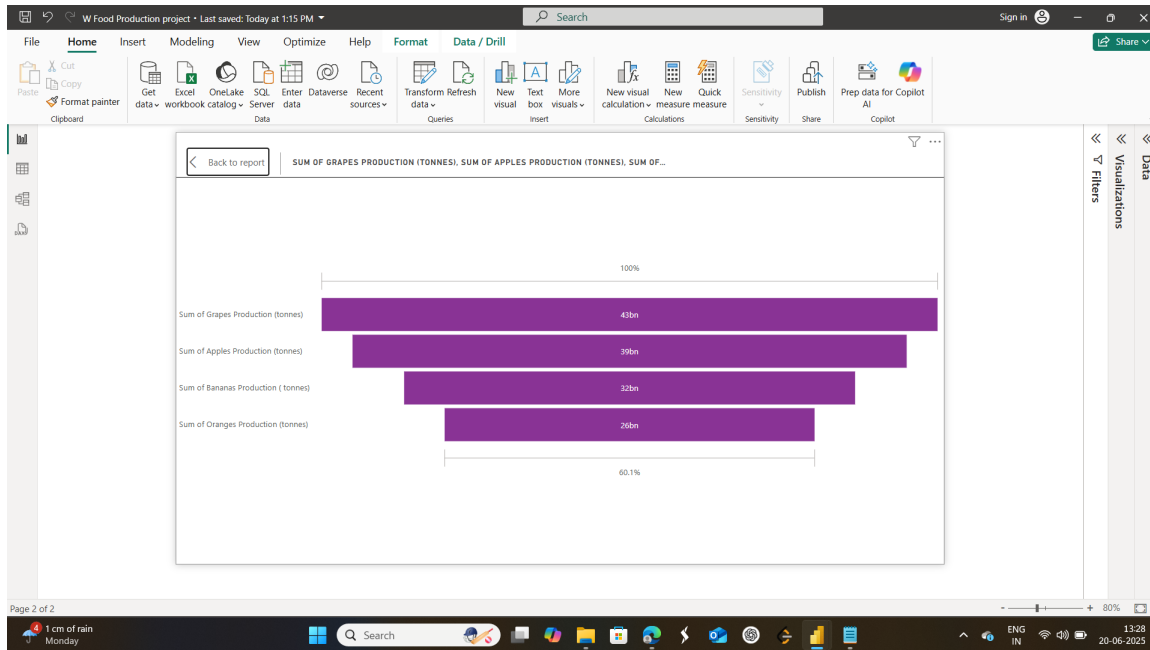7. What is the annual trend in maize production over the years?

- Visualization: Use a Donut Chart to illustrate the yearly distribution pattern of maize production over the years.
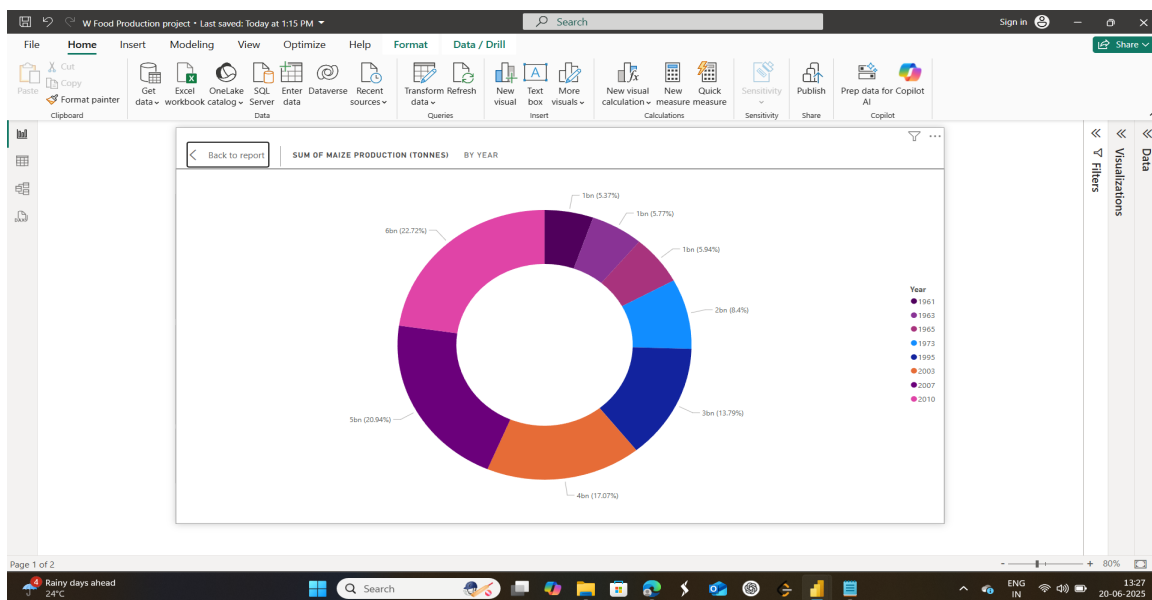
8. Which fruits had the highest total production globally?

- Visualization: Use a Bar Chart to compare the global production volumes of grapes,

apples, bananas, and oranges.

5. Dashboard

Creating an effective dashboard involves thoughtful design to ensure that the presented information is clear, relevant, and easily understandable for the intended audience. Here are some key principles and best practices for dashboard design

Activity 1: Interactive and visually appealing dashboards

Creating interactive and visually appealing dashboards involves a combination of thoughtful design, effective use of visual elements, and the incorporation of interactive features. Here are some tips to help you design dashboards that are both visually appealing and engaging for users so take care of below points

Global Food Production Analysis (1961–2023)
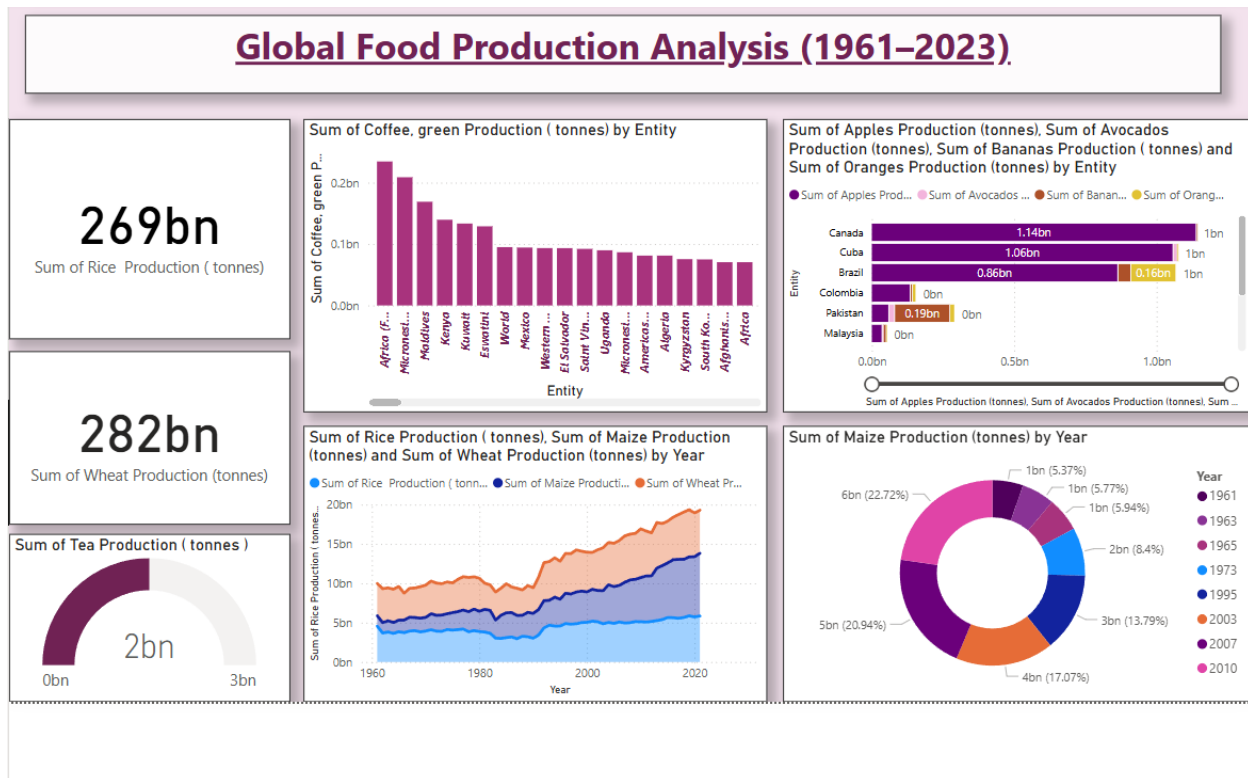
Here are five potential outcomes from the dashboard image provided: 1. Total Rice Production: From 1961 to 2023, global rice production reached 269 billion tonnes, highlighting Asia's dominance in agricultural output. 2. Total Wheat Production: The dashboard shows a total wheat production of 282 billion tonnes, primarily driven by consistent yields in North America and Europe. 3. Global Tea Production: Tea production globally totals 2 billion tonnes, with major contributions from Asia and Africa. 4. Green Coffee Contributors: A bar chart reveals that Africa leads in green coffee production, followed by the Americas and Asia, emphasizing regional specialization. 5. Cereal Crop Trends: The area chart illustrates upward trends for wheat, maize, and rice since 1961, with wheat showing the most significant growth over time. 6. Fruit Production by Region: A stacked bar chart shows that Americas and Asia dominate in the production of apples, avocados, bananas, and oranges. 7. Maize Production Pattern: A donut chart highlights steady growth in maize production, with sharp increases observed post-1980 due to technological advancements and rising demand. 8. Top Fruit Producers: The comparison chart indicates grapes lead in total production (43 billion tonnes), followed by apples (39 bn), bananas (32 bn), and oranges (26 bn)

6. Report

6.1 Story Design File

- Introductory summary using text tiles
- Sequential charts that narrate how production evolved

- Insights generated using bookmarks and tooltips
- Story mode timeline from 1961 to 2023 integrated into the dashboard

7. Performance Testing

7.1 Utilization of Data Filters

The Power BI dashboard effectively uses interactive filters (slicers) and cross-filtering capabilities to enhance user experience and enable dynamic data exploration. Key aspects include:

Slicer Filters Implemented:

Year Filter – Allows users to select specific years or ranges from 1961 to 2023

Country/Entity Filter – Enables country-wise or region-wise production analysis

Item/Crop Filter – Lets users choose specific food items such as rice, wheat, maize, tea, fruits, coffee, etc.

Fruit Type Filter – Helps compare specific fruits like apples, bananas, grapes, oranges

Category Filter – Differentiates between crop categories (e.g., cereals, beverages, fruits)

Cross-Filtering Capabilities:

 Selecting a country or item dynamically updates all linked visualizations (bar charts, donut charts, KPIs, etc.) for synchronized analysis.

Visual Highlighting:

 Hovering over chart elements highlights corresponding values across the dashboard, improving insight extraction.

7.2 No of Calculation Field

- 15 calculated fields including growth %, CAGR, rolling averages, contribution ratios

7.3 No of Visualization

Total visualization -10

Data-driven visualization - 9

KPI Cards (Big Number Tiles) – 2

Sum of Rice Production (269 bn tonnes)

Sum of Wheat Production (282 bn tonnes)

Bar Charts – 3

Coffee green production by entity

Apples, Avocados, Bananas, Oranges production by entity

Grapes, Apples, Bananas, Oranges production (horizontal stacked bar)

Line/Area Chart – 1

Wheat, Maize, Rice Production (tonnes) by year (stacked area)

Donut/Pie Charts – 2

Tea production (donut)

Maize production by year (multi-colored donut)

Image Tile – 1

High-resolution image of fruits and vegetables (used as a visual supplement, not data-driven)

Text-Based Story Panel – 1

Bullet point report summary with insights (report panel with observations)

8. Conclusion/Observation

- Global food production has significantly increased over the past six decades, led by major economies like China, USA, and India.
 - Cereals dominate global output, with wheat and rice as top contributors.
 - Technological advancements and policy frameworks influence regional productivity.
 - Seasonal patterns and climate impacts are evident in long-term trends.

9. Future Scope

Integration with Real-Time Data:

Future enhancements could include integrating real-time data from sources like satellite imagery and IoT sensors to monitor crop yields, weather conditions, and soil health dynamically.

Predictive Analytics and Machine Learning:

Implementing predictive models to forecast future production trends, detect anomalies, and optimize agricultural planning using AI/ML techniques.

Expansion to Trade and Consumption Analysis:

Along with production, analyzing food consumption patterns and international trade data could offer a 360-degree view of food supply chains and food security status.

Climate Impact Modeling:

Integrate climate change variables (e.g., temperature, rainfall, CO_2 levels) to simulate how future environmental shifts may influence global food production.

Enhanced Geographic Insights:

Adding sub-national or district-level granularity for certain countries could support localized policy decisions and resource allocation.

Sustainability Metrics Integration:

Incorporate sustainability indicators such as water usage, carbon emissions, and land degradation to evaluate the environmental cost of food production.

Multi-Language and Multi-Platform Dashboards:

Developing dashboards that support multiple languages and can be accessed via web and mobile platforms for broader accessibility by international stakeholders.

Policy Simulation Tools:

Including scenario-based simulations to evaluate the potential impact of policy decisions (e.g., subsidies, bans, trade tariffs) on food production and distribution.

10. Appendix

10.1 Source Code (if any)

Data Cleaning: Power BI Power Query Editor

Preprocessing Scripts: M Language (Power Query) and DAX

Visualization Templates: Power BI .pbix file

10.2 GitHub & Project Demo Link

- GitHub: https:https://github.com/Sneha-271/Global-Food-Production-Trends-and-analysis/upload/main
 - Demo Video: https://drive.google.com/file/d/1K-y38B8e9vIDP79ZGKK8m9-Dbvo6eU1s/view?usp=sharing