

Analysis of Food Security & Access

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Abstract—This report analyzes and provides an understanding of food security and accessibility across the United States, offering a multifaceted understanding of the challenges and opportunities in this domain. It aims to design interactive visualizations that allow users to explore food security indicators, such as insufficient food consumption, acute food insecurity, and vulnerable populations. The analysis includes studying income levels, food accessibility across states and counties (both urban and rural settings), food prices in different categories, and food security across demographics. This report also delves into the underlying socio-economic factors responsible for disparities in access to adequate nutritious food. Furthermore, this report tries to understand vulnerable populations and communities and try to shed light on reasons for food insecurity. This report aims to equip policymakers with essential insights into food security.

Key Terms - Food security, food accessibility, income levels, food prices, demographics, Data Visualization, Tableau, ETL, Pandas, Seaborn, Matplotlib

I. INTRODUCTION

Food security and Accessibility are critical issues affecting millions worldwide. Our analysis aims to pinpoint regions in need of intervention and support to enhance food security for all individuals and communities. By presenting data in an interactive and user-friendly manner, we strive to simplify complex information for decision-makers to act upon. Additionally, our project will delve into how food security intersects with various social and economic factors like race, gender, and geography to offer a more holistic view of the challenges faced by marginalized groups. By highlighting these disparities, we seek to guide more targeted and effective strategies to combat food insecurity in the United States. Ultimately, our objective is to contribute to the ongoing work of establishing a fair and sustainable food system that guarantees access to nutritious and affordable food for everyone. We believe that by utilizing data visualization techniques, we can empower stakeholders to make informed choices and drive positive change in the battle against food insecurity.

II. MOTIVATION

In a world where millions of people still suffer from hunger and malnutrition, it becomes necessary to understand and analyze food security and accessibility across the United States and around the globe. Food insecurity has far-fetched consequences not only on individuals but also on communities, and entire society. It is essential to address these challenges to promote public health, reduce poverty and inequality, and

build more sustainable and resilient food systems. While researching food security we came across some statistics which state almost 820 million people globally suffer from chronic hunger, and according to USDA approximately 10.5% [1] of households in the United States faced food insecurity in 2019. These compelling statistics compelled us to pick this topic for a project. This project aims to understand the complex web of interconnected causes like poverty, unemployment, lack of transportation, and limited access to affordable and healthy food options. Furthermore, we are accessing the physical, economic, and social barriers that restrict individuals from accessing affordable and nutritious food. By employing the power of analytics, we are trying to uncover hidden patterns, identify key factors, and identify areas of intervention. We seek to empower policymakers, government, non-profit organizations, and communities to make informed decisions and implement effective policies.

III. PROBLEM STATEMENT

Food insecurity presents a wide range of challenges, from limited access to healthy food to immediate threats to food availability. It is crucial to comprehend the extent of inadequate food consumption and acute food insecurity to develop effective intervention strategies. Additionally, examining the affordability of food options highlights disparities in food accessibility, especially among marginalized communities. By exploring these aspects, policymakers can identify areas with high demand and customize interventions to tackle the underlying causes of food insecurity. Moreover, a comprehensive understanding of vulnerable populations is vital for creating targeted support programs. Vulnerabilities differ among various groups, such as children, the elderly, and low-income families, each facing distinct obstacles. By recognizing these at-risk demographics and their specific requirements, policymakers can introduce personalized interventions to ensure fair access to food resources and assistance services. Through evidence-based analysis and visualization, this initiative aims to offer practical insights to empower stakeholders in their fight against food insecurity and advocate for universal food access.

IV. OBJECTIVE

- **Comprehensive Understanding:** To provide a comprehensive understanding of food security indicators.
- **Inform Decision-Making:** To equip policymakers and organizations with data-driven insights to make decisions and develop effective strategies for addressing food insecurity.

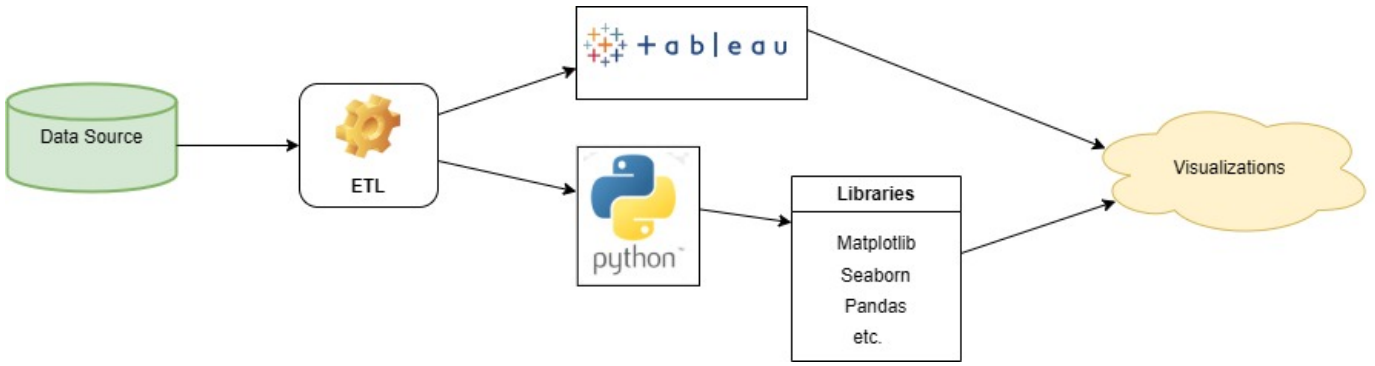


Fig. 1. Workflow for project

- **Raise Awareness:** To raise awareness about the prevalence of food insecurity in the United States and foster empathy towards vulnerable populations.
- **Promote Accountability:** Encouraging stakeholders to take action to solve problems.
- **Develop Interactive Visualizations:** Create interactive visualizations that allow users to explore food security indicators, such as the prevalence of insufficient food consumption, acute food insecurity, and vulnerable populations.
- **Identify Trends and Patterns:** Understand trends and patterns in food security over time, different demographics of the population, and geographical locations in the United States.
- **Facilitate Comparative Analysis:** Provide a comparative analysis of food security indicators between different geographical areas and demographic groups to identify disparities and prioritize particular demographics of people or areas to improve access to nutritious and affordable food resources.
- **Equip Stakeholders:** Equip stakeholders, including policymakers, NGOs, and community leaders with actionable insights to take action.
- **Accessibility and Usability:** To make access to food security data and insights accessible to various audiences for easier access and better usability.

V. LITERATURE REVIEW

Food security and accessibility have been enduring concerns for policymakers, researchers, and humanitarian organizations across the globe. An examination of the existing body of literature uncovers a plethora of studies that delve into various facets of food insecurity, encompassing its causes, repercussions, and potential remedies.

Numerous studies have scrutinized the prevalence and determinants of food insecurity at both the global and national levels. These studies frequently employ quantitative methodologies to analyze survey data and identify factors associated with food insecurity, such as income inequality, unemployment rates, and access to social safety nets. For instance, the research conducted by Barrett et al. (2019) discovered that

economic shocks, such as fluctuations in food prices or loss of income, significantly impact the food security of households in low-income countries.

In addition to quantitative analyses, qualitative research has yielded invaluable insights into the lived experiences of individuals and communities affected by food insecurity. Qualitative studies often utilize interviews, focus groups, and ethnographic methods to delve into the socio-cultural, economic, and environmental factors that influence patterns of food access and consumption. For example, the work carried out by Loopstra et al. (2019) [2] emphasizes the significance of social support networks and community resilience in mitigating the impact of food insecurity among marginalized populations in urban settings. Moreover, recent advancements in data visualization methods have made it easier to explore and communicate complex food security issues. Interactive dashboards, geographic information systems (GIS), and other visualization tools allow stakeholders to analyze spatial and temporal trends in food insecurity, pinpoint areas of vulnerability, and evaluate the impact of intervention programs. For instance, the Food Insecurity Mapping Tool created by the United States Department of Agriculture (USDA) permits users to view food insecurity rates at the county level and delve into demographic characteristics linked to food insecurity.

Despite the considerable headway made in understanding food security and accessibility, there are still knowledge gaps, particularly in terms of how food insecurity intersects with other social determinants of health like race, ethnicity, gender, and immigration status. Future research should aim to address these gaps by taking interdisciplinary approaches that draw on insights from sociology, public health, economics, and other relevant fields. By adopting a comprehensive and multifaceted viewpoint, researchers can contribute to the formulation of more effective policies and interventions geared toward promoting food security and equality for all individuals and communities.

VI. WORKFLOW

The data process gives brief about the steps we have followed to complete this project 2. As we moved ahead in the project and finalize the topic Food Security and Ac-

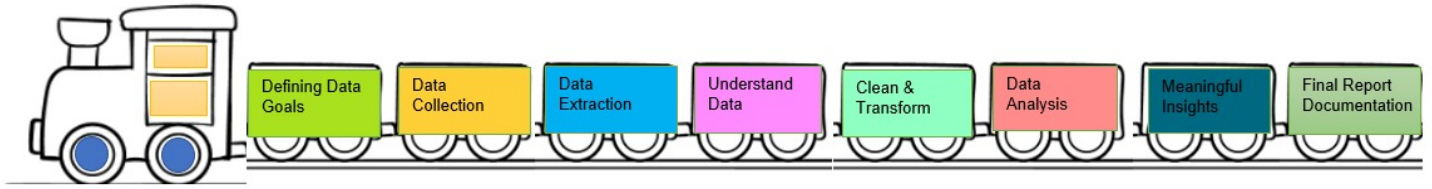


Fig. 2. Data Process Flow

cess, we started to gather the right information required for it. The datasets used in this project are sourced from various government websites. After data sourcing is completed, the dataset is downloaded in CSV format. Loaded the dataset in various tools like Google Cloud for further cleaning and processing. We created multiple buckets based on the type of data we are using and imported data from the above-mentioned sources. We created a bucket for income levels, food prices, food access, and food insecurity. Each bucket was used as a repository for a specific category of data making it easier to manage and access during subsequent data processing stages. This cloud-loaded data is then moved to Google Dataprep and also loaded in Python for further cleaning. Once we are done with the cleaning process the data was shared among everyone for understanding and analyzing and improvement. Once the understanding and storing of the dataset was over we moved to do exploratory data analysis using Python Pandas, Matplotlib, Seaborn, and Tableau. We created dynamic visualizations to really understand the data visually which will help stakeholders and policy makers to take a rightful decision which are beneficial to society. We also created a comprehensive dashboard to help understand the scarcity and accessibility of food in different areas. The insights are derived based on the visualizations.

VII. METHODOLOGY

A. Understanding Policy makers Requirements

To understand policymakers' perspective we leveraged USDA website to see the current state of food availability and what parameters are being considered for assessing food insecurity and food access. Since USDA is a government website it helped us gain insights into what parameters are widely considered while defining agricultural policies.

B. Data understanding

Quality of data before doing analysis is important hence we checked the data quality and validity using inbuilt methods available in Python like `info()` to understand shape and datatypes, `description()` - to understand spread of the data, `isnull()` - to track all null values in datasets, etc.

C. Data Collection

Data for this project is collected from multiple sources like government websites USDA etc. To understand the income levels of various demographic groups we collected data from

the United States government website for a census and from Wikipedia. To understand food access cost of food plays an important part hence we also collected information about the prices of various food items like fruits and vegetables over a period of time, this data is collected from [1]. USDA has a plethora of information related to food access and food insecure areas. We tried to tap into this vast resource of information to get relevant data to understand food access and food insecurity.

D. Data Cleaning/Data Pre-processing

Data cleaning stands as a critical juncture within the pipeline due to its important role in ensuring that data visualizations accurately and efficiently communicate insights. This accuracy fosters well-informed decision-making and facilitates a deeper understanding of the underlying patterns and trends inherent within the dataset. Data pre-processing serves as an initial phase aimed at readying raw data for visualization by meticulously cleaning, organizing, and transforming it. The quality of pre-processing directly influences the precision, clarity, and usefulness of the resulting data visualizations. The raw data was imported into the cloud using Google Cloud Platform (GCP) for further processing and cleaning. To organize the data efficiently we created multiple buckets based on the type of data we are using and importing data from the above-mentioned sources.

- **Removed Unnecessary columns** We removed unnecessary columns, we focused only on the data that truly mattered for decision-making. By doing this, we made sure that the visualizations we created were clear and directly relevant to the decisions that needed to be made. This streamlined approach will help decision-makers quickly grasp the important insights without being bogged down by irrelevant details.
- **Combining datasource** The distorted data was combined as the data for fresh-food and processed food were separated into various categories and for each like packed, dried, processed, etc. This data was combined from a single sheet for each fruit/vegetable to a combined sheet of processed and fresh food.
- **Removing null values** The data when collected had many discrepancies so making it correct was necessary for further analysis one of which included null values so we took the average price of the packed values and created

a new sheet which has the averaged price of processed and fresh food.

- **Changed Data types/formats** While in the google cloud prep, the sheets should have the same datatypes as after ETL they need to be stored in BigQuery

E. Data Visualizations and Analysis

After data cleaning next step is to explore data and create interactive visualizations. To create visualizations we use Python and Tableau. we uploaded cleaned CSV files using pandas in DataFrame, also we uploaded csv files in Tableau by using DataConnection Tab. Apart from csv we connected BigQuery to Tableau as DataSource to extract data from BigQuery and perform visualizations. We created a total of 4 dashboards consisting of various visualizations to explore different indicators of food insecurity such as income levels and disparity in income. Overall growth of prices of vegetables and fruits over the years, Food access and availability to various demographics of population based on location and distance range, and understanding food insecurity across US.

VIII. DATA DESCRIPTION

The information utilized in this document is sourced from reputable outlets such as the United States Census Bureau and the Economic Research Service (ERS) of the U.S. Department of Agriculture (USDA). Specifically, it references the following datasets and publications:

1) *Income in the United States: 2022:*

- Source 1:
 - **Source** Census Bureau [2]
 - **Format** CSV
 - **Description** This report provides estimates on income, earnings, and inequality in the United States for the year 2022. It is based on data collected in the 2023 and previous Current Population Survey Annual Social and Economic Supplements (CPS ASEC) conducted by the Census Bureau. The publication offers insights into real median household income, changes in earnings across various demographic groups, and shifts in workforce dynamics. Additionally, it includes measures of income inequality and post-tax income estimates.
 - **Ingested into**
- Source 2:
 - **Source** Office of the assistant secretary for planning and evaluation website [2].
 - **Format** CSV
 - **Description** This dataset presents poverty guideline figures since 1982 for the 48 contiguous states and the District of Columbia. It includes information on the poverty thresholds for different household sizes and provides a historical perspective on changes in poverty guideline computations over time.
 - **Ingested into**

2) *Food Prices:*

- Source 1:
 - **Source** U.S. Department of Agriculture website [3]
 - **Format** CSV
 - **Description** USDA contains comprehensive data related to prices of food across the United States over the years. USDA collected prices for fruits and vegetables over the years for urban and rural areas. They also keep track of agricultural produce generated and consumed over years and respective properties.
 - **Ingested into** From this dataset we collected price information about the most consumed fruits and vegetables over years. We collected data for frozen and fresh produce for price comparison.

3) *Food Access:*

- Source 1:
 - **Source** U.S. Department of Agriculture website
 - **Format** CSV
 - **Description** Economic Research Service (ERS), USDA Description: This compilation of reports, publications, and interactive tools offers comprehensive insights into food security and accessibility in the United States [4] [5]. It includes annual reports on household food security status, definitions of food security, key statistics, and trends in food insecurity over time. Additionally, it provides research papers, webinars, and resources related to the impact of food security on public health, social well-being, and economic stability.
 - **Ingested into** From this dataset we picked information related to how many households have access to affordable and nutritious food within 1, 10, or 20 miles of the area. This dataset also considers the factor of vehicle availability to procure food from the nearest food accessibility center such as stores or supermarkets.

4) *Food Insecurity:*

- Source 1:
 - **Source** U.S. Department of Agriculture website [6]
 - **Format** CSV
 - **Description** Additionally to food access USDA keeps information about food insecurity where they maintain data of food secured and food insecure households based on various categories such as education, marital status, and employment status. [7] This data source also provided us with food security for children and people with disabilities.
 - **Ingested into** We procured data related to food insecurity by households. We are considering food insecurity by various categories such as by education level, employment state, and marital state. Apart from these, we are also considering children who are facing food insecurity.

IX. VISUALIZATIONS AND ANALYSIS

A. Trends of Median Income by Races

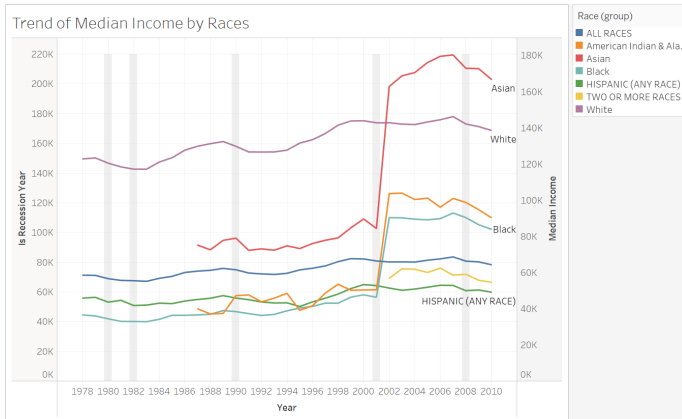


Fig. 3. Trends of Median Income by Races

In 3, the line graph presents a clear visual representation indicating that the Asian demographic exhibited superior economic resilience and performance compared to their white and black counterparts during the recessionary period [8]. A notable upward trajectory in income levels can be observed in the year 2001, which could potentially be attributed to the advent of the technological era. This move towards a more technology-based and innovative economy likely led to a corresponding increase in salaries and pay, which could explain the noticeable rise in income levels during that year. From the graph, we can also infer that the median income level of whites and Hispanic people remained relatively the same from 1978 to 2010.

B. High and Low Income Groups Over Years

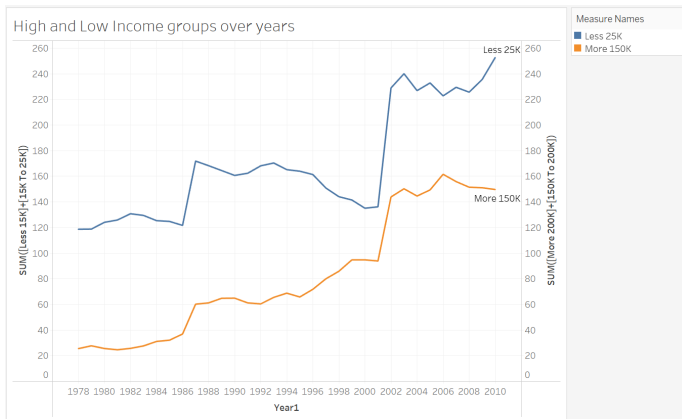


Fig. 4. High and Low Income Groups Over Years

In 4 we can see that the graph gives an in-depth insight into the income range of less than 25k and more than 150k and from the graph we can determine the gap between the income levels of people and we can see there has been a gradual increase in the group of people having 25k income compared

to the people who have 150k income. This shows the income of more number of people is between 15k to 25k and there are only few groups or section of people who have more or equal to 150 income. This gives us comprehensive knowledge about the buying capacity of people.

C. <15K income by Races

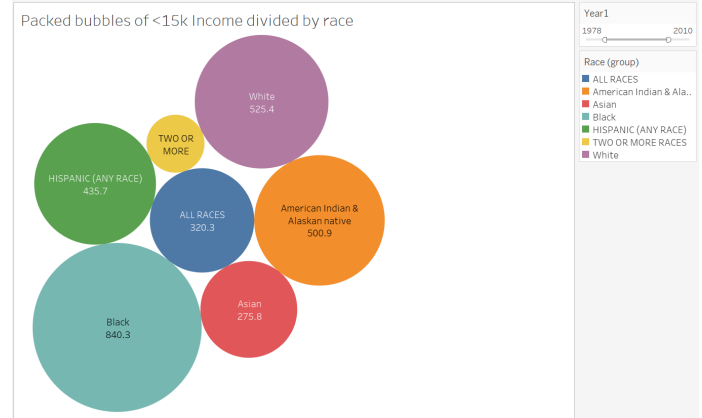


Fig. 5. <15K income by Races

5 provides insights into the population distribution across different racial groups for those earning less than 15k annually. The size of the bubbles in the chart corresponds to the number of people within each racial category falling into this low-income bracket. Notably, the largest bubble represents the black population, indicating that they have the highest concentration of individuals earning below 15k. In contrast, the Asian population is depicted by the smallest bubble, suggesting that they have the lowest number of people within this income range among the racial groups shown.

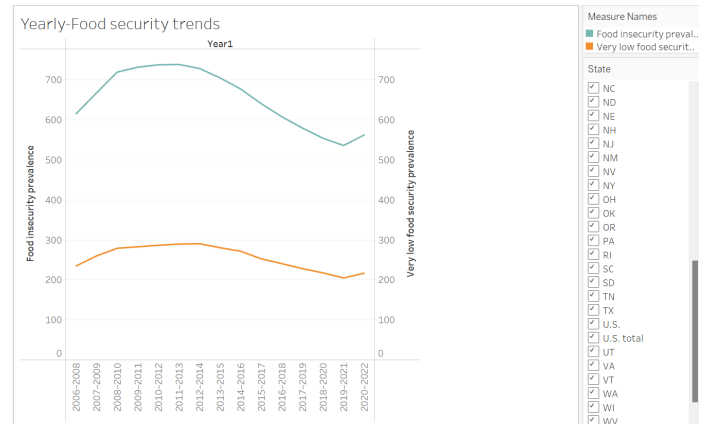


Fig. 6. Yearly Food Security Trend

D. Yearly Food Security Trend

We can see from 6 that the food insecurity was low from 2008 - 2015, then this insecurity increased over time. The average number of households with food insecurity in states has been increasing over the years, which means food security

is declining due to factors like lack of accessibility, stagnant or decreasing income levels, and limited availability of food options

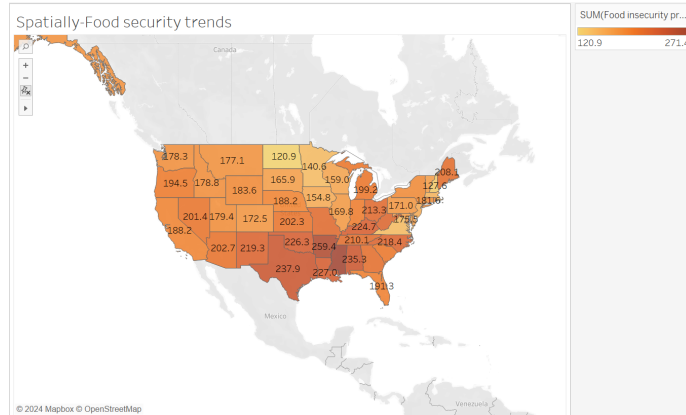


Fig. 7. Spatially Food Security Trends

E. Spatially Food Security Trends

If we look at 7, is a map of the average Food security indicator across the states for the year bracket chosen in the dashboard. It indicates that Northwest regions have low food insecurity compared to the southern parts of the United States. Mississippi and Arizona are the areas with the highest food insecurity values. It might be because of various geographical and social reasons around the region. Another observation is developed states shows less food insecurity.

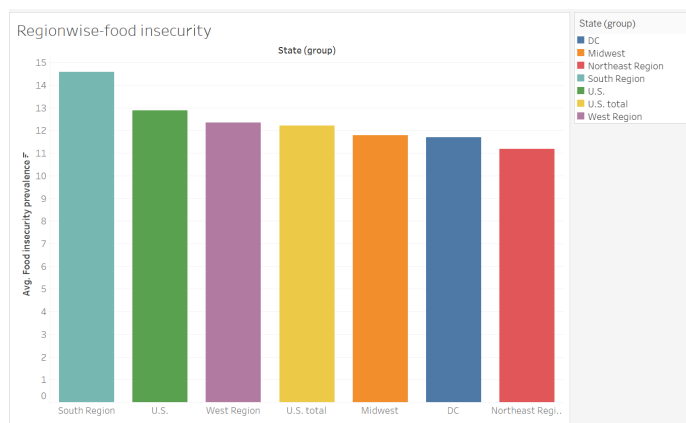


Fig. 8. Region-wise Food Insecurity

F. Region-wise Food Insecurity

Looking at 8, we can see that the southern region has the highest level of food insecurity compared to other regions, especially the northeast which has the lowest prevalence. However, the differences in food insecurity rates across regions are relatively small. While the southern states face the most significant challenges, the issue of food insecurity is present across the nation, though to varying extents.

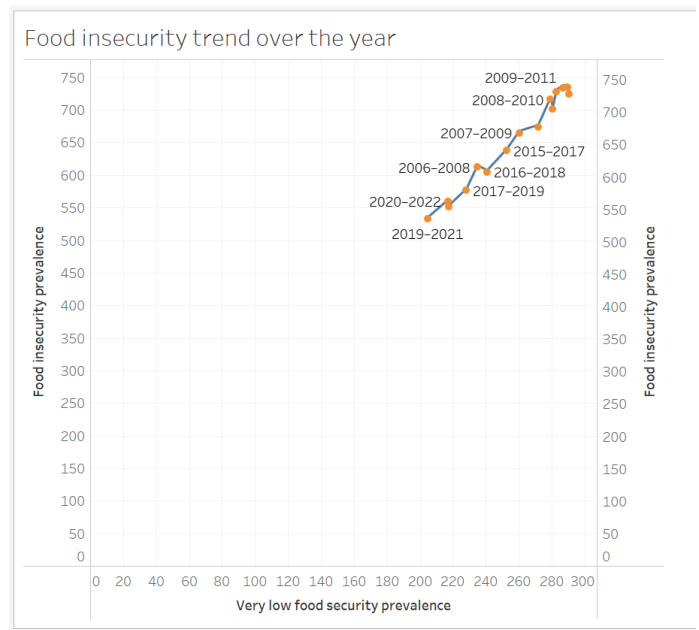


Fig. 9. Food Insecurity Trend Over Years

G. Food Insecurity Trend Over Years

9 shows a consistent decline in food insecurity over the years. The prevalence of food insecurity, measured by the Food Insecurity Prevalence (FIP), was around 750 in 2009-2011 but gradually decreased to around 500 in 2019-2021. This steady reduction in food insecurity levels is commendable progress that should continue for the country to further improve food security

H. Food insecurity by Education levels

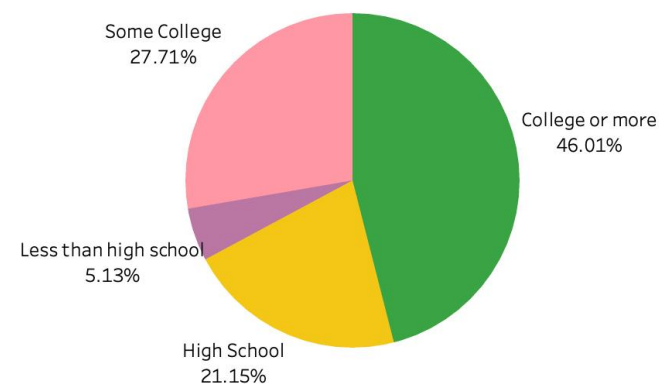


Fig. 10. Food insecurity by Education levels

10 shows an unexpected trend where people with a college degree or higher education seem to experience higher levels of food insecurity. Two potential reasons could explain this finding: 1) There may be a lack of job opportunities or

high unemployment for those with higher education degrees, leading to food insecurity. 2) The survey data could be skewed if people with less education did not participate as much, under representing their food insecurity levels. This counter intuitive result warrants further examination to understand and address food insecurity across different educational backgrounds.

I. Food insecurity by Disability

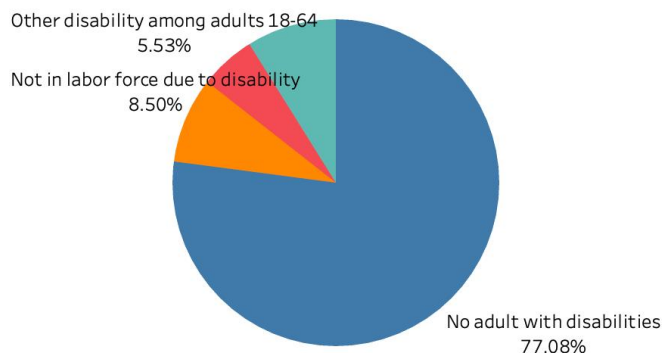


Fig. 11. Food insecurity by Disability

For 11 we can clearly let that a significant proportion of people with disabilities face food insecurity, including those unable to work due to their disability. Although the percentage of people with disabilities (8.5 percent) is lower than those without disabilities, this still represents a very high number of food-insecure individuals within the disabled population, given their smaller overall size compared to the non-disabled population.

J. Food insecurity by Employment

The 12 reveals food insecurity affecting both retired individuals and those with full-time jobs. A significant number of retirees face this issue, likely due to insufficient retirement income. Concerningly, even people employed full-time experience food insecurity, suggesting their wages are inadequate for sustaining a reasonable living standard in the current economy. This data highlights the need to reassess wage levels and retirement benefits to ensure access to basic nutritional needs across different life stages.

K. Processed Food VS Fresh Food

In the 13 we see that over the years, the average price of fresh foods is lower than processed foods. While the availability of both fresh and processed foods has increased, there is a larger increase in processed fruits compared to fresh fruits. However, the opposite trend is seen for vegetables, where there is a greater increase in the availability of fresh vegetables compared to processed vegetables.

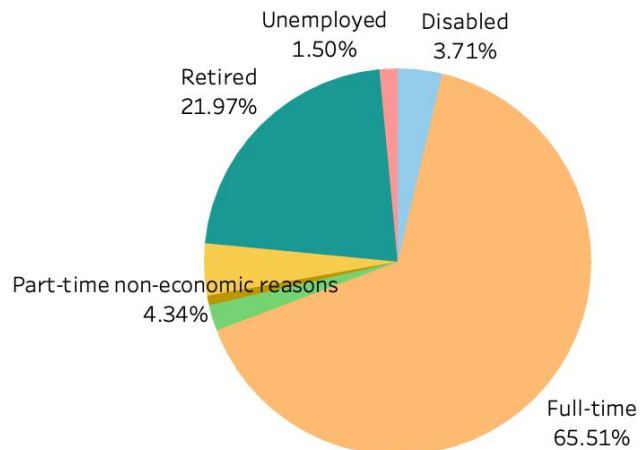


Fig. 12. Food insecurity by Employment

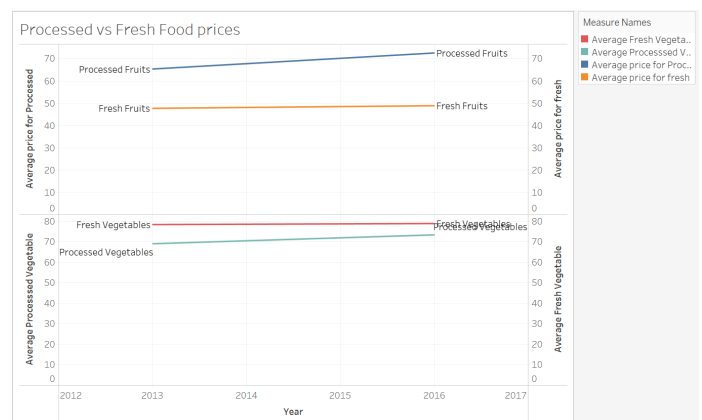


Fig. 13. Trends of food prices over years

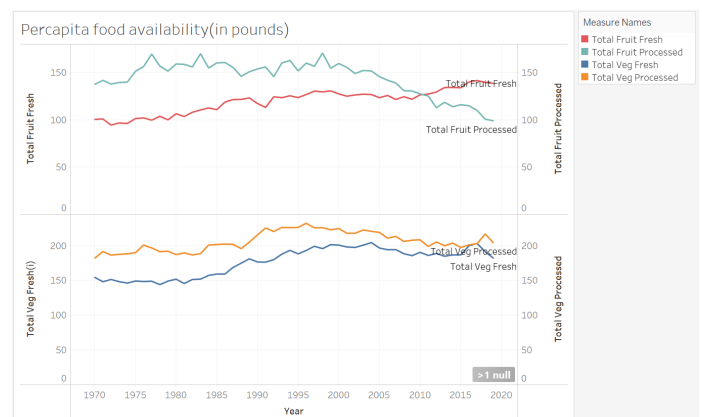


Fig. 14. Per Capita Food Availability

L. Per Capita Food Availability

[htbp] 14 shows the per capita availability of fresh food over the year here you can see that over all there is an increase in the fresh food when compared to processed food the per capita-availability of fresh fruits show that people are demanding more fresh fruits the reason might be concern towards the health that people are becoming health concious and are demanding fresh fruits rather than processed also another point might be the availability of fruits ie there is an increase in production of fresh foods like fruits and vegetables.

M. Average Vegetable Price

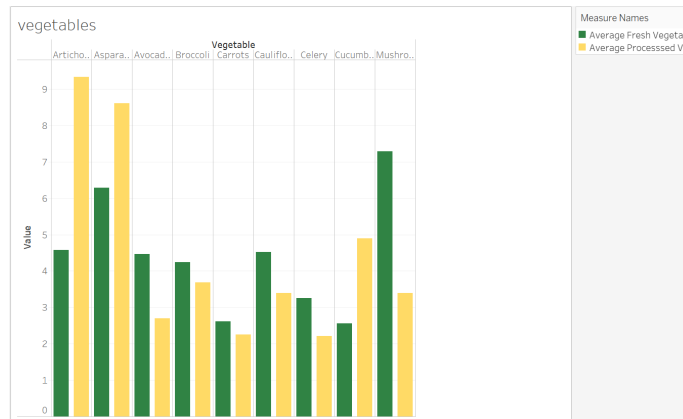


Fig. 15. Average Vegetable Price

16 and 15 presents the prices of various fruits and vegetable available in the markets. Conducting this survey was crucial as it helps analyze whether the income levels of people influence or drive up the prices of food items in the markets. By analysing the relationship between consumer income and fruit prices, insights can be gained into the affordability and accessibility of fresh produce for different groups.

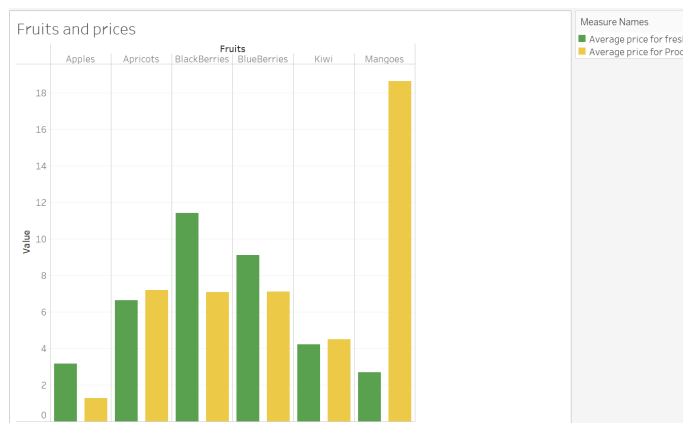


Fig. 16. Fruit Prices

X. FINDINGS AND RESULTS

17 provides a comprehensive overview of income levels across different racial groups. This data allows for an analysis

of the purchasing power and economic status of various racial demographics. The figure presents the median annual income, as well as the ranges for high and low incomes over multiple years. This information is crucial for understanding the income disparities and growth trajectories among different sectors of the population. By examining these income trends across racial lines, policymakers can gain valuable insights to inform interventions and strategies aimed at addressing socioeconomic inequalities and promoting equitable economic opportunities for all communities. 18 shows the prices of common vegetables and fruits that people consume daily. It also provides data on the per capita availability of these foods, which is the amount available for each person, typically measured in pounds. By looking at both the prices and the per capita availability along with people's income levels, we can analyze if individuals from different income groups can afford to buy enough fruits and vegetables at the given market prices. This analysis helps understand if people across all income levels have access to these nutritious foods based on their purchasing power. 19 provides an overview of food accessibility across different regions. The graph illustrates the availability of food per region, which helps assess whether people have access to food within their local area. Additionally, it indicates the distance in miles that people need to travel to access food sources. This information is crucial for understanding the food environment and identifying potential food deserts or areas with limited access to nutritious options. By analyzing this data, policymakers and stakeholders can develop targeted strategies to improve food accessibility, particularly in regions where access is limited or requires traveling long distances. 20 presents geospatial trends in food insecurity across different regions. It highlights the commendable decrease in overall food insecurity levels over time. The dashboard categorizes food insecurity data, providing insights into how various segments of the population are impacted by limited food access. Additionally, it depicts the yearly food security trends, which show a relatively small increase. By analyzing this comprehensive regional data on food insecurity prevalence and its decline, along with the contrasting trends in food security, stakeholders can gain a nuanced understanding of the progress made and the areas that still require focused interventions to ensure equitable access to adequate nutrition.

XI. TOOLS AND TECHNOLOGIES

A. Google Cloud

We used various tools provided by GCP for various purposes but mainly we used GCP as a Data Warehouse. After extracting data from various sources we imported this data into buckets. Buckets were categorized based on the type of data eg. Income level data, Food prices, and consumption, Food Access, and Food insecurity data. This categorization of data helped us segregate our data by specific domain.

B. Python

Python is widely used for extraction and data processing. In our project, we used Python for data cleaning, extraction, and

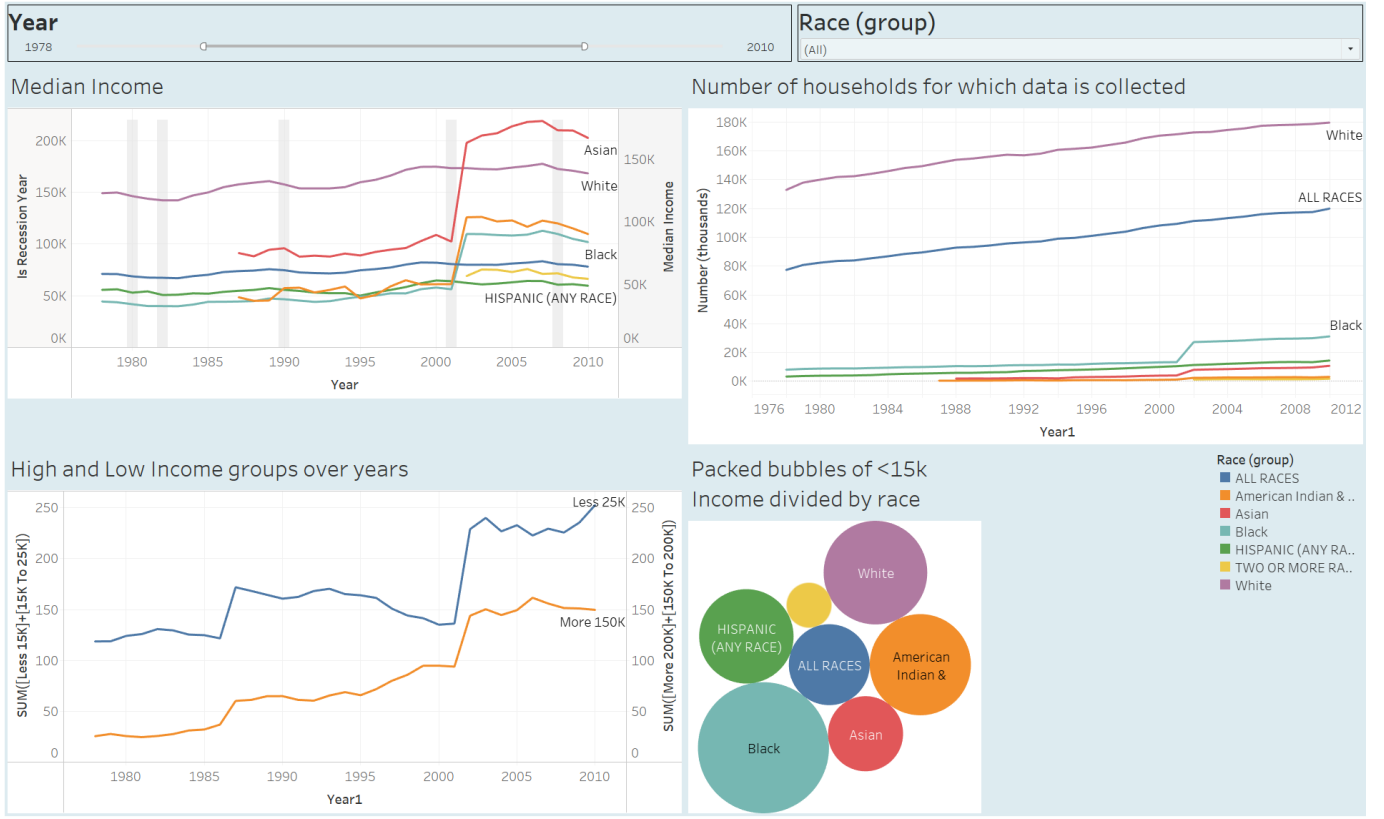


Fig. 17. Dashboard for income levels

visualizations. We used libraries such as Pandas, Matplotlib, seaborn, etc. Rich library set and ready-to-use functions in Python for data cleaning and data visualizations simplified much of our work.

C. Tableau

We used Tableau to provide interactive visualizations/dashboards. These dashboards allow users to explore the data visually, uncover patterns, and understand how various factors of food security and food access. Using Tableau we connected to BigQuery and extracted the data. The main challenge we faced was connecting the data to use in the same Tableau book. Since most of our data was not directly related to establishing a connection among it (foreign key) hence, for some visualizations we had to rely on Python for data frame manipulations.

D. Jupyter Notebook

Jupyter Notebook served as our primary platform for Python-based data extraction and cleaning tasks. Its interactive environment facilitated iterative development and allowed for seamless integration of code, visualizations, and documentation. Through Jupyter Notebook, we streamlined our data processing workflow, enhancing collaboration and reproducibility.

E. APIs and Drivers

For connecting with BigQuery we used Google Cloud. BigQuery driver. This driver helped us establish a connection between Python and BigQuery and allowed us to query BigQuery. This use of a driver made the connection very easy, we just had to create a service account in Google Cloud and give permission to access BigQuery. Then in Python code, we have to access the OS library and add a credentials path to it. credentials path is the file path and name of a JSON file downloaded while creating service account credentials.

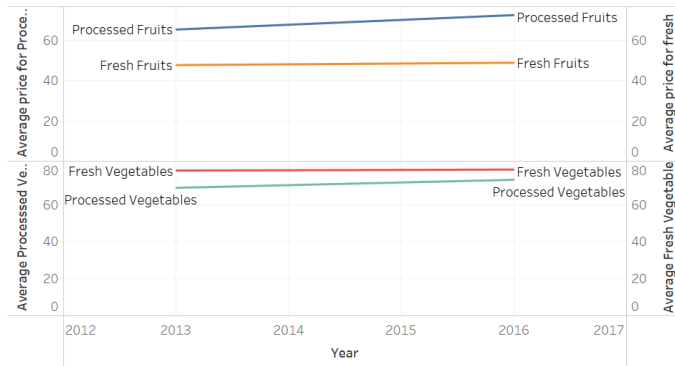
F. Excel

Excel enabled the visualization and analysis of data but faced challenges when dealing with extensive datasets. Working with large files frequently resulted in performance issues and delays. Moreover, memory limitations hindered intricate analyses, leading to the consideration of other software options. While Excel's interface is easy to use, its shortcomings with big datasets required the adoption of more scalable alternatives.

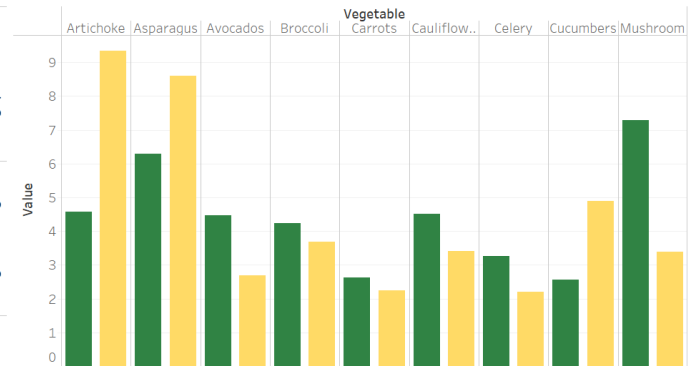
G. Google Trifacta DataPrep

We used this tool for Data cleaning and data preparation. Trifacta provides GUI tools for exploring, cleaning, and transforming data which omits the need for depending on programming languages such as Python for data preparation purposes.

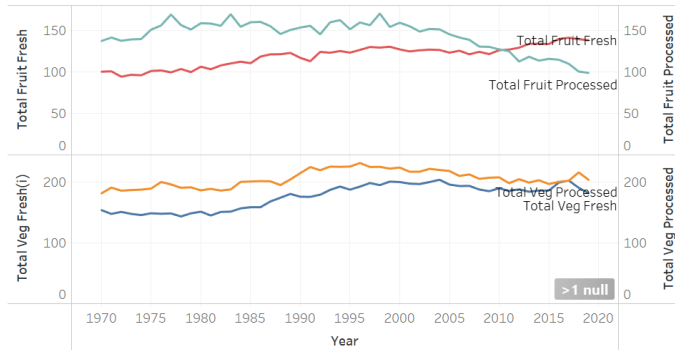
Processed vs Fresh Food prices



vegetables



Percapita food availability(in pounds)



Fruits and prices

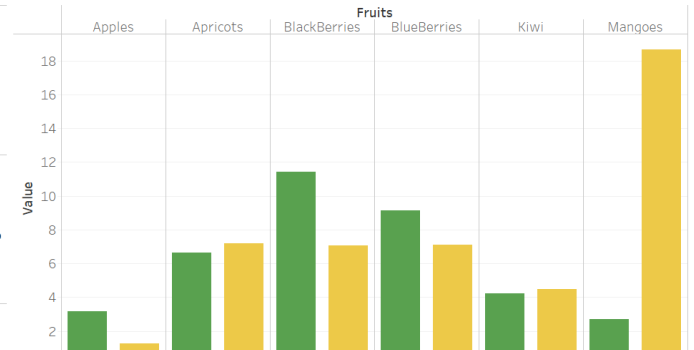


Fig. 18. Dashboard for food prices

We used a wide range of pre-built recipes. Using DataPrep we cleaned data by dropping null values and filling in mismatch values also, we dropped and renamed some columns. Tools like Dataprep made tedious and time consuming process of data cleaning and transformation very easy and efficient.

H. BigQuery

Google BigQuery served as a repository for our cleaned dataset from Google Trifacta DataPrep, enabling seamless storage and efficient data retrieval. Its integration with Tableau facilitated interactive visualizations, enhancing data exploration and analysis. Leveraging BigQuery's columnar storage architecture, we experienced accelerated query performance, empowering us to extract insights swiftly from our data. In summary, BigQuery played a pivotal role in optimizing our data pipeline, enabling streamlined data management and insightful analysis.

XII. LIMITATIONS

There are several inherent limitations that constrain the extent and depth of our study. Firstly, our analysis is restricted to data available up to 2022, which means we may have missed recent developments that could significantly impact food insecurity. This underscores the importance of ongoing monitoring and updating to ensure the relevance and accuracy of our findings in a constantly changing socio-economic landscape.

Additionally, our project narrowly focuses on specific indicators for evaluating food insecurity, potentially overlooking important nuances and interconnections within the issue. Food insecurity is a multifaceted phenomenon shaped by various socio-economic, cultural, and environmental factors. By confining our analysis to predetermined metrics, we risk oversimplifying the complexity of the problem and missing key insights needed for effective intervention strategies.

Lastly, our research is confined to the United States, limiting the applicability of our findings to a global context. Different regions may exhibit variations in cultural norms, government policies, and socio-economic structures that lead to unique expressions of food insecurity. Recognizing these constraints, future efforts should embrace broader perspectives and interdisciplinary approaches to comprehensively tackle the multifaceted nature of food insecurity.

XIII. FUTURE SCOPE

Understanding food security requires a comprehensive examination that goes beyond surface-level analysis and explores the intricate socio-economic and demographic factors that impact access to food. One promising avenue for future research involves conducting a detailed analysis of food security across various demographics and segments of society. By breaking down data based on factors such as income levels, household composition, and geographical location, researchers can gain

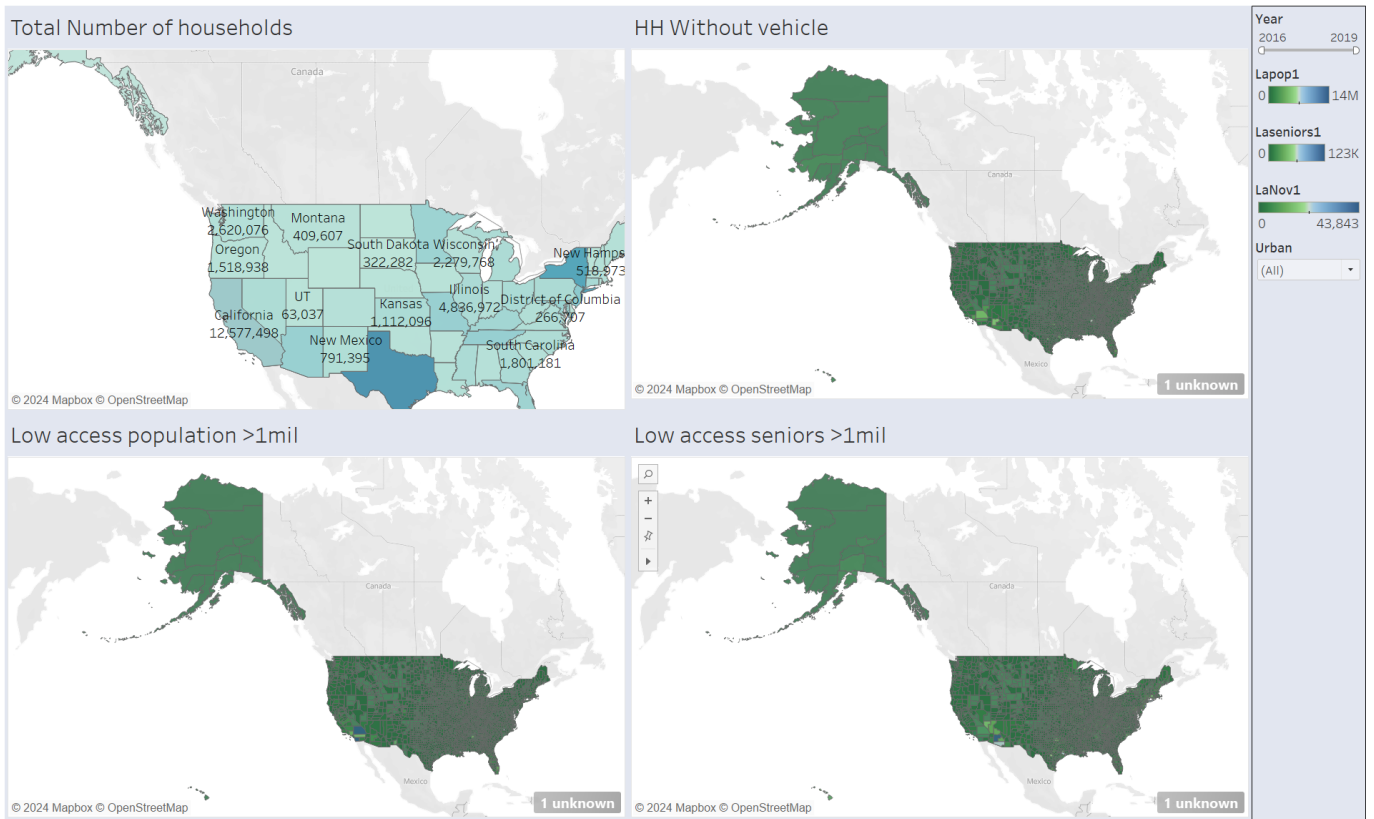


Fig. 19. Dashboard for food access

valuable insights into the specific obstacles faced by vulnerable populations. This approach not only allows for a more targeted allocation of resources but also enables policymakers to design interventions that cater to the unique needs of different groups.

Furthermore, studying food preferences specific to different demographics provides a valuable perspective for assessing food availability and accessibility. By understanding the dietary habits and cultural preferences of diverse communities, researchers can identify potential gaps in the food supply chain and develop strategies to ensure equal access to nutritious food options. This tailored approach recognizes the diversity of food systems and consumption patterns, thus paving the way for more inclusive policies and programs aimed at promoting food security.

Looking ahead, it is also crucial to expand the scope of food security assessments to include analyses at the county and city levels. While national-level data offer valuable insights into broader trends, they may overlook localized disparities and inequalities. By zooming in on specific geographic areas, researchers can uncover spatial variations in food access and vulnerability, thereby informing targeted interventions at the regional level. This localized approach acknowledges the diversity of food environments and emphasizes the importance of context-specific solutions tailored to the unique challenges faced by different communities.

The future of food security research lies in embracing a

multi-dimensional and context-sensitive approach. By delving deeper into the complex factors influencing access to food, conducting granular analyses, and considering demographic-specific preferences, researchers and policymakers can work together to develop effective strategies that address the diverse needs of populations and promote food security for all.

XIV. RECOMMENDATIONS

- **Invest in Sustainable Agriculture** To promote productivity and environmental sustainability, practice sustainable farming practices. Support small farmers to increase food availability in remote areas.
- **Strengthen Social Safety Nets** Expand social protection programs such as food vouchers and providing subsidized food in schools to provide vulnerable populations with food.
- **Targeted Interventions** Implement targeted interventions where we need to support food security, especially for children, the elderly, and persons with disabilities.
- **Enhance Food Distribution Systems** Improve infrastructure for storage, transportation, and distribution of food products. Improve food accessibility in remote areas.
- **Promote Nutritional Education and Awareness** Implement nutrition education programs to promote healthy eating habits and optimal nutrition practices.

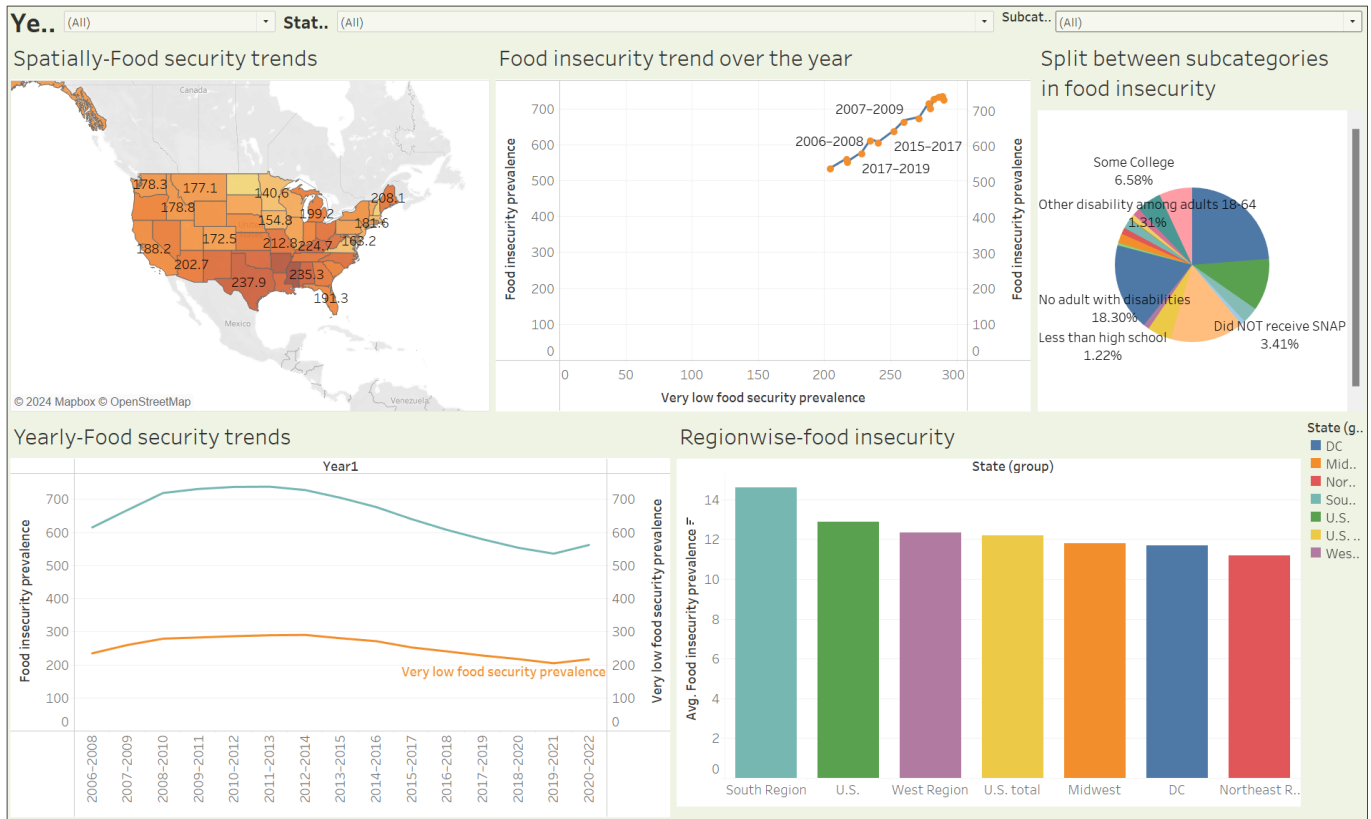


Fig. 20. Dashboard for food security

XV. CONCLUSION

In summary, our thorough examination of food security and accessibility throughout the United States provides a detailed insight into the obstacles and possibilities within this crucial field. By delving into factors such as income levels, food availability in different regions, demographic characteristics, and socio-economic gaps, we have shed light on the intricate web of variables that impact food security. Our results emphasize the pressing need for targeted interventions to tackle the underlying causes of food insecurity and ensure fair access to nutritious and affordable food resources for all individuals and communities.

Looking ahead, we propose a comprehensive approach to addressing food insecurity that includes policy measures, community involvement, and technological advancements. Enhancing access to affordable and nutritious food choices, especially in underserved areas, is vital for advancing public health, alleviating poverty, and promoting social equity. Furthermore, utilizing data visualization tools and analytics can empower decision-makers in government, policy agencies, and non-profit organizations to make well-informed choices and implement effective strategies. By prioritizing sustainable agriculture, strengthening social safety nets, and promoting nutritional education, we can strive towards establishing a just and resilient food system that upholds the basic right to food for all.

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