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

1. Introduction:

1.1 Project overviews

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.

1.2. Objectives

Scenario 1: Sum of Rice Production (tonnes)

This section prominently displays the total global rice production, amounting to 269 billion tonnes over the period from 1961 to 2023. It highlights the significant volume of rice produced, emphasizing its importance as a staple food crop worldwide.

Scenario 2:Sum of Wheat Production (tonnes)

Highlighting the global wheat production, this section shows a total of 282 billion tonnes produced between 1961 and 2023. This underscores wheat's crucial role in global food security and its widespread cultivation.

Scenario 3: Sum of Tea Production (tonnes)

This section shows a gauge chart illustrating the total tea production, amounting to 2 billion tonnes. The visual emphasizes the scale of tea production compared to other major crops.

Scenario 4:Sum of Coffee, Green Production (tonnes) by Entity

A bar chart depicting the distribution of green coffee production among various entities. Africa, Asia, and America are leading producers, reflecting regional contributions to global coffee Supply.

Scenario 5: Sum of Wheat, Maize, and Rice Production (tonnes) by Year

An area chart showing the annual production trends of wheat, maize, and rice from 1961 to 2023. It highlights the growth trajectories and fluctuations of these essential crops over the years.

Scenario 6: **Sum of Apples, Avocados, Bananas, and Oranges Production (tonnes) by Entity**

This stacked bar chart illustrates the production volumes of apples, avocados, bananas, and oranges by different entities. It highlights the diverse contributions to global fruit production.

Scenario 7:Sum of Maize Production (tonnes) by Year

A donut chart depicting the yearly maize production distribution across different years. It shows how maize production has evolved, with specific years highlighted for their significant contributions.

Scenario 8: Sum of Grapes, Apples, Bananas, and Oranges Production (tonnes)

This bar chart compares the total production volumes of grapes (43 billion tonnes), apples (39 billion tonnes), bananas (32 billion tonnes), and oranges (26 billion tonnes). It provides a comparative view of the global production scales of these popular fruits.

2. Project Initialization and Planning Phase

2.1. Define Problem Statement

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	I'm an agriculture strategy manager at a Company	Get a clear, big-picture view of how global food production has changed over the past 60 years especially for rice, wheat, maize, and other key crops	The data I have is scattered across different sources and formats, and it's really hard to pull everything together	The information covers too many years, regions, and commodities to analyze manually or through simple charts	Frustrated that I can't easily uncover trends or use the data to plan long-term strategies
PS-2	I'm a business analyst in our supply-chain team	Build easy-to-understand reports that highlight where production is rising or falling	Most of the tools I have are static spreadsheets, no filters, nothing interactive	My managers want quick insights and visual dashboards to help with forecasting	Stressed because I spend too much time cleaning data instead of analyzing it
PS-3	I'm a policy and decision making lead in the research division	Use real data to guide sustainable agriculture policies and investment decisions	I don't have a single dashboard that shows reliable, up-to-date production information in one place	We rely on multiple disconnected reports that don't tell the full story	Concerned that I might make decisions based on incomplete or outdated information

2.2. Project Proposal (Proposed Solution)

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, providing ABC Company with actionable insights on crop performance, regional contributions, and long-term agricultural patterns to aid strategic decision-making.
Scope	The project focuses on collecting, cleaning, and analyzing agricultural production data for key commodities such as rice, wheat, maize, tea, coffee, grapes, apples, bananas, and oranges. The analysis is limited to production quantities (in tonnes) and covers the period 1961–2023

	across global regions. The deliverables include a Power BI dashboard, trend visualizations, and a comprehensive analytical report.
Problem Statement	
Description	ABC Company faces difficulty understanding and interpreting global food production data due to its massive scale, fragmented sources, and lack of a unified analytical system. Traditional reports and spreadsheets do not provide the interactive insights required for data-driven planning and forecasting.
Impact	Developing an interactive Power BI dashboard will enable ABC Company to monitor long-term food production trends, identify emerging patterns, and make informed strategic decisions in the agricultural sector. This enhances efficiency, data accessibility, and evidence-based planning across teams.
Proposed Solution	
Approach	The project will follow a structured data analytics workflow: 1. **Data Collection:** Acquire datasets from FAO and verified open data sources covering 1961–2023. 2. **Data Preparation:** Clean, normalize, and transform the data using Power Query in Power BI. 3. **Data Modeling:** Build a star schema model with fact and dimension tables (Commodity, Country, Year). 4. **Visualization:** Create Power BI visuals such as bar charts, area charts, KPI cards, and maps. 5. **Dashboard Development:** Integrate visuals into an interactive dashboard with filters and slicers. 6. **Reporting & Testing:** Generate insights, document methodology, and validate performance.
Key Features	• Interactive Power BI dashboard covering 8 major scenarios (rice, wheat, maize, tea, coffee, fruits, regional contributions, and comparative trends). • Real-time filtering by year, country, and commodity. • Trend analysis and performance tracking from 1961–2023. • KPI cards and area charts for high-level insights. • Drill-down and dynamic slicers for flexible exploration. • Comprehensive documentation and demo presentation.

Resource Requirements

Resource Type	**Description**	**Specification/Allocation**
Hardware		
Computing Resources	CPU/GPU specifications, number of cores	Intel Core i7 / Ryzen 7 processor (8 cores)
Memory	RAM specifications	16 GB RAM

Storage	Disk space for data, models, and logs	1 TB SSD
Software		
Frameworks	Power BI Desktop for data visualization and analysis	Power BI (latest version)
Libraries	Power Query (in Power BI), DAX (for calculations)	Built-in Power BI tools
Development Environment	Power BI Desktop, Excel for preprocessing, GitHub for version tracking	Microsoft Power BI, Excel, GitHub
Data		
Data	Source, size, format	Kaggle dataset, 2.14MB, csv/excel format

3. Data Collection and Preprocessing Phase

3.1. Data Collection Plan and Raw Data Sources Identified

Data Collection Plan

Section	Description
Project Overview	The project "Global Food Production Trends and Analysis (1961–2023) Using Power BI" focuses on analyzing worldwide food production trends over six decades. It aims to identify patterns in crop production (e.g., rice, wheat, maize, fruits, tea, and coffee) to help ABC Company gain data-driven insights into agricultural performance and regional contributions. Power BI is used to visualize the data, enabling interactive exploration and strategic decision-making.
Data Collection Plan	The dataset used for this study was collected from Kaggle, an open-source data platform hosting reliable and curated datasets for research and analytics. The dataset titled "World Food Production" by Rafsun Ahmad provides comprehensive production information (in tonnes) for major food commodities from 1961 to 2023 across multiple countries and regions. The data was downloaded in CSV format and imported into Power BI Desktop for cleaning, transformation, and visualization.
Raw Data Sources Identified	The project relies on a single primary dataset World Food Production (1961–2023) obtained from Kaggle. The dataset includes columns such as Entity (country/region), Code, Year, and production quantities for major crops including rice, wheat, maize, tea, coffee, grapes, apples, avocados, bananas, and oranges. This dataset provides the foundation for all analyses and Power BI visualizations developed in this project.

Raw Data Sources

Source Name	Description	Location / URL	Format	Size	Access Permissions
World Food Production (1961–2023)	Contains annual global food production data for major crops and fruits, recorded in tonnes. Each record includes Entity (country/region), Code, Year, and production values for crops such as rice, wheat, maize, coffee, tea, apples, bananas, grapes, avocados, and oranges. This dataset forms the primary source for visualization and analysis in Power BI.	https://www.kaggle.com/datasets/rafsunahmad/world-food-production	CSV	2.18 MB	Public (Free Access)

3.2. Data Quality Report

The Data Quality Report 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 (Technical Solution)
Global Food Production Dataset (1961–2023)	Missing values in production data for certain years and commodities due to incomplete reporting by countries.	High	Used Power Query's "Replace Missing Values" and interpolation techniques to fill gaps based on historical averages or nearest available data. For non-critical gaps, replaced nulls with zeroes to maintain aggregation consistency.
Global Food Production Dataset (1961–2023)	Blank rows and metadata lines in raw CSV files.	Low	Removed unnecessary header/footer rows using Remove Top/Bottom Rows and Filter Non-Null Rows in Power Query during the data import stage.
Global Food Production Dataset (1961–2023)	Unbalanced data across regions (e.g., some countries missing multiple commodities).	Moderate	Identified coverage gaps using count and distinct measures in Power BI; documented limitations while ensuring consistent calculations across available data points.

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 global food production records from 1961 to 2023, capturing key agricultural commodities such as rice, wheat, maize, apples, avocados, bananas, oranges, grapes, tea, and green coffee. Each record includes the Entity (country/region), a unique code, and the annual production quantity (in tonnes). The data provides a comprehensive overview of global agricultural trends across more

Section	Description
	than six decades, serving as the foundation for visualization and trend analysis in Power BI.
Data Cleaning	During cleaning, the dataset was inspected for missing values, duplicates, and inconsistencies. • Missing production values were replaced with zeros or interpolated based on previous years to maintain trend continuity. • Duplicate records (same entity, year, and commodity) were identified and removed using Power Query's Remove Duplicates feature. • Inconsistent entity names (e.g., "USA" vs "United States") were standardized for uniformity. • Outliers with unrealistically high or low production figures were flagged for review.
Data Transformation	The Power Query Editor in Power BI was used extensively for data shaping. • Unnecessary columns were filtered out. • Sorting and pivoting were applied to reorganize data by year and commodity. • New calculated columns were created to compute total production per year and percentage contributions by commodity and region.
Data Type Conversion	Each column was verified and converted to the correct data type: • *Entity* → Text • *Year* → Whole Number • Production columns → Whole Number (tonnes). This ensured that Power BI could perform accurate aggregations and time-series analyses.
Column Splitting and Merging	Column operations were performed to enhance usability. • The Entity and Code fields were retained separately to allow for both textual and coded references. • No major splitting was required, but some combined columns were separated for clarity. • Aggregated production metrics were created by merging related production columns using DAX calculations.
Data Modeling	A star schema was created in Power BI for efficient data analysis. • The Fact Table contains annual production values for all commodities. • Dimension Tables include Entity (Country/Region), Commodity, and Date (Year). • Relationships were established between these tables using primary keys such as Entity and Year.

Section	Description
	• DAX measures were developed to calculate KPIs like total production, year-over-year growth, and commodity share.
Save Processed Data	The cleaned and transformed dataset was saved as a Power BI Data Model (.pbix) file and also exported as a cleaned CSV for future analysis. This ensures reproducibility, allowing updates or new visualizations to be built easily without repeating the preprocessing steps.

4. Data Visualization

4.1. Framing Business Questions and Developing Visualizations

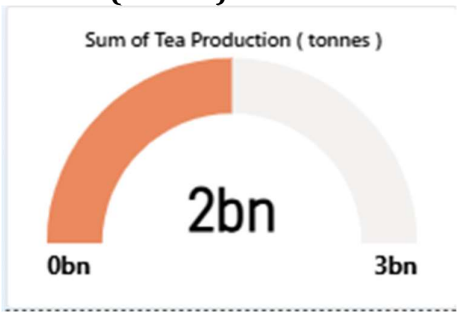
Business Questions and Visualisation

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 visualisation that provide insights.

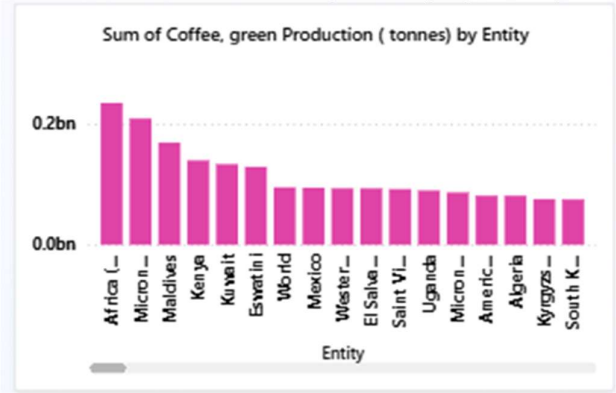
Activity 1.1: Sum of Rice Production (tonnes)

Activity 1.2: Sum of Wheat Production (tonnes)

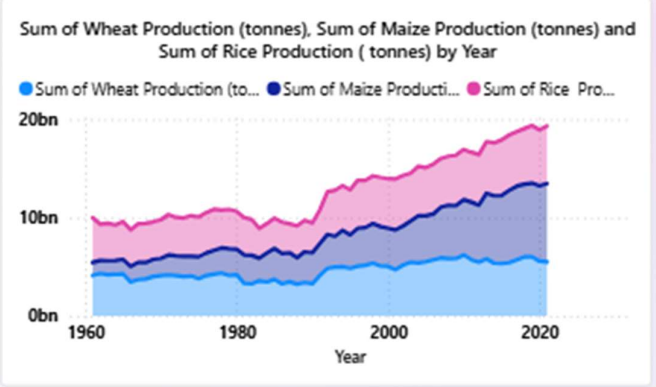
Activity 1.3: Sum of Tea Production (tonnes)



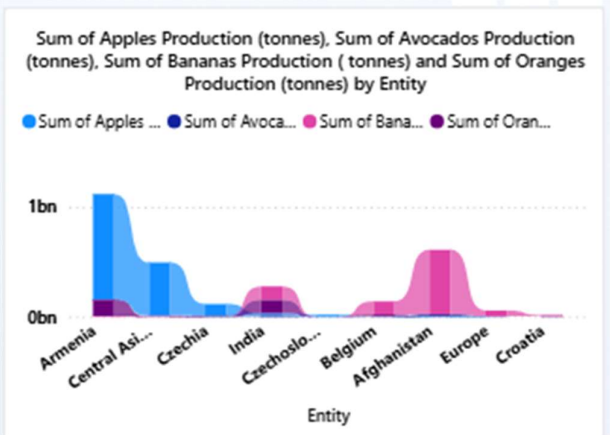
Activity 1.4: Sum of Coffee, Green Production (tonnes) by Entity



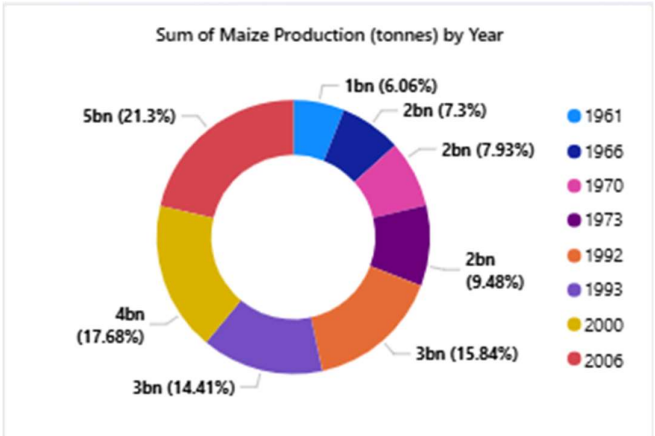
Activity 1.5: Sum of Wheat, Maize, and Rice Production (tonnes) by Year



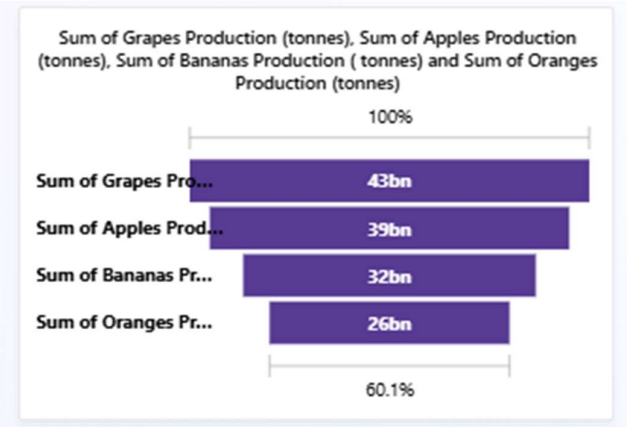
Activity 1.6: Sum of Apples, Avocados, Bananas, and Oranges Production (tons) by Entity



Activity 1.7: Sum of Maize Production (tonnes) by Year



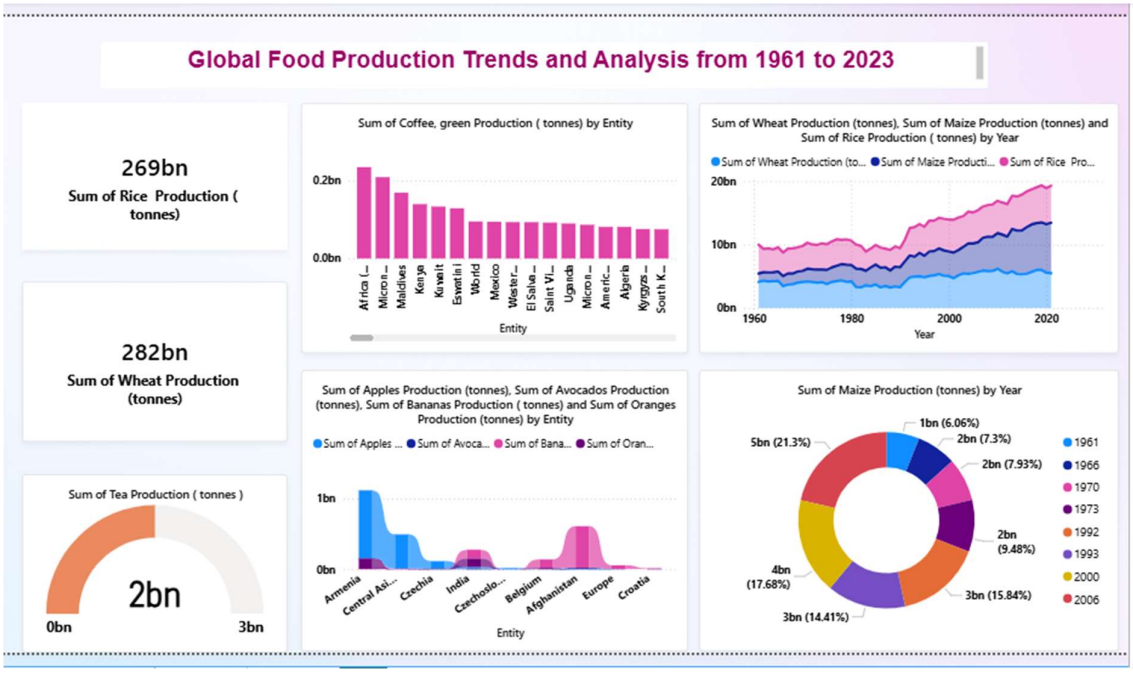
Activity 1.8: Sum of Grapes, Apples, Bananas, and Oranges Production (tonnes)



5. Dashboard

5.1. Dashboard Design File

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 five key outcomes derived from the **"Global Food Production Trends and Analysis from 1961 to 2023"** dashboard:

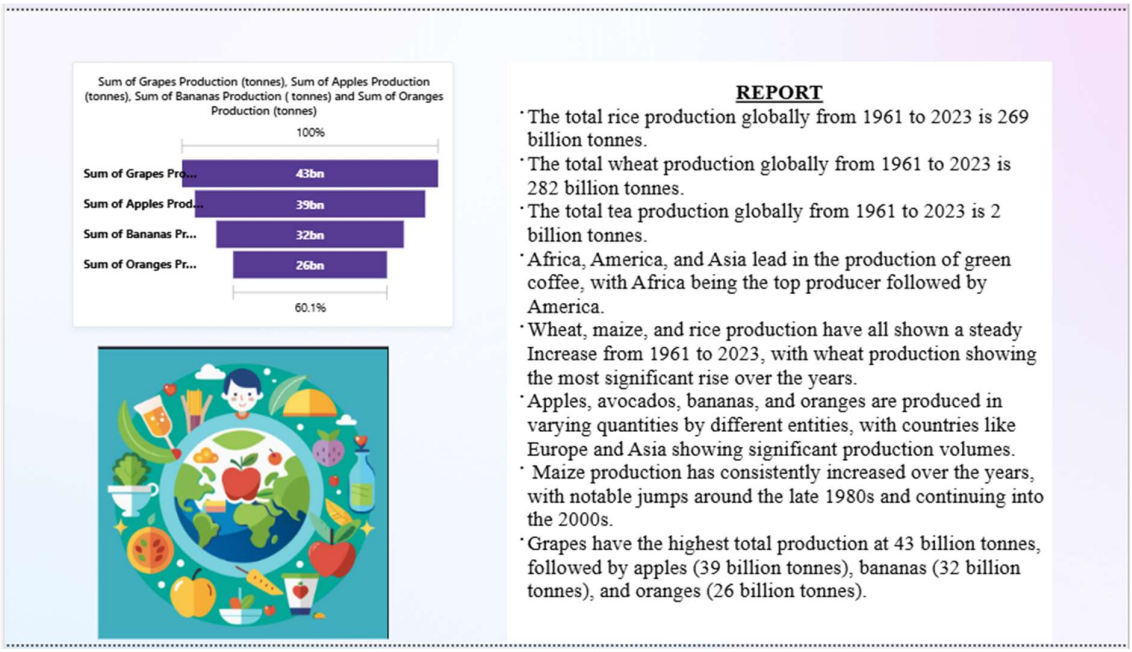
1. **Total Wheat and Rice Production:**
    - Wheat production leads globally with 282 billion tonnes, followed by rice at 269 billion tonnes, highlighting their dominance in global food output.
2. **Tea Production Overview:**
    - The world produces approximately 2 billion tonnes of tea, reflecting moderate but consistent growth in global tea cultivation.
3. **Coffee Production Leaders:**
    - African and Latin American regions are top contributors to green coffee production, significantly surpassing other regions in output.
4. **Historical Growth Trends (1961–2023):**
    - The area chart shows a steady increase in rice, maize, and wheat production, especially after 1980, indicating advancements in agricultural technology and productivity.
5. **Maize Production Distribution:**
    - The donut chart reveals progressive growth across decades, with maize production increasing from 1 billion tonnes (6%) in 1961 to 5 billion tonnes (21%) by 2023, showcasing rising demand and improved yields.

6. Report

6.1. Story Design File

A report is a comprehensive document that provides a detailed and structured account of data analysis, findings, and insights. It is typically used for in-depth analysis, documentation, and communication of results. Reports are suitable for a diverse audience, including decision-makers, analysts, and stakeholders who need a comprehensive understanding of the data.

Designing a report in Power BI involves connecting to data sources, creating visualizations like charts and graphs, customizing their appearance and interactivity, organizing them logically on the canvas, formatting elements for consistency and clarity, and optionally creating dashboards for a summarized view. Throughout the process, it's essential to consider the audience's needs and ensure the report effectively communicates insights from the data. Finally, iterate based on feedback to continually improve the report's design and usefulness.



Observations drawn from reports in Power BI can provide valuable insights into business performance and trends.

1. Dominance of Wheat and Rice:

Wheat production (282 billion tonnes) surpasses rice production (269 billion tonnes), making it the top-produced crop globally during 1961–2023.

2. Tea and Coffee Production Patterns:

Tea production reached **2 billion tonnes**, while **Africa leads in green coffee production**, followed by America and Asia—showing regional specialization in beverage crops.

3. Steady Growth in Staple Crops:

Wheat, maize, and rice production show a **consistent upward trend** over the decades, with the most notable acceleration in wheat output, driven by technological advances and improved farming methods.

4. Fruit Production Rankings:

Grapes have the highest total fruit production at **43 billion tonnes**, followed by **apples (39bn)**, **bananas (32bn)**, and **oranges (26bn)**—indicating their global agricultural importance.

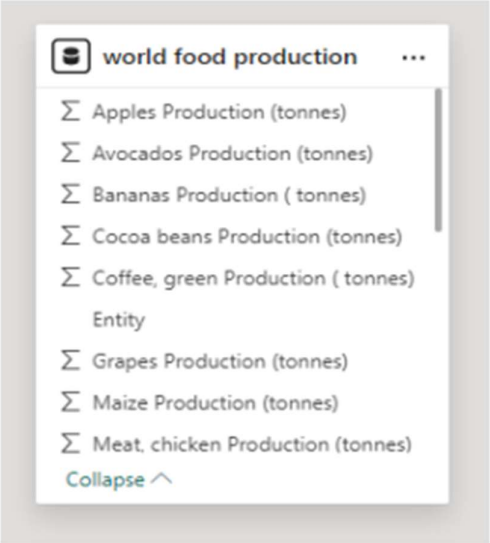
5. Regional and Temporal Insights:

Maize production has seen major growth since the late 1980s, and **countries in Europe and Asia** show strong performance in fruit cultivation, highlighting diverse agricultural strengths worldwide.

7. Performance Testing

7.1 Amount of Data Loaded

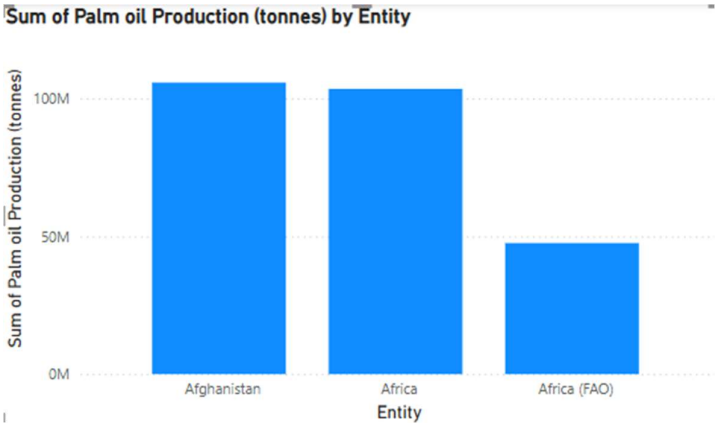
"Amount of Data Loaded" refers to the quantity or volume of data that has been imported, retrieved, or loaded into a system, software application, database, or any other data storage or processing environment. It's a measure of how much data has been successfully processed and made available for analysis, manipulation, or use within the system.

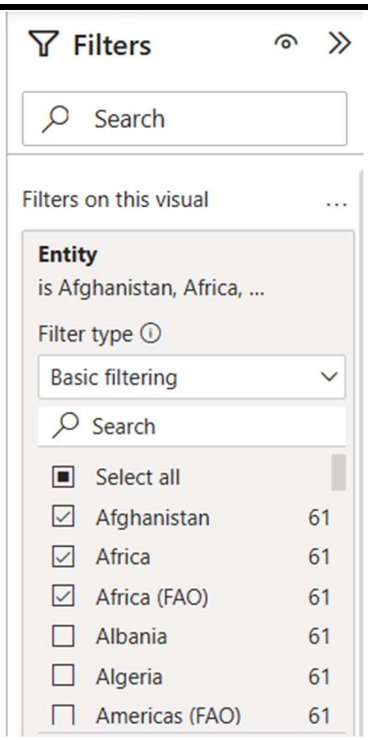


7.2 Utilization of Filters

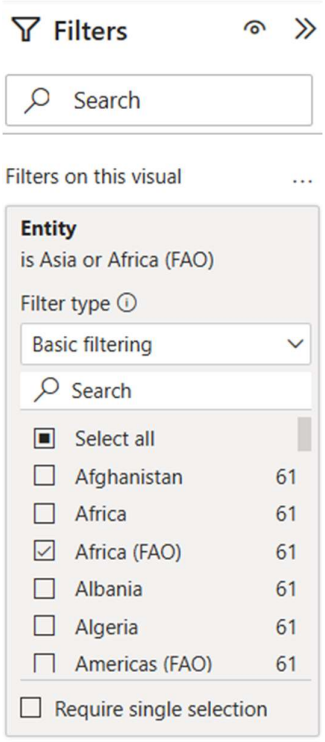
"Utilization of Filters" refers to the application or use of filters within a system, software application, or data processing pipeline to selectively extract, manipulate, or analyze data based on specified criteria or conditions.

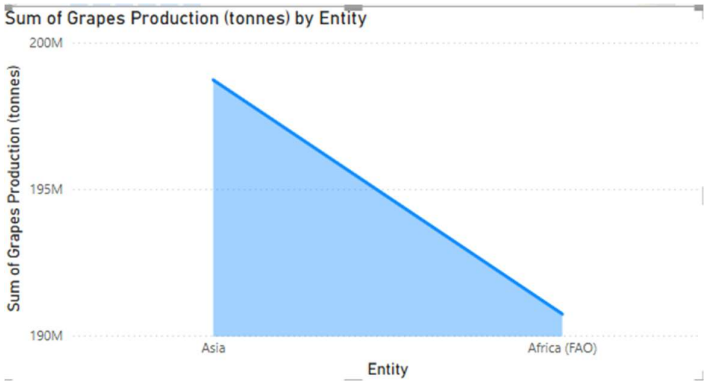
Selected “Entity” as Filter





Selected “Entity” as Filter





7.3: No of Visualizations/ Graphs

- The total Oranges Production (tonnes)
- The total Sugar Cane Productions (tonnes)
- The total Soybeans Production (tonnes)
- The total Palm Oil Production (tonnes) by Entity
- The total Grapes Production (tonnes) by Entity
- The total Meat,Chicken Production (tonnes) by Year
- The total Maize Production (tonnes) by Year
- The total Peas, dry Production (tonnes)
- The total Rice Production (tonnes) by Entity
- The total of Grapes, Apples, Bananas, Oranges, Coffee, Avocado Productions (tonnes)

8. Conclusion / Observation

The analysis highlights a substantial global increase in food production between 1961 and 2023. Technological innovations, improved agricultural practices, and regional specialization have contributed significantly. Wheat, rice, and maize dominate global output, while fruit and beverage crops demonstrate strong regional diversification.

9. Future Scope

- Integration of **climate and soil data** to understand environmental impacts on yield.
- Predictive modeling using **AI and machine learning** for future production forecasting.
- Inclusion of **economic indicators** (e.g., export values, consumption rates).
- Expansion to include sustainability metrics like water usage and carbon footprint.

10. Appendix

10.1 GitHub & Project Demo Link

- https://drive.google.com/file/d/1gsu2_L0Ae0RFIy1R2UTvz5ipwLb55Nbw/view?usp=drive_link
- https://github.com/Zunairafatima9/Global-Food-Production-Trends-and-Analysis-A-Comprehensive-Study-From-1961
- https://drive.google.com/drive/folders/1Gu9WXXBDA9AuMf3cl1oqAQvTei8MWNgo?usp=drive_link