Food Insecurity of Children in the Food Bank of Central and Eastern North Carolina Food Bank Service Area

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Abstract— **North Carolina is labeled as the 10th hungriest state in America, with almost 1 in 5 children in North Carolina facing hunger regularly. Based on these numbers alone, childhood hunger is an important issue that needs to be addressed. This paper focuses on the thirty-four counties serviced by the Food Bank of Central and Eastern North Carolina. Each county is mapped out, showing the percentage of children receiving free or reduced meals. These numbers are then compared to the number of Weekend Power Packs, Kid Cafes, and School Pantry locations per county. This project illustrates the strength of visual analytics for decision making.**

Keywords—visual analytics, data visualization, geocoding, food insecurity, food banks,

I. INTRODUCTION

Childhood hunger in the public school system is a huge problem. Many of us find it hard to believe that some kids only have one meal a day, which is often the meal they get from school. America is divided into the haves and the have-nots [1]. The distance between the two groups is snowballing instead of decreasing, impacting children the most [1, 2, 3, 4]. In fact, in many ways, children are considered the most vulnerable members of society. Children who end up on the have-nots side often grow up without the food that they need.

The consequences of childhood food insecurity related to poverty are very detrimental to children. Children experience food insecurity and poverty very differently than adults. Many times, when an adult falls into poverty and faces food insecurity, it is only temporary. On the other hand, when a child falls into poverty, "they may be poor for a lifetime – rarely does a child get a second chance at an education or a healthy start in life" [5]. Studies have shown that even short periods of food deprivation can be detrimental to children's long-term development [5]. "If children do not receive adequate nutrition, they lag behind their peers in size and intellectual capacity, are more vulnerable to life-threatening diseases, perform less well in school, and ultimately are less likely to be productive adults" [5]. "Child poverty threatens not only the individual child but is likely to be passed on to future generations, entrenching and even exacerbating inequality in society" [5].

This research project aims to bring awareness to childhood food insecurity and its impacts on children. The project's overall main goal is to show visual analytics of the counties in central and eastern North Carolina that have children receiving free and reduced meals in relation to the placement of food bank resources provided by the Food Bank of Central and Eastern North Carolina. A major aim of this project is to demonstrate how visual analytics can present data in a way that makes it easy to interpret and so support decisions in an intuitive way.

A. Visual Analytics

Visual analytics provides a multi-disciplinary focus on large volumes of data by exploiting the complementary strengths of computational data analytics and human visual perception and comprehension. Visually presenting large datasets facilitates human comprehension of critical aspects of the data and thus supports informed and effective decision making. As Keim et al. state, "Visual analytics combines automated analysis techniques with interactive visualizations for an effective understanding, reasoning, and decision making based on extensive and complex datasets" [6]. Fekete et al. note that data visualization enables faster elimination of competing theories purportedly explaining the data "by relying on the speed of the perceptual system "[7].

When working with large datasets, data visualization provides unmatched cognitive support. Vision has an intimate connection with the cognitive centers of our brain, and data visualizations act "as a frame of reference or as a temporary storage area for human cognitive processes" and augment our memory with a large working set for analysis "and thus become external cognitive aids" [7]. Visualizing data replaces symbolic, logical inferences, which have a heavy cognitive load, with the more rapid inferences possible with visual perception [8]. Visualizing data can make it easier and more efficient to obtain the information and gain the insights needed to perform tasks, thus making task performance more

efficient. Our group's previous work on food availability shows the strength of visual analytics in this area [9].

As one would expect from the multi-disciplinary nature of visual analytics, in addition to human perception and comprehension, visual analytics uses a multitude of tools, including databases, spreadsheets, automatic analysis tools, programming techniques, and especially visualization tools.

Many different tools were used for visual analytics, including database-related tools, mapping tools, and data analysis tools that automatically sorted through data. For this research, many different data visualization tools were used. Spatial analysis tools were used to make a geocoded reference to the different food locations for children within each of the thirty-four county service areas. Visual data analysis was employed by using Tableau to create map layers of private data and public data obtained for this research.

B. Research Questions

This project primarily focused on the following research questions' visual analysis, specifically the thirty-four counties serviced within the Food Bank of Eastern and Central North Carolina.

1) Where are the locations per counties of the Weekend Power Packs (WPP), Kid Cafes (KC), and School Pantries (SP) for children? Are the WPP, KC, and SP placed in locations where there are the highest rates of children receiving free and reduced meals based on the National School Lunch program data?

Weekend Power Packs are within schools that offer backpacks with meals for children over the weekend that are nonperishable. Kid cafes are locations within the community that children can go to after school to get help with homework, a snack, and dinner. School pantries are food pantries located within schools in some of the Food Bank of Central and Eastern North Carolina counties that allow children and their families to come in and get a box of food that contains fifteen to twenty meals.

2) Are the Weekend Power Pack, Kid Cafes, and School pantries being utilized by a good percentage of the food insecure children in each of the thirty-four counties that are serviced by the Food Bank of Central and Eastern North Carolina?

The Food Bank of Central and Eastern North Carolina has three kid feeding programs. This research focused on the numbers of children who are food insecure and receiving free and reduced meals according to the National School Lunch Data for the 2019-2020 school year [10]. The data obtained from the National School Lunch Program was used to create a choropleth map based on those percentages.

3) How has COVID-19 impacted the number of children using services from the School Pantries, Kid Cafes, and Weekend Power Packs increased compared to previous years?

Twenty-three out of the thirty-four counties serviced by the Food Bank of Central and Eastern North Carolina have greater than sixty-five percent of their students receiving free or reduced meals. This is just for the 2019-2020 school year. This research question aims to compare the percentage of students receiving free or reduced meals per county to the percentage of children using the food bank's resources per county. Data was collected and analyzed for the years 2018-2020.

This project aims to map out all of the Kid Cafes, School Pantries, and Weekend Power Packs per county. It is explicitly focusing on the thirty-four counties serviced by the Food Bank of Central and Eastern North Carolina. This information will be made available to the Food Bank of Central and Eastern North Carolina so that they will be better equipped to place these locations in counties that need food resources for children more than others.

C. Matching Providers with Those in Need

The Food Bank of Central and Eastern North Carolina serves thirty-four counties. The majority of those counties have over sixty percent of their children receiving free and reduced meals. In some of those counties with the highest rates of children receiving free or reduced meals, there are no food bank resources for those children. This project aims to help the food bank by providing visual data analytics of the children in need vs. resources available to them.

II. DATA MODELING

A. Data Collection

The data required for this visualization is location data for all food resources for children in the Food Bank of Central and Eastern North Carolina service area, which consists of thirty-four counties. The food bank provided a list of the kid programs per county. The Weekend Power Packs, Kid Cafes, and School Pantries were developed in collaboration with the food bank. The data of the children receiving free or reduced meals per county was provided by the National School Lunch Program [10]. The Weekend Power Pack, Kid Cafes, and School Pantry addresses were obtained using a google search. The goal was to include as much data as possible to get a complete picture of the food resources available to children per county within the food bank's thirty-four county service area.

B. Data Sources

Static data was used for the visualizations. Datasets were obtained from the most up-to-date sources available to avoid inaccurate or out of date information. Some data files needed to be created from Microsoft Excel or Google searches since some of the data was not tabulated. Listed here are each data group's sources and the size (rows x columns) of the data file obtained or created.

- Kid Café: Meals and Kids Serviced during school year 2018-2019 (94 x 9)

- Schools Pantries: Boxes given and Kids Serviced during school year 2018-2019 (79 x 8)

- Weekend Power Packs: Backpacks given and Kids Serviced during school year 2018-2019 (186 x 7)

- School Pantry: Boxes given and Kids Serviced during school year 2019 -2020 (78 x 8)

- Weekend Power Packs: Backpacks given and Kids Serviced during school year 2019 - 2020 (135 x 7)

- Kid Cafes: Meals and Kids Serviced during school year 2019 - 2020 (75 x 10)

- Percentage of children receiving free or reduced meals per the thirty-four county service area (35 x 6)

C. Data Cleaning Process and Tools Used

RStudio was employed for data organization by filtering out the pounds coming to each of the thirty-four counties via the Weekend Power Pack program, Kid Café program, and the School Pantry program. RStudio was also used to filter out the number of kids serviced per each child program per county. The information was also sorted via the 2018-2019 and 2019-2020 school year. A spreadsheet was created and downloaded to make data visualizations using Tableau Software.

Once the names of the Weekend Power Pack, Kid Café, and School Pantries were obtained, a google search was obtained to get the actual address of the different locations. Geocoding was then performed on those addresses. The number of children per county was obtained and cleaned from the National School Lunch program and created percentages of children per county receiving free or reduced meals. Tableau was used to create visual analytics of the data obtained throughout this research.

III. METHODOLOGY

A. Geocoding

Geocoding was used to transform the addresses of the different School Pantries, Weekend Power Packs, and Kid Café locations. The resulting locations were used for mapping the different points on the map. The information was then entered into a spreadsheet. The spreadsheet was then uploaded to Tableau to create the maps with different color markers for each county's different locations. Colors broke down the locations regarding the type of location: School Pantry, Kid Café, and Weekend Power Pack. These locations were then mapped out on a graph.

We were then able to create map layers to create a choropleth map of the percentages of children in each county who receive free or reduced meals. The darker the color, the higher percentage of children in that county who receive free or reduced meals.

B. Sorting and Graphing

The data was obtained from the Food Bank of Central and Eastern North Carolina. The data was in the form of a database. We used RStudio and R programming to filter out the columns and rows relevant to our research interests. This research project was interested in the following column headings: Weekend Power Pack, Kid Café, School Café, after school programs, number of meals, pounds of food, number of boxes distributed. This data was then used to create a

spreadsheet. The spreadsheet was then uploaded to Tableau to create charts of the number of kids serviced per county and the number of meals given per county. This information was placed on a map as well as shown in the graph formats.

C. Interpereting the Data

The data was interpreted once the various graphs were created. The maps of the thirty- four-county service areas were broken down into six different service branches. The six different service branch locations are: Sandhills, Wilmington, New Bern, Durham, Raleigh, and Greenville—see Figure 1.

Figure 1: Thirty-Four Counties Separated by Their Service Branch Location by Color.

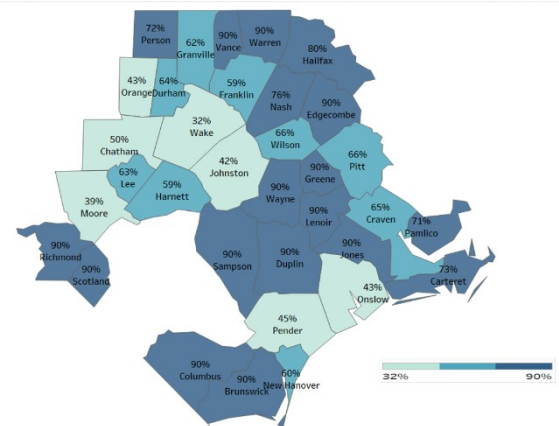## IV. RESULTS

A. Placement vs. Needs

Figure 2: Choropleth Map of Children Receiving Free or Reduced Meals in the Thirty-Four Counties.

Visual Analysis in Figure 2 shows that many children are receiving free or reduced meals. Based on Figure 2, the following counties have ninety percent of children receiving free or reduced meals: Vance, Warren, Edgecombe, Greene, Wayne, Lenoir, Jones, Duplin, Sampson, Brunswick, Columbus, Scotland, and Richmond. Those are staggering

numbers. There are only six counties with under fifty percent of children receiving free or reduced meals in the count; those counties are listed as follows: Wake, Johnston, Onslow, Pender, Chatham, and Moore.

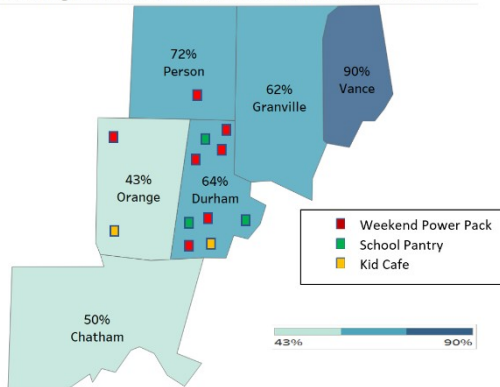Percentage of Children Receiving Free or Reduced Meals in the Durham Service Branch Area

Figure 3: Placement vs. Need in Durham Service Branch Area

As shown in Figure 3, the Durham Service Branch serves six counties in their area. The six counties have 44,911 children receiving free or reduced school meals. That makes 60% of the children in the whole service area. This map contains the weekend Power Pack Locations, Kid Cafes, and School Pantries. If one looks closely at the map, one will notice that some counties with the highest rates of children receiving free or reduced meals do not have a Weekend Power Pack site, Kid Café, or School Pantry. Vance especially has 90 % of students receiving free or reduced meals, and they have nothing in their county for the children to get easy access to food if they need it. There is a concentration of resources in Durham county; however, Chatham, Granville, and Vance do not have any resources available to the children even though these three counties have more than 50% of the children receiving free or reduced meals.

Percentage of Children Receiving Free or Reduced Meals in the Greenville Service Branch Area
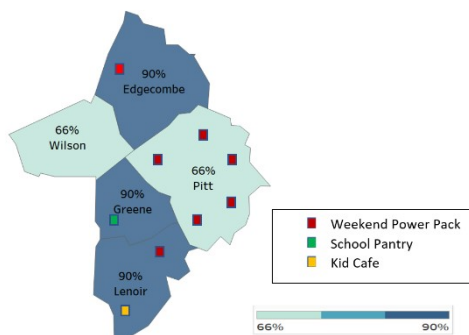

Figure 4: Placement vs. Need in Greenville Service Branch Area

As we see in Figure 3, the Greenville Service Branch area has 42,499 children who receive free or reduced school meals. That makes up 81% of the children in the service branch area. Figure 3 map shows where the School Pantries, Kid Cafes, and Weekend Power Pack locations are in relation to the

different counties. The Greenville Service Area consists of five counties. For the most part, this service area has at least one of the three resources for the children to access. However, Pitt county has five-weekend power pack sites. It would be a great idea to close one of those sites and move it to Wilson county, with 66% of students who do not have access to the weekend power pack, kid café, or school pantry.

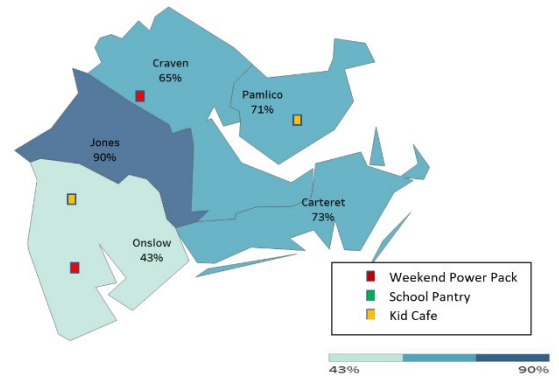Percentage of Children Receiving Free or Reduced Meals in the New Bern Service Branch Area

Figure 5: Placement vs. Need in New Bern Service Branch Area

Figure 5 shows the New Bern Service Branch, which serves five counties. When we combine all five counties, there are 28,502 children total who are receiving free or reduced school meals. The New Bern service branch area does not have any Weekend Power Pack programs in their service branch area. Jones county has ninety percent of their school-age children in their service area who receive free or reduced meals, yet they have no Weekend Power Pack location, Kid Café, or School Pantry. The same goes for Carteret county, with 73 percent of its students. On the other hand, Onslow County has just 43% of the children in their county receiving free or reduced meals, yet they have both a School Pantry and a Kid Café while other counties with higher numbers do not.

Percentage of Children Receiving Free or Reduced Meals in the Sandhills Service Branch Area
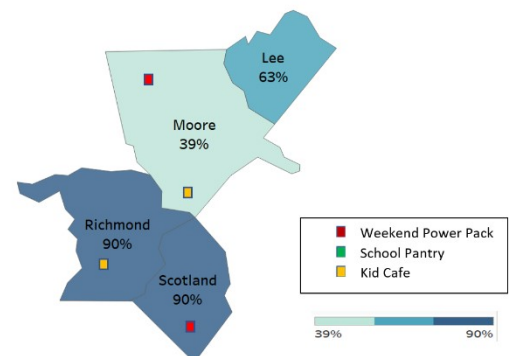

Figure 6: Placement vs. Need in Sandhills Service Branch Area

Figure 6 shows the Sandhills Branch Service Area, which serves four counties. There are 24,565 children in this service area who receive free or reduced school meals. That means

that 71% of the school-age children in this area are receiving free or reduced meals. It is interesting to note that this service area does not have any School Pantries, nor does it have other official pantries located within the service area. It does have Weekend Power Packs within the service area, but those are not the same thing. Lee county has 63 percent of its students receiving free or reduced meals, yet there is no Kid Café, Pantry, or Weekend Power Pack program for the kids to access food if they need it. On the other hand, Moore County has just thirty-nine percent of students receiving free or reduced meals, yet they have a Weekend Power Pack location as well as a Kid Café.
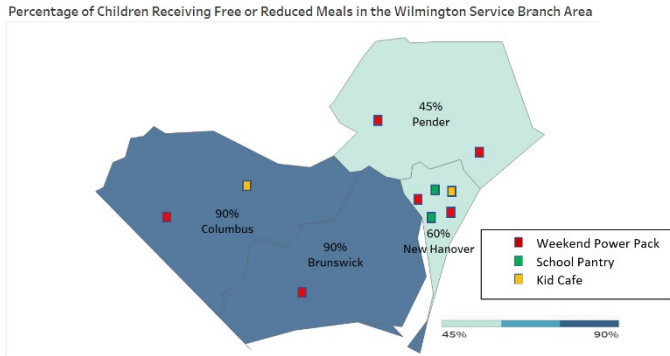

Figure 7: Placement vs. Needs in Wilmington Service Branch Area

The Wilmington Service Branch is shown in Figure 7, and it services four counties. There are 41,928 children who receive free or reduced meals in the Wilmington Service branch area. That makes 71% of school-aged children in this service area. This is one of the better service areas because, as we can see, there is at least one out of the three in each county. However, there is room for improvement. Brunswick has ninety percent of students receiving free or reduced meals, yet New Hanover county has more resources. New Hanover has A Kid Café, two Pantries, and two Weekend Power Pack Programs. It seems like some of those resources can be used to open a new location in Brunswick County.
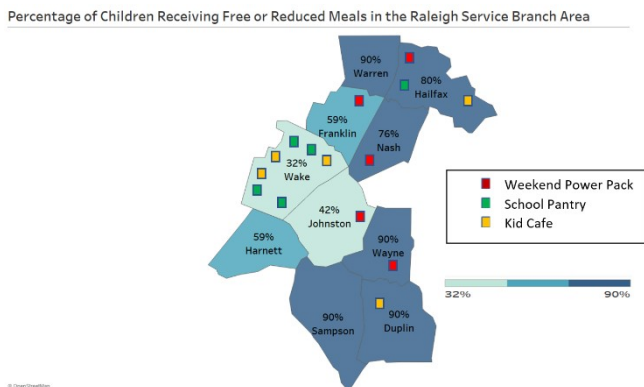

Figure 8: Placement vs. Needs in Raleigh Service Branch Area

The Raleigh Service Branch area is shown in Figure 8. The Raleigh Service Branch has 145,034 children who are receiving free or reduced meals. That makes up 71% of the children in the service area who are affected. Wake county has 32% of children who receive free or reduced meals. Even though Wake county has the lowest percentage of children receiving free or reduced meals, this county still has four school pantries and three kid cafes. Warren and Sampson Counties have 90% of their children who receive free or reduced meals, and those counties do not have any resources available for the children. Harnett County has 59% of their children who are in need, but they do not have any resources available to the children either. Wake County has an oversaturation of resources available to their children, yet they have the lowest need.   Some of Wake County's resources should be relocated to other counties with higher needs that do not have any resources available.
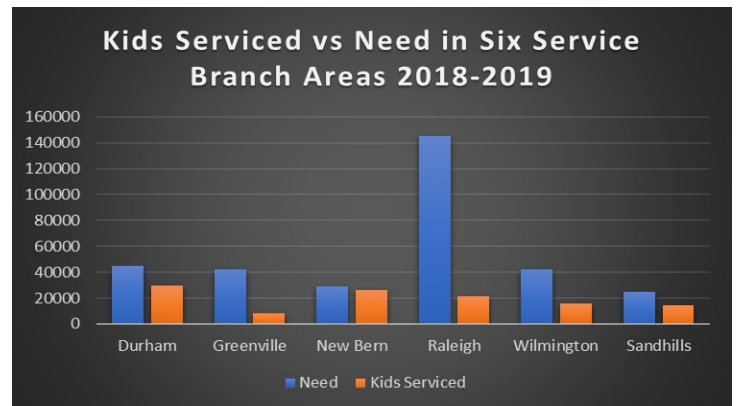
B.   Utilization of Services

Figure 9: Kids Serviced vs. Need in the Six Service Branch Areas for the School Year 2018-2019

Figure 9 shows the total number of kids serviced in each of the six service branch areas alongside the total number of kids in need in each of the six service branch areas. The total number of kids serviced in each service branch area includes the Weekend Power Pack, Kid Cafes, and School Pantries kid totals.   There were 44,911 children in need in the Durham branch, and 29,719 of those children received services through either the Weekend Power Pack, Kid Café, School Pantry programs. The Greenville service branch has 42,499 children in need, but only 7,882 children were serviced through either of the three programs. New Bern has 28,680 children in need, but only 26,257 of the children received services through the kid programs. Raleigh has 145,034 children in need, but only 21,624 of the children were reached via the three programs available in the service area. Wilmington service branch area has 41,928 children in need; however, only 15,884 of the children were reached through the services available in the service area. Sandhills Branch area has 24,565 children in need in the service area; however, only 14,135 of the children were reached through the three different services provided to the children.
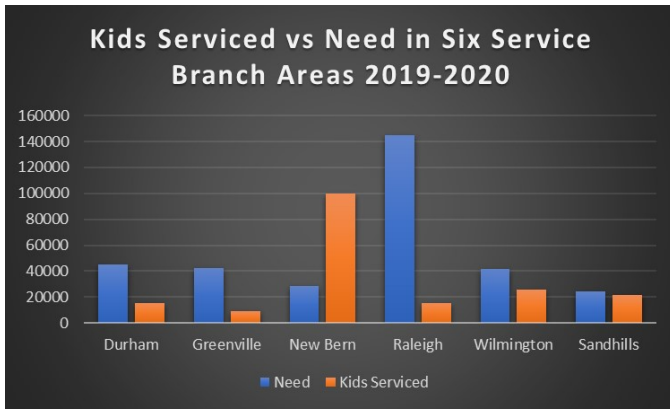
Figure 10: Kids Serviced vs. Need in the Six Service Branch Areas for the School Year 2019-2020

Figure 10 shows the total number of kids serviced in each of the six service branch areas alongside the total number of kids in need in each of the service branch areas for the 2019-2020 school year. The total number of kids serviced in each of the service branch areas include the Weekend Power Pack, Kid Cafes, and School Pantries kid totals. In the Durham service branch area, there are 44,911 kids in need, and there were 15,521 kids serviced. In Greenville, there are 42,499 kids in need, but only 9,162 kids were serviced. New Bern has 28,680 children in need, but only 9,675 kids were serviced. In the Raleigh service branch area, there are 145,034 kids in need, but only 15,683 children were serviced. In the Wilmington service branch area, there are 41,928 kids in need, but only 25,526 of the children were serviced. In the Sandhills Branch service area, there are 24,565 children in need, and a total of 21,812 children were serviced.
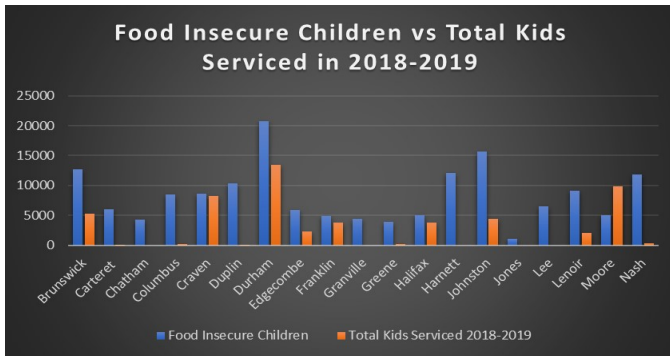

Figure 11-A: Food Insecure Children vs Kids Serviced by Counties for the 2018-2019 School Year
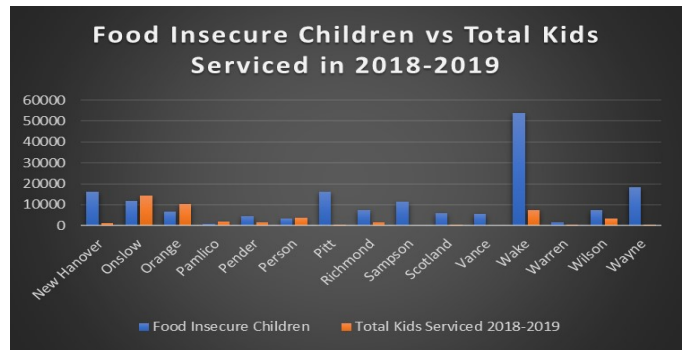

Figure 11-B: Food Insecure Children vs Kids Serviced by Counties for the 2018-2019 School Year

Figure 11-A and Figure 11-B show the list of all counties for the 2018-2019 school year of children in need alongside. total kids serviced. Chatham, Granville, Harnett, Jones, Lee, Sampson, and Vance county did not reach any of the children in need in those counties. Craven, Durham, Franklin, Halifax, Moore, New Hanover, Onslow, Pamlico, and Person Counties reached over half of the children in the counties who were food insecure.
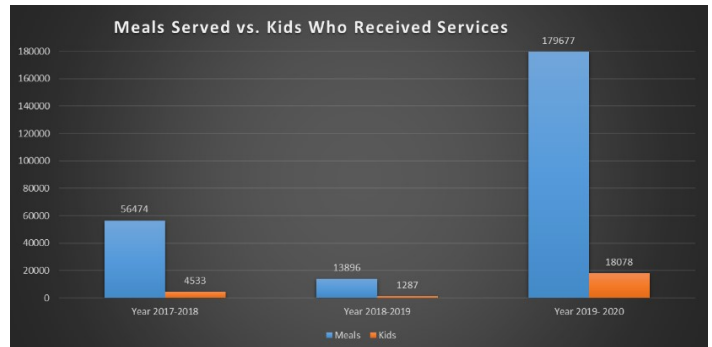
C. Impact of COVID-19

Figure 12: Meals Served from June to August for the School Years 2017-2018, 2018-2019, and 2019-2020

The goal of this research objective was to cover the impact that COVID-19 has had on the Food Bank of Central and Eastern North Carolina. To see the increased demand, it was imperative to establish a baseline of the children serviced over the whole thirty-four counties for the summers of the previous two school years and the summer of school year 2019-2020. Figure 12 shows the meals given alongside the number of kids serviced for the summers of these three school years. In the suumer of year 2017-2018, there were 4,533 kids that were given a total of 56,474 meals. In the summer of school year, 2018-2019, 1,287 kids were served 13,896 meals. In the summer of the 2019-2020 school year, 18,078 kids were served over 179,677 meals. Based on this data, over 2.5 times as many meals were given during the summer of the COVID-19 crisis than were served in the previous two summers combined, and over three times as many kids were served in the summer of 2019-2020 than in the previous two summers combined. This is quite convincing evidence of the impact of

COVID-19 on the mission of the Food Bank of Central and Eastern North Carolina.

V. CONCLUSION

A. Key Research Findings

- Vance county in the Durham Service branch area has 90% of children receiving free or reduced meals, but the county does not have any available resources for the children.
- Chatham and Granville both have over 50% of their children who receive free and reduced meals, but they do not have any available resources for the children in those counties either.
- Durham County has an oversaturation of resources for the children in their county, even though only 64% of the county's children are food insecure.
- Wilson County has 66% percent of the county children who receive free or reduced meals, but the county does not have any resources available to the county's children.
- Pitt county has five Weekend Power Pack locations even though the county only has 66% of the children in the county who receive free or reduced meals. Some of the resources in Pitt county could be relocated to other counties that need the resources more.
- Jones county has 90% of children receiving free or reduced meals, and Carteret county has 70% of its children affected, yet the two counties do not have anything available to the children in those counties.
- Lee county has 63% of the children who receive free or reduced meals, but the county does not have any children's resources. In contrast, Moore County only has 39% of its children affected, yet this county has both a Kid Café and a Weekend Power Pack location.
- Sampson, Warren, and Harnett Counties each have over 50% of the children in their counties who receive free or reduced meals, yet those counties do not have any resources for the children.
- Wake county has only 32% of its children who receive free or reduced meals, yet this county has three kid cafes and four school pantries.

B. Findings on Using Visual Analytics

The use of visual analytics in this research project yielded great results. The use of data layer analysis was significant in mapping out the locations of the Kid Cafes, Weekend Power Packs, School Pantries. Because of data layer analysis, we were able to place the geocoded locations on top of the choropleth maps of children receiving free or reduced meals. This was very essential to addressing our research concerns. In future work, it is the goal to use different types of correlation analysis on the data found to address related issues. The use of R and RStudio was critical in wrangling the data, and the use of Tableau was essential in creating the charts and graphs that

were used throughout the report. In the future, our goal is to use Tableau to explore the ongoing COVID-19 pandemic.

C. Transition to Practice

The final deliverable is to begin working with the Food Bank of Central and Eastern North Carolina to help to expand their efforts in feeding children in their thirty-four-county service area. Most of the information was provided by the food bank. However, the use of visual analytics is incredibly beneficial to the food bank. This project brought together all of the kid programs across the Food Bank of Central and Eastern North Carolina in the most up to date format to show all of the resources available in their service area. The Food Bank of Central and Eastern North Carolina will use the provided data to work towards better food access to the children in counties with the most need. This final iteration of the project includes an updatable spreadsheet of files containing all of the gathered spatial location data and an interactive map.

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