Kpler Technical Assessment

Technical Documentation for USDA Supply and Demand Calculator

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Table of Contents

Executive Summary

The USDA Supply and Demand Calculator is an interactive web application designed to streamline agricultural data analysis for commodity analysts, researchers, and policymakers.

Built using Python and Streamlit, the application integrates live data from the United States Department of Agriculture (USDA) Production, Supply, and Distribution (PSD) API. It allows users to dynamically select a commodity, country, and market year, retrieve real-time supply and demand statistics, edit key parameters such as production, imports, and exports, and immediately view recalculated supply-demand balances.

The app emphasizes usability, auditability, and transparency:

- Analysts can interactively modify critical supply-demand metrics.
- Calculated fields such as Total Supply, Domestic Consumption, Total Use, and Ending Stocks are automatically updated in real time.
- All underlying logic, formulas, and data sources are fully documented within the application.

In addition to user-facing analysis, the tool incorporates technical best practices, including API error handling, input validation, caching for performance optimization, and exportable outputs in CSV format for further downstream reporting or decision-making.

This calculator aims to reduce manual work for commodity forecasting, minimize human error, and improve the speed and accuracy of agricultural market analysis.

Quick Highlights:

Feature	Description
Live Data Integration	Direct connection to USDA PSD API
Interactive Editing	Editable supply-demand fields with real-time recalculation
Downloadable Output	Results downloadable as a clean CSV file
Documentation Embedded	Methodologies and assumptions transparently provided
Error Handling	Robust checks ensure user input and API call integrity

Objective of the Application

The objective of the USDA Supply and Demand Calculator is to provide a reliable, efficient, and user-centered platform for the retrieval, adjustment, and analysis of agricultural commodity supply and demand data.

The application is designed to address the following primary goals:

2.1 Core Objectives

Automate Data Access:
Enable users to retrieve commodity-specific data directly from the USDA Production, Supply, and Distribution (PSD) system without the need for manual downloads or direct API handling.

Facilitate Real-Time Scenario Analysis:
Allow users to modify supply and demand parameters such as Production, Imports, and Consumption, and immediately recalculate key metrics such as Total Supply, Total Use, and Ending Stocks.

Ensure Transparency and Auditability:
Document the methodologies, assumptions, and calculation formulas used within the application to ensure results are traceable and verifiable.

Improve Analytical Efficiency:
Reduce manual processing time and minimize the risk of errors associated with traditional spreadsheet-based supply and demand balancing.

Maintain Data Integrity and Robustness:
Implement strict validation checks and input controls to ensure that user interactions do not produce invalid or unrealistic results.

2.2 Secondary Objectives

Optimize Performance:
Utilize caching mechanisms to minimize redundant API requests and improve application responsiveness.

Support Portability and Scalability:
Develop the application using lightweight, open-source tools (Python and Streamlit) to facilitate easy deployment on local machines or cloud environments.

Enable Future Extensions:
Build the architecture in a modular manner to allow seamless future enhancements, including multi-year forecasting, additional commodity coverage, or enhanced data visualization features.

Data Sources and APIs Used

The USDA Supply and Demand Calculator retrieves agricultural commodity data directly from the United States Department of Agriculture (USDA) Production, Supply, and Distribution (PSD) database through authenticated API requests. This section outlines the key endpoints used, the authentication mechanism, data handling strategies, and error management approaches adopted within the application.

3.1 USDA PSD API Endpoints

The application interacts with four primary USDA PSD API endpoints, each serving a specific purpose as summarized below:

Endpoint	Purpose
/commodities	Retrieves the list of available commodities, including commodity names and their associated codes.
/countries	Retrieves the list of reporting countries along with their respective country codes.
/commodityAttributes	Provides mappings between commodity attribute names, such as "Production" and "Imports," and their corresponding internal attribute IDs.
/commodity/{commodity_code}/country/{country_code}/year/{year}	Fetches detailed supply and demand statistics for a specified commodity, country, and market year combination.

Each API response is received in JSON format and subsequently parsed within the application for internal processing and display.

3.2 API Authentication

All requests made to the USDA PSD API require authentication via a valid API Key. The application handles authentication by embedding the API Key in the request header under the field X-Api-Key. Requests made without valid authentication credentials are rejected by the server with an HTTP 401 Unauthorized error. To ensure smooth user experience, the API Key is securely stored within the application's environment and automatically appended to all outgoing requests.

3.3 Data Retrieval and Handling

The application employs HTTP GET requests for all data retrieval operations. Upon receiving a response from the server, the data—delivered in JSON format—is parsed into native Python data structures such as dictionaries and lists for further processing. Static datasets, including the list of commodities and countries, are retrieved once and cached to optimize application performance and minimize redundant network requests. Dynamic datasets, specifically supply and demand data for selected commodity-country-year combinations, are retrieved live based on user input to ensure real-time accuracy.

3.4 Error Handling in API Requests

Error handling is implemented at every point of external data retrieval to ensure application robustness and data integrity. Each API response is checked for an HTTP status code of 200 (OK) before any attempt at parsing. In cases where the response is unsuccessful or the JSON structure is malformed, the application gracefully handles the failure by issuing user-facing warnings and safely falling back to empty structures. This strategy prevents application crashes and ensures that users are informed of any data retrieval issues without disruption to the application's operation.

3.5 Data Caching Strategy

Caching is applied to optimize the application's responsiveness and server load. Static metadata such as commodities, countries, and attribute mappings is cached using Streamlit's @st.cache_data mechanism. This cached data persists across user sessions until the application is restarted, ensuring that frequently accessed metadata does not require repetitive API calls. In contrast, dynamic datasets related to specific commodity supply and demand data are fetched live to maintain the freshness and accuracy of user-selected outputs.

Technical Architecture

The USDA Supply and Demand Calculator is a modular, event-driven web application developed using Python and Streamlit. The application is structured across distinct layers to ensure separation of concerns, scalability, and maintainability.

The architecture can be logically divided into the following components: the User Interface Layer, the Data Retrieval Layer, the Computation Layer, and the Output Layer.

4.1 User Interface Layer

The User Interface (UI) Layer is responsible for capturing user inputs and rendering dynamic outputs. It is built using Streamlit's standard UI components organized across a tabbed navigation system, which separates the application into three main sections: Introduction, Supply & Demand Calculator, and Appendix.

Key UI elements include:

UI Component	Purpose
Dropdowns (st.selectbox)	Selection of commodity, country, and market year
Number Inputs (st.number_input)	Editable fields for production, imports, consumption, and exports
Subheaders and Captions	Section labeling and user guidance
Data Tables (st.dataframe)	Display of recalculated supply and demand metrics
Download Buttons	Export of calculated results to CSV format

The UI layer ensures an interactive and responsive user experience, updating outputs dynamically based on user modifications without requiring manual refreshes.

4.2 Data Retrieval Layer

The Data Retrieval Layer handles all interactions with the USDA PSD API. It is responsible for constructing authenticated HTTP GET requests, parsing server responses, and caching static metadata.

Key functions within this layer include:

- Retrieving the list of available commodities (/commodities endpoint).
- Retrieving the list of countries and reporting codes (/countries endpoint).
- Mapping attribute names to attribute IDs (/commodityAttributes endpoint).
- Fetching detailed commodity-country-year supply and demand data (/commodity/{commodity_code}/country/{country_code}/year/{year} endpoint).

Static data such as commodities and countries is cached using Streamlit's @st.cache_data decorator to minimize repeated network requests and optimize application responsiveness.

Authentication is managed by embedding the API Key into the HTTP request header under the X-Api-Key field.

4.3 Computation Layer

The Computation Layer performs all necessary supply and demand calculations based on user-edited inputs.

The following formulas are implemented:

Metric	Formula
Total Supply	Beginning Stocks + Production + Imports
Domestic Consumption	Feed Domestic Consumption + FSI Consumption
Total Use	Domestic Consumption + Exports
Ending Stocks	Total Supply - Total Use

Calculations are triggered in real time whenever a user modifies any editable input field. This architecture ensures that supply-demand balances are consistently accurate based on the latest user-defined values.

4.4 Output Layer

The Output Layer is responsible for presenting the final results and offering export options.

It consists of:

- A styled DataFrame that displays both user-edited fields and system-calculated metrics, with distinct highlighting for calculated fields.
- A download functionality (st.download_button) that allows users to export the recalculated supply-demand metrics as a clean CSV file.

Styling within the results table differentiates between direct user inputs and calculated outputs to maintain clarity and improve readability for downstream analysis.

4.5 Architectural Overview

The overall design promotes modularity and extensibility, ensuring that future enhancements such as multi-year trend analysis, advanced visualizations, or additional export formats can be incorporated with minimal impact to the existing structure.

A high-level overview of component interaction is illustrated below:

Layer	Responsibility
User Interface Layer	Capture inputs and render outputs
Data Retrieval Layer	Connect to USDA API and parse data
Computation Layer	Perform supply-demand calculations
Output Layer	Display results and enable downloads

The architecture is lightweight enough for local desktop deployments while being scalable to server- or cloud-based environments if required.

User Interface Design

The User Interface (UI) of the USDA Supply and Demand Calculator is designed for simplicity, clarity, and responsiveness. Built using Streamlit's UI components, the interface guides users through a structured workflow, allowing efficient selection, editing, recalculation, and export of agricultural supply and demand data.

The UI is divided into three primary components: the Tab Structure, Input Components, and Output Components.

5.1 Tab Structure

The application uses a tab-based layout to organize content logically and improve navigation efficiency. Each tab serves a distinct purpose:

Tab Name	Purpose
Introduction	Presents an overview of the tool's functionality and instructions for usage.
Supply & Demand Calculator	Allows users to select commodities, edit input values, view real-time recalculations, and download results.
Appendix & Methodology	Provides detailed documentation on data sources, calculation formulas, user input descriptions, and error handling strategies.

The tabbed design ensures that users can easily access specific functionalities without navigating away from the main application environment.

5.2 Input Components

Within the Supply & Demand Calculator tab, user inputs are gathered through the following Streamlit components:

- **Commodity Selection (st.selectbox)**: Dropdown menu allowing users to select a commodity of interest.
- **Country Selection (st.selectbox)**: Dropdown menu to select the reporting country.
- **Market Year Selection (st.number_input)**: Numeric input field for selecting the desired analysis year, with boundary validations to prevent invalid years.
- **Editable Metrics (st.number_input)**: Numeric input fields prefilled with fetched USDA data for Production, Imports, Feed Domestic Consumption, FSI Consumption, and Exports. Users can manually adjust these fields to model different scenarios.

Input fields are constrained with minimum and maximum values to ensure data integrity. For example, production and consumption inputs are restricted to non-negative values within a realistic operational range.

5.3 Output Components

The results of user selections and edits are dynamically displayed through the following components:

- **Real-Time Calculated Metrics**: Supply and demand fields such as Total Supply, Domestic Consumption, Total Use, and Ending Stocks are recalculated instantly based on the latest user inputs.

- **Styled Data Table (st.dataframe)**: The recalculated results are presented in a formatted table that differentiates between user-input and system-calculated fields. Calculated fields are highlighted to improve readability.
- **Download Button (st.download_button)**: Enables users to export the final set of supply and demand metrics as a CSV file. The exported file preserves the structure and clarity of the on-screen data, allowing for immediate use in external analysis or reporting tools.

The real-time feedback from editable inputs to calculated outputs enhances user experience, reduces analytical errors, and accelerates decision-making workflows.

5.4 Design Principles

The UI design follows the following guiding principles:

- **Minimalism**: Avoid unnecessary complexity; only essential options are presented to the user.
- **Responsiveness**: All edits trigger instant recalculations and updates without requiring manual refreshes.
- **Clarity**: Each section is clearly labeled, and help texts are provided where necessary to guide the user.
- **Accessibility**: Input validations prevent invalid operations, ensuring robustness across all user actions.

The overall design ensures that even users with minimal technical expertise can efficiently operate the application and derive meaningful insights.

Functional Workflow

The USDA Supply and Demand Calculator follows a structured, user-driven workflow that guides users from data selection through to result analysis and export. This section details the sequence of interactions and system responses from the moment the user accesses the application.

6.1 Application Launch

Upon launching the application, users are presented with a tabbed interface containing three main sections: Introduction, Supply & Demand Calculator, and Appendix & Methodology. Users are directed by default to the Introduction tab, where they can review the application's purpose, functionalities, and navigation instructions.

6.2 Commodity and Country Selection

Within the Supply & Demand Calculator tab, users initiate the analysis process by selecting:

- A commodity from a dropdown menu populated with live data retrieved from the USDA PSD /commodities endpoint.
- A country from a dropdown menu populated with live data from the /countries endpoint.
- A market year via a numeric input field, constrained between predefined minimum and maximum acceptable values.

Once these selections are made, the application uses the selected commodity code, country code, and year to query the USDA PSD /commodity/{commodity_code}/country/{country_code}/year/{year} endpoint to retrieve corresponding supply and demand data.

If no data is available for the selected parameters, a user-facing warning is displayed, and further execution is halted to maintain data integrity.

6.3 Data Loading and Pre-Filling of Editable Metrics

Upon successful data retrieval, the application pre-fills editable fields with key supply and demand values. Editable metrics include:

- Production
- Imports
- Feed Domestic Consumption
- FSI Consumption
- Exports

Beginning Stocks, if available, are displayed as a read-only field, reflecting carryover inventory from the previous market year.

Values are loaded into st.number_input components, allowing users to adjust them based on hypothetical or real-world scenarios.

6.4 Real-Time Calculations

Each time a user modifies any editable input field, the following recalculations are triggered automatically:

- **Total Supply** is calculated as Beginning Stocks plus Production plus Imports.
- **Domestic Consumption** is calculated as Feed Domestic Consumption plus FSI Consumption.
- **Total Use** is calculated as Domestic Consumption plus Exports.
- **Ending Stocks** are calculated as Total Supply minus Total Use.

Real-time recalculations ensure that users receive immediate feedback on the impact of their changes without needing to refresh or manually trigger recalculation actions.

6.5 Results Display

Recalculated metrics are presented in a structured data table using Streamlit's st.dataframe component. The table differentiates between direct user inputs and system-calculated fields by applying distinct styling:

- User-input fields retain standard formatting.
- System-calculated fields are highlighted with a distinct background color and bold text to clearly indicate derived values.

This structured display improves clarity and supports analytical review.

6.6 Data Export

Once users are satisfied with their adjustments and recalculations, they can download the final dataset using the provided st.download_button component. The output is generated as a CSV file containing:

- Metric names
- Corresponding values

The CSV file preserves the structure displayed on screen and allows users to further manipulate, archive, or present the data externally as needed.

6.7 Error Handling during Workflow

At each stage of the workflow, error handling mechanisms are active:

- If API responses fail or return malformed data, appropriate warnings are displayed.
- If no data is available for selected parameters, users are notified and the workflow is halted safely.
- Input fields are validated to ensure values remain within logical, realistic ranges, preventing computational anomalies.

These measures ensure application robustness and user confidence throughout the analytical process.

Key Calculations and Formulas

The USDA Supply and Demand Calculator performs a series of real-time computations based on user-edited supply and demand inputs. This section details the specific formulas applied within the application, including the variables used and the logical relationships between them.

7.1 Definitions of Variables

The following variables are used throughout the application's supply and demand calculations:

- **Beginning Stocks**:
  The quantity of a commodity carried over from the previous marketing year into the current analysis year.
- **Production**:
  The total domestic output of the commodity during the selected marketing year.
- **Imports**:
  The total quantity of the commodity imported into the country during the selected year.
- **Feed Domestic Consumption**:
  The quantity of the commodity used for feeding livestock and poultry.
- **FSI Consumption**:
  The quantity of the commodity used for food, seed, and industrial purposes.
- **Exports**:
  The total quantity of the commodity exported out of the country during the marketing year.

7.2 Calculation Formulas

The following formulas are implemented in the application's computation layer:

1. Total Supply

Total Supply = Beginning Stocks + Production + Imports

Total Supply represents the total volume of the commodity available for use within the country during the marketing year.

2. Domestic Consumption

Domestic Consumption = Feed Domestic Consumption + FSI Consumption

Domestic Consumption aggregates the commodity volume used internally, excluding exports.

3. Total Use

Total Use = Domestic Consumption + Exports

Total Use represents the sum of domestic consumption and exports, accounting for all uses of the commodity within and outside the country.

4. Ending Stocks

Ending Stocks = Total Supply − Total Use

Ending Stocks measure the remaining inventory of the commodity at the close of the marketing year, after all domestic consumption and exports have been accounted for.

7.3 Real-Time Recalculation Logic

Each of the above calculations is performed dynamically in response to any change in user-edited inputs. Upon modification of production, imports, feed domestic consumption, FSI consumption, or exports, the application immediately recalculates Total Supply, Domestic Consumption, Total Use, and Ending Stocks to reflect the updated scenario.

This real-time recalculation design ensures that users can model different hypothetical conditions and immediately observe their impact on national commodity balances.

Error Handling and Data Validation

The USDA Supply and Demand Calculator incorporates multiple layers of error handling and input validation to ensure application robustness, protect data integrity, and deliver a seamless user experience. This section describes the key mechanisms deployed to detect, report, and manage errors throughout the application workflow.

8.1 API Response Validation

Every interaction with the USDA PSD API is followed by strict response validation to confirm successful data retrieval.

- Each API response is checked for an HTTP status code of 200 (OK) before proceeding.
- If a response indicates a failure (e.g., status codes 4xx or 5xx), the application:
    - Displays a warning message to the user indicating the unavailability of requested data.
    - Safely halts further processing to prevent downstream computational errors.
- In cases where the response is successful but contains malformed or empty JSON data, the application defaults to safe fallback structures (e.g., empty lists or dictionaries) rather than attempting to process invalid data.

These mechanisms ensure that API failures do not compromise the stability or reliability of the application.

8.2 No-Data Handling for Commodity-Country-Year Combinations

In some instances, the USDA database may not contain data for a selected combination of commodity, country, and year.

- If no matching data is retrieved:
    - The application triggers a user-facing warning message.
    - Execution is stopped for the current session to prevent the display of empty or misleading outputs.

This ensures users are immediately informed of data unavailability and are encouraged to adjust their selections accordingly.

8.3 Input Validation for Editable Fields

All editable input fields within the Supply & Demand Calculator tab (e.g., Production, Imports, Feed Domestic Consumption, FSI Consumption, Exports) are subjected to strict validation constraints:

- Only non-negative numerical values are accepted.
- A realistic maximum value (set to 1,000,000.0 units) is enforced to prevent entry of unrealistic or erroneous data magnitudes.
- Step size restrictions are applied to ensure meaningful incremental adjustments.

These constraints protect the application from computational overflows, maintain the realism of analytical scenarios, and prevent accidental user errors.

8.4 Safe Recalculation Logic

The real-time recalculation engine is designed to handle all possible scenarios gracefully:

- If any necessary input is missing or set to an invalid value, calculations default to safe fallback values (typically zero) to prevent application crashes.
- Calculations involving subtraction (e.g., Ending Stocks = Total Supply - Total Use) are structured to avoid negative inventory balances unless such scenarios are a legitimate consequence of user inputs.

This approach ensures continuous operational stability even in the face of edge cases and non-ideal user behaviors.

8.5 Caching Error Protection

Caching is selectively applied only to static data (commodities list, countries list, attribute mappings) to avoid caching invalid or incomplete dynamic results. Any failure during initial caching operations immediately triggers user warnings and disables dependent downstream processes, preserving application coherence.

By combining proactive error detection, user feedback, controlled data flows, and safe fallback mechanisms, the application ensures that analytical outputs are always based on valid, verified data and that user experience remains stable under a wide range of operational conditions.

Download and Export Features

The USDA Supply and Demand Calculator provides users with the capability to download the final recalculated supply and demand metrics as a structured CSV file. This functionality supports further offline analysis, reporting, and integration into broader decision-making workflows.

9.1 CSV Export Structure

Upon completing their selections and adjustments within the Supply & Demand Calculator tab, users are presented with a download button labeled "Download Supply and Demand Metrics CSV." Clicking this button triggers the generation of a CSV file containing the following structure:

Column Name	Description
Metric	The name of the supply or demand parameter (e.g., Production, Imports, Total Supply, Ending Stocks).
Value	The numeric value associated with the corresponding metric, reflecting user edits and real-time recalculations.

The order of metrics in the CSV mirrors the order presented in the on-screen table, ensuring consistency between the user interface and the exported file.

9.2 Export Process Details

The export process follows a streamlined sequence:

- A Pandas DataFrame is created from the final recalculated supply and demand metrics.
- The DataFrame is converted into CSV format in memory without writing intermediate files to disk.
- Streamlit's st.download_button component is utilized to serve the CSV content directly to the user's browser.
- The downloaded file is named supply_demand_metrics.csv by default.

This approach ensures that the export process is lightweight, fast, and compatible across various devices and browsers without requiring external dependencies.

9.3 Design Considerations for Export

Several design decisions were made to ensure the usability of exported files:

- **Flat Structure**: A simple two-column layout was adopted to facilitate easy reading, sorting, and incorporation into spreadsheet tools or business intelligence platforms.
- **Consistent Formatting**: Numeric fields maintain formatting to avoid issues with data parsing in external tools.
- **Immediate Availability**: No server-side file generation is required, ensuring user privacy and minimizing infrastructure requirements.

These measures collectively enhance the portability and utility of the supply and demand outputs generated by the application.

Limitations and Future Improvements

The USDA Supply and Demand Calculator, while functional and robust in its current form, has certain limitations and identified areas for enhancement. This section summarizes the known boundaries of the application and proposes potential future improvements.

10.1 Current Limitations

The following limitations are acknowledged in the current version:

- **Data Availability Dependence**:
  The application relies on live data from the USDA PSD API. If the API does not contain records for a selected commodity-country-year combination or becomes unavailable, the application cannot retrieve or display corresponding data.
- **Fixed Input Constraints**:
  Editable fields are restricted between 0.0 and 1,000,000.0 units. While adequate for most commodities and countries, this range may not accommodate extreme cases without external adjustment.
- **Simplified Commodity Balance**:
  The application uses basic supply and demand calculations without accounting for additional factors such as losses, unreported stocks, or residual discrepancies. Outputs should be treated as high-level estimates.
- **Single-Year Analysis**:
  Only one marketing year can be analyzed at a time. Multi-year trends and forecasting features are not supported in the current version.
- **No Deep Validation of User Inputs**:
  While value ranges are enforced, logical consistency checks (e.g., that consumption should not exceed supply) are not automatically validated.

10.2 Proposed Future Improvements

Enhancements identified for future versions include:

- **Multi-Year Analysis**:
  Extend functionality to allow users to analyze trends across multiple marketing years and generate comparative outputs.
- **Enhanced Input Validation**:
  Implement cross-field logical validation to detect and warn about implausible input combinations.
- **Extended Input Ranges**:
  Dynamically adjust maximum allowable values based on commodity and country size classifications.
- **Additional Metrics**:
  Incorporate fields for residual losses, stock adjustments, or unaccounted variations to provide more comprehensive balance sheets.
- **Data Visualization**:
  Introduce graphical representations, such as bar charts or line graphs, to complement tabular outputs and improve data interpretation.
- **Offline Mode**:
  Enable functionality to load previously cached data when the USDA API is unavailable.

These improvements are planned in alignment with the application's modular architecture, ensuring that new features can be incorporated with minimal disruption to the core functionality.

Appendix

This appendix provides supporting technical details referenced throughout the USDA Supply and Demand Calculator documentation. It includes endpoint references, attribute mapping explanations, user input definitions, and a sample structure of the exported output.

11.1 API Endpoint References

The following API endpoints from the USDA Production, Supply, and Distribution (PSD) system are utilized by the application:

Endpoint	Purpose
/commodities	Retrieve the list of available commodities and their codes.
/countries	Retrieve the list of reporting countries and their codes.
/commodityAttributes	Retrieve mappings between attribute names (e.g., Production, Imports) and internal attribute IDs.
/commodity/{commodity_code}/country/{country_code}/year/{year}	Retrieve supply and demand data for a specified commodity-country-year combination.

All API interactions are secured using an authentication key passed through the request header field X-Api-Key.

11.2 Attribute Mapping

The application relies on internal mappings between human-readable commodity attributes and their respective numeric IDs provided by the USDA API. Selected attributes critical for calculations include:

Attribute Name	Description
Beginning Stocks	Stock carried over from the previous year.
Production	Total domestic output during the year.
Imports	Quantity imported into the country.
Feed Domestic Consumption	Quantity used for animal feed.
FSI Consumption	Quantity used for food, seed, and industrial uses.
Exports	Quantity exported out of the country.

This mapping allows seamless access to corresponding numerical values during data retrieval and computational processes.

11.3 User Input Descriptions

Users interact with the following primary editable input fields within the Supply & Demand Calculator:

Input Field	Definition
Production	Total production within the reporting country for the selected year.
Imports	Total imports received by the reporting country.

Feed Domestic Consumption	Domestic use for feed purposes.
FSI Consumption	Domestic use for food, seed, and industrial purposes.
Exports	Total quantity exported from the reporting country.

Beginning Stocks is displayed as a read-only field populated based on available USDA data.

11.4 Sample Exported Output Structure

The downloadable CSV file generated by the application contains the following columns:

Column	Description
Metric	Name of the supply-demand metric (e.g., Production, Total Supply, Ending Stocks).
Value	Numerical value corresponding to the metric.

Metrics are ordered consistently with their presentation within the on-screen results table to ensure traceability.

References

The USDA Supply and Demand Calculator was developed using publicly available resources, official documentation, and automated assistance tools to ensure accuracy, consistency, and technical completeness. The following references were utilized during the development and documentation processes:

1. **United States Department of Agriculture (USDA) Production, Supply, and Distribution (PSD) Online Database**
    - Official Source: https://apps.fas.usda.gov/psdonline/app/index.html
    - API Access and Documentation: https://apps.fas.usda.gov/OpenDataAPI/api/PSD/Help
2. **Streamlit Official Documentation**
    - Streamlit Open-Source Application Framework: https://docs.streamlit.io/
3. **Pandas Library Documentation**
    - Data manipulation and export library used for CSV generation: https://pandas.pydata.org/docs/
4. **Python Official Documentation**
    - Language reference for application development: https://docs.python.org/3/
5. **ChatGPT by OpenAI**
    - ChatGPT (GPT-4 model) was utilized to assist in drafting and refining technical documentation, structuring reports, improving phrasing, and ensuring technical completeness.
    - Service Reference: https://openai.com/chatgpt