

Access to Nutritional Food for SNAP Recipients through the Sustainable Farming
Method of Aquaponics

by

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Abstract

As rates of recipients qualifying for the Supplemental Nutrition Assistance Program (SNAP) in Tennessee increase, so do non-communicable diseases due to poor diet. It is imperative to direct attention to this issue in an effort to address the factors that lead to inaccessibility to healthy nutrition for SNAP recipients. This thesis reviews the factors and issues specific to a population of SNAP recipients through a review of literature available on this topic. Additionally, this thesis proposes interventions for SNAP recipients and a possible solution to decreasing food deserts and increasing accessibility to healthy nutrition.

Keywords: SNAP recipients, Accessibility, Nutrition, Aquaponics

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Glossary

Aquaponics: Aquaponics is a sustainable aquaculture system combining aquaculture and hydroponics. Aquaculture is the act of farming fish and other water life; hydroponics being the act of growing plants in a system on water without soil (W., 2018).

Non-Communicable Diseases: “Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behaviors factors” (World Health Organization, 2017).

Food Insecurity: “The U.S. Department of Agriculture (USDA) defines food insecurity as a lack of consistent access to enough food for an active, healthy life” (What is food insecurity in America? 2018).

Nutritional Food: Nutritional food is defined by the government standards of healthy nutrition and is also interchangeably referred to as “healthy food” and “nutrition”.

SNAP: The Supplemental Nutrition Assistance Program. (SNAP) is a nutrition assistance program through the federal government created to supplement household food costs for low income Americans.

Introduction

Background

Accessibility to healthy nutrition for low-income Americans is a topic many have studied (Fox, Hamilton, & Lin, 2004; Shenkin, & Jacobson, 2010; Denton, 2016). The extraneous variables that play into the issue of access to healthy foods have left researchers looking at each variable individually instead of collectively (Shenkin & Jacobson, 2010). Although there has been ample research done, accessibility to healthy food continues to worsen. According to the government's financial standards, the neediest population in United States (U.S.) are recipients of SNAP. In Tennessee, there are over a million people who fall below the poverty line and rely on government assistance for basic necessities (USDA, 2018). Part of that reliance is on the ability to purchase healthy food. Research indicates that the amount of assistance recipients of SNAP in Tennessee receive does not yield a possibility for the purchase of a healthy and balanced diet (Drewnowski & Eichelsdoerfer, 2010).

The goal of this thesis is to provide a possible solution that will make healthy nutrition more accessible to SNAP recipients; aquaponics is an alternative sustainable farming method. Aquaponics has the potential to address the lack of access to healthy food when linked with community participation and education. The following literature review includes insight into the different components that affect access to healthy food such as distance, money, and education which are significant issues for SNAP recipients. This information contained in the literature review can have a substantial impact. Findings will aid other scholars and individuals researching this issue. Furthermore, contents of literature may be used to assist in locating funding for a Participatory Action Research (PAR) pilot study, a study that includes community

involvement, to fund an aquaponic greenhouse to assist in providing accessibility to fresh produce in the community of Murfreesboro.

This thesis begins to search for what could be done to improve access to healthy foods for a population that frequently faces pressures of food insecurity. The food we put into our bodies plays a broad and complex role in our everyday lives (Denton, 2016). Denton (2016), noted that it is important to understand how one's diet will ultimately affect healthy bodily functions. Nutrition is significant to minimizing the onset of non-communicable diseases which are directly related to a healthy diet. When it comes to the effects food has on our health, low income individuals suffer disproportionately over others (Shenkin, & Jacobson, 2010). For individuals to receive SNAP benefits their "gross monthly income generally must be at or below 130 percent of the poverty line" (Center on Budget and Policy Priorities, 2017). For SNAP recipients, a limited budget and low education are main barriers to purchasing healthy foods and while aquaponics has been largely for hobbyists, there is sufficient evidence on how it can be used to supply nutritional food where there is not access to it. The inspiration for this thesis topic comes from personal knowledge of how food impacts the body. Furthermore, the topic for this thesis can be stated as such: Access to nutritional food for SNAP recipients through the sustainable farming method of aquaponics.

Creation of SNAP / Why SNAP Was Created

The first government-based food assistance program was formerly created in 1961, which began as food stamp pilot programs (Hollenbach, & Yosoda, 2017). These small, federally-funded programs allotted food stamps to assist people who could not afford to purchase food due to food insecurity, and to help the farmers who had a

surplus of produce (Hollenbach, & Yosoda, 2017). Over the next three years, numerous pilot programs were funded to address the issue of food insecurity that then affected then approximately 11% of U.S. citizens (Hollenbach, & Yosoda, 2017). These programs fed millions of people across the nation while the economy was low and helped millions survive starvation and malnutrition. In 1964, legislation was passed that took food assistance programs from pilot studies to a nation-wide program designed to alleviate hunger (Hollenbach, & Yosoda, 2017).

History of SNAP

During the Kennedy administration, different food assistance programs were implemented across the U.S., but they were not part of a uniform program. In 1964, President Johnson called upon Congress to pass a federal act to establish the food stamp program as a permanent program. Once the bill passed, its official purpose was to strengthen the agricultural economy and provide an increase in better nutrition for low-income households. Once the Food Stamp Act passed in 1964, the government could regulate it (Hollenbach, & Yosoda, 2017). Until 1967, the bill passed was not effective at reaching citizens due to strict requirements and poor state implementation (Hollenbach, & Yosoda, 2017). In 1967, the Food Stamp Act was starting to get attention about its limited effectiveness by the Senate. This prompted a petition to change the regulations of the nutrition assistance program to reach more people (Hollenbach, & Yosoda, 2017). From 1967 to 1977 the program went through a series of edits and changes until 1977 when the next major legislation was passed (Hollenbach, & Yosoda, 2017).

The Food Stamp Act of 1977, the next major bill passed, was designed to reach more low-income families (Hollenbach, & Yosoda, 2017). At this time, the Thrifty Food Plan (TFP) was created as the guide for the allotment of food stamps. The TFP calculated a food plan based off the allotment of money given to participants each month through food stamps to determine if they could afford to purchase healthy food options (Hollenbach, & Yosoda, 2017). Unfortunately, this bill cut back the amount of food stamps an individual/family received, which made it harder for recipients to have the ability to purchase healthy food options. Major changes took place to the food stamp program due to questions such as budget and accountability; as participation was rising, major reform was taking place. Throughout the 80s, most of the reforms were cutbacks and more restrictions to the program; some of these amendments were “exclusion of energy assistance payments from consideration as income, lowered medical deduction costs from \$35 to \$25, and limited the workfare job search time period from thirty days to ten” (Hollenbach, & Yosoda, 2017, p.51).

The third major bill passed was The Food Insecurity Act of 1985. This act changed the maximum age limit of food stamp recipients from 54 to 50 years of age, required state agencies to encourage their recipients to get involved in the Expanded Food and Nutrition Education and Program (EFNEP), and changed the way the program determined food sale volumes with respect to food retailers, making the process of food stamps easier for the food industry (Hollenbach, & Yosoda, 2017). Then in 1986, the Human Services Reauthorization Act allotted three million dollars to the Community Food and Nutrition Program drawing attention back to the need of more assistance. Over the next decade, food assistance legislation focused more on Native American

tribes rather all low-income Americans. During this time, more cutbacks and restrictions were put in place over the food stamp program (Hollenbach, & Yosoda, 2017).

In 2000, the Electronic Benefit Transfer Interoperability and Portability Act was passed changing the national standard of how food stamps were allotted. This act amended the Food Stamp Act of 1977; its purpose was to make a uniform way to accept and process food stamps throughout the U.S. This 2000 Act changed the nutrition assistance program from paper food stamps to an Electronic Benefits Transaction (EBT) card. This change made food stamps more portable and easier for food retailers to unify the way food stamps were accepted (Hollenbach, & Yosoda, 2017). Finally, in 2002, the Farm Security and Rural Investment Act funded five million dollars for four years into programs to help improve access to nutrition assistance and implemented several state regulations regarding EBT cards (Hollenbach, & Yosoda, 2017).

In 2008, participation reached an all-time high due to low economic performance of the U.S. economy. At this time, Congress passed The Farm Bill promising to increase federal food assistance by 10 billion dollars for the next ten years. Congress also made amendments to legislation to change the amount of food assistance that was given to match current economic inflation (Hollenbach, & Yosoda, 2017). At this point in time, in conjunction with other bills, Congress passed the Food and Nutrition Act of 2008. This federal bill changed the Food Stamp Act of 1977 to the Supplemental Nutrition Assistance Program (SNAP), to reduce the negative stigma associated with the former name (Hollenbach, & Yosoda, 2017). In the state of Tennessee as of April 2018, there are 957,749 individuals living in 465,623 households, receiving SNAP aid amongst all Tennessee Counties (SNAP statistical information, 2018). As the number of SNAP

recipients increase, so should the state's efforts and responsibilities in promoting healthy diets.

Government Standard of Good Nutrition

Background

In 1977, the United States Senate Committee on Nutrition and Human Needs suggested changes in the diet of the American people (Sifferlin, 2016). These dietary recommendations stirred a lot of controversy amongst the different industries in the community including the cattle industry and environmentalists (Sifferlin, 2016). These industries had debates on issues such as whether red meat was healthy to consume and whether the food industry was concerned about sustainability and the impacts it had on the earth. This backlash started the debate on what is the standard of good nutrition for the American people. As the result of this debate, the U.S. Department of Agriculture (USDA) and the United States Department of Health and Human Services (HHS) partnered and created what would become the first Dietary Guidelines in 1980 (Sifferlin, 2016). In 1980, the government formed a committee to ensure that the Dietary Guidelines were accurate. Every five years, the government updates and publishes a new version of the Dietary Guidelines (Office of Disease Prevention and Health Promotion, 2015). These new guidelines include the newest scientific research on the human body and how it processes food. The role that good nutrition plays on the body is vast and complex (Shenkin, & Jacobson, 2010). For example, nearly half the population of the U.S., over 117 million individuals, suffer from nutrition related non-communicable diseases directly related to poor eating and lack of physical activity (Sifferlin, 2016).

More than two-thirds of adults and one-third of children are overweight or obese, and in Tennessee rates of childhood obesity are among the highest in the country (Holtzman, Manon, & Treering, 2011). Nearly 40% of Tennessee's youth are overweight or obese, giving Tennessee the fifth highest obesity rate nationwide (Holtzman, Manon, & Treering, 2011). Lower-income residents in Tennessee are likely to suffer from obesity and other diet-related health problems at rates significantly higher than those of the U.S. population (Shenkin, & Jacobson, 2010). "Nearly one million Tennessee residents, including more than 200,000 children, live in lower-income communities underserved by supermarkets" (Shenkin, & Jacobson, 2010). These health-related issues are continually increasing along with the projected cost of associated with treating these non-communicable diseases. As an example, the prevalence of non-communicable diseases has risen over the past twenty-five years, yet the Healthy Eating Index (HEI) scores, a measure of how food choices align with *Dietary Guidelines*, have remained low (Sifferlin, 2016). In order to prevent non-communicable diseases, a standard of proper nutrition is necessary.

Proper Nutrition

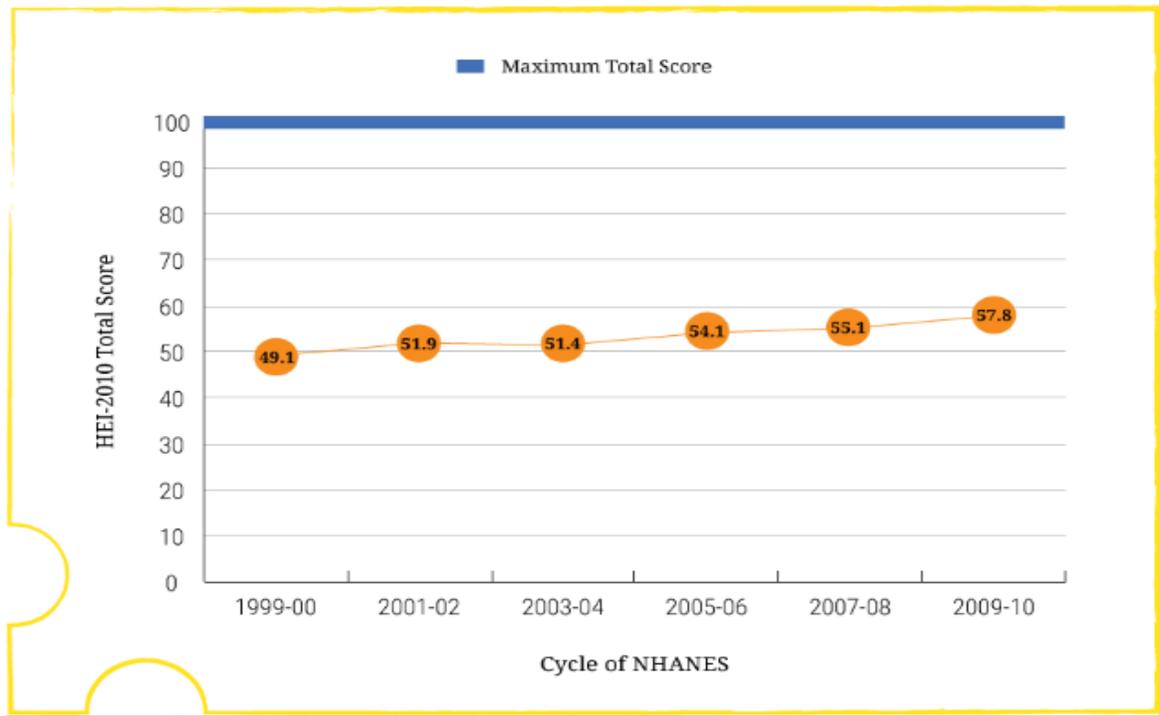
To determine if SNAP recipients have access to proper nutrition, proper nutrition must be defined. According to the latest addition of the *Dietary Guidelines 2015-2020*, an individual should try to consume 2,000 calories a day. These calories should be made up of a variety of food groups. The Dietary Guidelines recommend:

vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other. Fruits, especially whole fruits. Grains,

at least half of which are whole grains. Fat-free or low-fat dairy, including milk, yogurt, cheese, and/or fortified soy beverages. A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), and nuts, seeds, and soy products, along with healthy oils. (ODPHP, 2015)

According to the Dietary Guidelines, if SNAP recipients are to maintain a healthy diet, they should be consuming foods as listed above. However, analyses from *What We Eat in America* and the *National Health and Nutrition Examination Survey (NHANES)*, show that barely half the population in the U.S. is following the recommendations of the USDA’s Dietary Guidelines (Office of Disease Prevention and Health Promotion, 2015)(Figure 1). The question remains: Is it by choice?

Figure 1. Healthy Eating Index Total Score



To prove that households receiving SNAP aid could afford a nutritious diet, the U.S. government created a program called the Thrifty Food Plan (TFP). The TFP is the USDA's market-based, national standard for a low-cost nutritious diet, and is what the government uses to determine the maximum SNAP allotments for each household to this day. However, the ingredients and prep work for cooking what the TFP states in its plan is not concurrent with today's U.S. eating patterns or the Dietary Guidelines.

Research shows:

The TFP that underlies the SNAP benefit calculation assumes SNAP recipients will purchase unprocessed ingredients (e.g. vegetables, fruits, meat, etc.) and prepare the majority of their meals from scratch. It does not account for individual, household, and environmental factors like local food prices, the ability to access fresh foods, the availability of time to shop for and prepare foods, and

the costs of other needed goods and services (e.g. housing, transportation, and medical care). (Melton, 2017)

Table 1. SNAP Benefits by Household Size

Household Size	Maximum Monthly Benefit, Fiscal Year 2018	Estimated Average Monthly Benefit, Fiscal Year 2018 ¹
1	\$192	\$134
2	\$352	\$252
3	\$504	\$376
4	\$640	\$456
5	\$760	\$521
6	\$913	\$618
7	\$1,009	\$672
8	\$1,153	\$852
Each additional person	\$144	

¹ Estimated average benefits are based on FY 2016 SNAP Quality Control Household Characteristics data, the most recent data with this information.

Source: U.S. Department of Agriculture, "SNAP Fiscal Year 2018 Cost-of-Living Adjustments," https://fns-prod.azureedge.net/sites/default/files/snap/SNAP_Fiscal_Year_2018_Cost_of_Living_Adjustments.pdf. SNAP benefits in Alaska, Hawaii, Guam, and Virgin Islands are higher than in the other 48 states and DC because income eligibility standards, maximum benefits, and deduction amounts are different in those states and territories.

Throughout the evolution of the Dietary Guidelines, the cost of the TFP has exceeded the monthly maximum SNAP allotment (Table 1 & 2). Further research shows: “The SNAP maximum allotments vary by household size but do not account for geographic variation in food prices across the 48 contiguous states” (Melton, 2017). Because of this inconsistency, several institutions have suggested modifying the TFP to account for factors that influence a household’s ability to eat a nutritious, low-cost diet (Melton, 2017).

Table 2. Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, May 2018 ¹

Age-gender groups	Weekly cost ²				Monthly cost ²			
	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan
Individuals ³								
Child:								
1 year	\$21.60	\$28.80	\$32.70	\$40.10	\$93.70	\$124.90	\$141.80	\$173.90
2-3 years	\$23.70	\$30.50	\$36.70	\$44.60	\$102.70	\$132.00	\$159.00	\$193.10
4-5 years	\$25.00	\$31.40	\$39.10	\$47.80	\$108.40	\$135.90	\$169.20	\$207.10
6-8 years	\$31.70	\$44.10	\$53.30	\$63.40	\$137.50	\$191.10	\$230.90	\$274.70
9-11 years	\$35.80	\$47.90	\$61.90	\$72.20	\$155.20	\$207.70	\$268.10	\$312.60
Male:								
12-13 years	\$38.60	\$54.80	\$68.80	\$80.80	\$167.40	\$237.50	\$298.20	\$350.10
14-18 years	\$39.90	\$55.70	\$70.80	\$81.40	\$172.70	\$241.30	\$306.60	\$352.90
19-50 years	\$42.80	\$55.30	\$69.20	\$84.90	\$185.40	\$239.60	\$299.90	\$368.00
51-70 years	\$39.00	\$52.20	\$64.90	\$78.50	\$168.90	\$226.20	\$281.30	\$340.20
71+ years	\$39.20	\$51.30	\$63.70	\$78.90	\$170.00	\$222.40	\$276.10	\$341.90
Female:								
12-13 years	\$38.60	\$47.30	\$56.90	\$69.80	\$167.20	\$204.80	\$246.70	\$302.50
14-18 years	\$37.90	\$47.10	\$56.70	\$70.10	\$164.10	\$204.10	\$245.60	\$304.00
19-50 years	\$37.90	\$48.00	\$58.90	\$75.40	\$164.30	\$207.80	\$255.30	\$326.80
51-70 years	\$37.60	\$46.70	\$58.20	\$70.50	\$162.80	\$202.20	\$252.40	\$305.50
71+ years	\$36.40	\$46.00	\$57.20	\$69.20	\$157.70	\$199.30	\$248.00	\$299.80
Families								
Family (Male & Female) of 2: ⁴								
19-50 years	\$88.80	\$113.60	\$141.00	\$176.40	\$384.70	\$492.20	\$610.70	\$764.30
51-70 years	\$84.20	\$108.70	\$135.50	\$163.90	\$364.80	\$471.20	\$587.00	\$710.30
Family of 4:								
Couple (Male & Female), 19-50 years and children—								
2-3 and 4-5 years	\$129.40	\$165.10	\$203.90	\$252.70	\$560.80	\$715.40	\$883.40	\$1094.90
6-8 and 9-11 years	\$148.20	\$195.30	\$243.30	\$295.90	\$642.40	\$846.20	\$1054.20	\$1282.20

The government continued to try to assist SNAP recipients in affording a nutritious diet by implementing a program to help these recipients make informed and healthy choices: Supplemental Nutrition Assistance Program – Education (SNAP-Ed). SNAP-Ed is a research-based federal nutrition education and prevention program consistent with current Dietary Guidelines and is overseen by state and local agencies. “The SNAP-Ed goal is to improve the likelihood that persons eligible for SNAP will make healthy food choices within a limited budget and choose physically active lifestyles consistent with the current Dietary Guidelines for Americans and the USDA food guidance” (Tennessee Nutrition & Consumer Education Program SNAP-Ed, 2014).

The issue that remains is whether the SNAP-Ed program is being utilized. The latest annual report from the *Tennessee Nutrition & Consumer Education Program SNAP-Ed*, reported that the average monthly participation in SNAP was 1,312,505 for the Federal Fiscal Year 2014 (Tennessee Nutrition & Consumer Education Program SNAP-Ed, 2014). However, in the same year, participation and the direct education contacts made for SNAP-Ed were only 207,129 residents of Tennessee, less than 16%. These statistics indicate that SNAP-Ed is reaching a disproportionate amount of the SNAP recipient population. During the fiscal year of 2014, the government funded 2.71 million dollars in the SNAP-Ed program. From the same report, the participation versus the cost can be seen to be highly ineffective in the education of SNAP recipients. However, the SNAP-Ed program when utilized had positive results. Out of the 207,129 participants, the report shows that:

[. . .] 66 [%] increased their consumption of vegetables. [Seventy-two] percent increased their consumption of fruits. [Seventy-nine] percent increased their consumption of whole grains. [Seventy-one] percent increased their intake of fat-free or low-fat dairy products. [Seventy-four] percent reported selecting foods and beverages that promote healthy weight. [Seventy-four] percent adopted healthier lifestyles by increasing their physical activity. [Ninety] percent of youth and 93 [%] of adults washed their hands more often. Lastly, 81 [%] improved at least one practice related to food safety and food storage. (Tennessee Nutrition & Consumer Education Program SNAP-Ed, 2014)

Findings from the Office of Disease and Prevention and Health Promotions (2015), indicate SNAP-Ed is an effective program but is not reaching more than 16% of

SNAP recipients and that these 16% do not necessarily comply with the guidelines: “[C]ollective action is needed to create a new paradigm in which healthy lifestyle choices at home, school, work, and in the community are easy, accessible, affordable, and normative.” Education provided through SNAP-Ed is proven to be vital in the increase of consumption of healthy nutritious foods by SNAP recipients (Tennessee Nutrition & Consumer Education Program SNAP-Ed, 2014). Increasing SNAP-Ed has the potential to educate SNAP recipients and to help increase their access to and intake of nutritious foods. There is an opportunity through SNAP-Ed to increase knowledge about accessibility of nutritious foods for SNAP recipients if efforts are made to reach more SNAP recipients. Drewnowski (2009) notes that one way of modifying dietary behaviors is by modifying the environment.

Demographics of SNAP Recipients

Background

Government nutritional assistance began at the end of The Great Depression, in 1939. Assistance was provided in the form of food coupons as a convenient way to access affordable food for those greatly affected (DiNitto & Johnson, 2016). In the twenty-first century, the government has focused nutritional aid on helping those at lower income levels through SNAP. Total net income is used to calculate eligibility for SNAP: gross total income, minus taxes and certain deductions. Deductions can be expenses such as “housing costs, child support, medical expenses (for elderly or disabled people), or child-care costs” (SNAP, 2018). Research indicates that “SNAP is the largest program in the domestic hunger safety net. The Food and Nutrition Service works with State agencies, nutrition educators, and neighborhood and faith-based

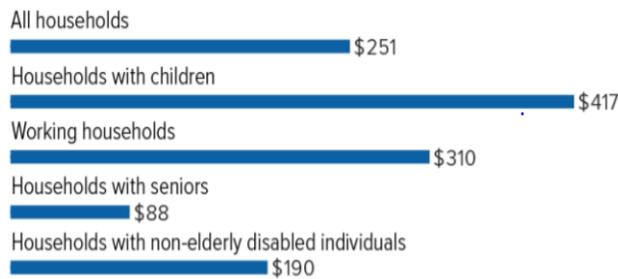
organizations” (Policy Basics: Introduction to the supplemental nutrition assistance program (SNAP), 2017). A more focused analysis allows insight into Tennessee’s SNAP recipient demographic.

Tennessee SNAP Recipients

U.S. Census data shows an estimated population of 6,715,984 people in Tennessee. As of the fiscal year of 2017, there were 1,047,000 Tennessee residents receiving SNAP, or 16% of the state population (1 in 6) (Center on Budget and Policy Priorities, 2018). This is higher than the national average of 13%. In Tennessee, out of the SNAP recipient population, more than 68% of SNAP recipients are families and children, 31% are elderly or have a family member with a disability, and more than 44% are working families (Center on Budget and Policy Priorities, 2018). The report from the Center on Budget and Priorities stated:

Many Tennessee households struggle to put food on the table. The most recent data show: 13.4% of households were “food insecure,” or struggled to afford a nutritionally adequate diet. The Median income was 1% below the 2007 level, after adjusting for inflation, and 15.8% of the population lived below the poverty

Figure 2. Average Monthly SNAP Benefit By Demographic Group, FY 2016, Tennessee



Source: U.S. Department of Agriculture, Office of Research and Analysis, “Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2016”

line. According to the poverty line, 22.4% of children lived below the poverty line, and 8.9% of elderly lived below the poverty line. (2018)

See Figure 2 for average monthly benefits by group.

Why Select SNAP Recipients?

Low-Income families are clearly at a disadvantage when it comes to incorporating healthy eating habits in the home. To receive SNAP, a participant must provide information to prove they are at or below 130% of the poverty line. Consequently, SNAP recipients are among Tennessee's lowest income families despite the aid they receive through SNAP. In many affluent neighborhoods, there is better access to supermarkets and higher quality produce (Drewnowski, 2009). This study and many others merely demonstrate that socioeconomic factors play a large role in access to healthy foods and lead to a profound effect on weight and health (Drewnowski & Eichelsdoerfer, 2010; Hollenbach & Yosoda, 2017; Holtzman, Manon & Treering, 2011; Leung, Hoffnagle, Lindsay, Lofink, Hoffman, Turrell...Blumenthal, 2012). Discrepancies in weight and health are the cause of the increase in non-communicable diseases being seen across lower-income neighborhoods.

Drewnowski (2009), found that one way to change dietary behaviors is to modify the food environment. Increasing consumer access to fresh produce and healthier alternative options, as well as increasing education of the standard to a balanced diet, is the main goal for increasing access to healthy nutrition for SNAP recipients. For SNAP recipients to receive healthy nutrition on a more consistent basis, access to healthy foods should be analyzed.

Accessibility to Healthy Nutrition

Accessibility to healthy nutrition for SNAP recipients is a serious social problem containing many complex variables that will be explained. Since SNAP-Ed only educates 16% of SNAP recipients, the program is simply not effective enough in helping recipients maintain a healthy lifestyle (Tennessee Nutrition & Consumer Education Program SNAP-Ed, 2014). Research by Drewnowski & Eichelsdoerfer (2010), directly related income to the accessibility of a balanced diet today in the U.S. The problem itself is difficult to fix because there are many causes of inaccessibility to healthy nutrition. The causes include: food insecurity, transportation, the cost of food, literacy through education, and time poverty. Inaccessibility to nutritional food is usually tied to food insecurities caused by food deserts.

Food Insecurity

The American Nutrition Association defines a food desert as “parts of the country void of fresh fruit, vegetables, and other healthful whole foods, usually found in impoverished areas (USDA defines food deserts, 2018). Because of food insecurity, many Americans lack the ability to maintain a healthy diet. Food insecurity in low-income communities is greater when compared to middle to upper class communities. For example, in Tennessee “low-income ZIP codes have 25 percent fewer per capita supermarkets than middle-income ZIP codes” (Bell, Mora, Hagan, Rubin, & Karpyn, 2017). Investigating the issue of food deserts across Tennessee, Bell et al. found a trend in supermarkets disinvesting in lower-income communities leading to a public health crisis. While many low-income areas in Tennessee and across the U.S. have lost whole food providers, they have seen increased numbers of local quick markets, fast food

restaurants, and liquor/tobacco stores; such alternatives to supermarkets are known contributors to the obesity epidemic and diet related non-communicable diseases (USDA, 2018).

Food insecurity is a state-wide issue impacting both urban and rural areas in Tennessee and prevents family's accessibility to a healthy balanced diet (Holtzman, Manon, & Treering, 2011). A growing body of research shows that people who live in communities without a supermarket, or who lack transportation to get to one, suffer from disproportionately high rates of non-communicable diseases (Holtzman, Manon, & Treering, 2011). The report further concluded, "Increasing the availability of nutritious and affordable food in communities with high rates of diet-related diseases does not guarantee a reduction in the incidence of these diseases. If barriers to supermarket access can be removed, however, people in these communities can more easily obtain an adequate diet" (Bell, Mora, Hagan, Rubin, & Karpyn, 2017).

Transportation

One of the most detrimental factors for families trying to access healthy nutrition is location of supermarkets. In Tennessee, there are grocery suppliers that accept EBT cards and SNAP benefits, however not all communities have access to such grocery stores and, consequently experience food insecurity. Holtzman, Manon, & Treering (2011), reported that "supermarkets in Tennessee are unevenly distributed, and lower-income communities are categorically underserved with respect to supermarket access" (p.3). Without local access to whole food retailers such as supermarkets, many Tennesseans must travel to obtain them.

Statewide research (Table 3.), indicates how many households lack a reliable vehicle and rely on public transportation instead. In Tennessee, 6% of residents do not

Table 3. Comparison of Surrounding and Peer State Households Without Access to a Private vehicle

States	Total Number of Households	Households with No Available Vehicle	Percentage Without a Vehicle
Kentucky	1,691,716	132,605	8%
Florida	7,147,013	491,123	7%
North Carolina	3,693,221	241,438	7%
Georgia	3,508,477	236,401	7%
Washington	2,619,995	174,452	7%
Missouri	2,358,270	171,138	7%
Indiana	2,478,846	164,456	7%
Minnesota	2,101,875	148,725	7%
Mississippi	1,087,791	75,422	7%
Arkansas	1,128,797	73,623	7%
Texas	8,782,598	520,304	6%
Tennessee	2,468,841	154,425	6%
Alabama	1,837,576	118,707	6%
Virginia	880,873	39,828	5%
Utah	880,873	39,828	5%

TDOT 25-year long-range transportation policy plan demographic & employment changes & trends policy paper (2018.)

have a reliable mode of transportation (TDOT, 2018). Tennessee is not unique to this situation, and it can be seen as an issue nationwide (Bell, Mora, Hagan, Rubin, & Karpyn, 2017). The Tennessee Public Transportation Association (TPTA) reported, “in the United States people board public transportation 35 million times each weekday” (2018). Even with the major supermarkets accepting SNAP benefits, the issue of transportation to the grocery suppliers remains. The majority of Tennessee has poor public transportation. In Rutherford and Davidson county alone, there are thousands of people who rely on public transportation to get them where they need to be (Think Tennessee, 2016). According to a 2016 report from the Tennessee Department of Transportation,

In Middle Tennessee it is referenced nearly more than one in four residents lacks regular vehicle access. Citywide, nearly 3,100 households have no vehicle available. For residents without regular access to a vehicle, affordable and reliable

transit options are critical. Absenteeism, sometimes due to the lack of a way to get to work, is one of the most common reasons the working poor are fired.

Transportation costs eat up the household budgets of the working poor:

Americans in the lowest 20% income bracket spend roughly 42% of their annual income on transportation, compared to 22% for middle-income Americans.

In the same report, between 11-20% of senior citizens and 11.6%, or nearly one in five adults with disabilities, rely on public transportation to get their destination (Think Tennessee, 2016). This is a major issue because many SNAP recipients are adults with disabilities and senior citizens. This further supported by the Center of Budget and Policies (2018) stating, “almost 31% of SNAP recipients in Tennessee are families with members who are elderly or have disabilities” (p.15). In the 2018 census, nearly 3.5 million Americans reported never leaving their home, and more than half of these individuals (1.9 million) has a disability; a majority indicated that transportation issues were the primary contributor to being homebound (Think Tennessee, 2016).

As discussed above, reliable transportation is essential to many residents in Tennessee. Individuals who work non-traditional hours or have obligations outside of public transportation hours, must find other less reliable ways to get to their destination. Additionally, working parents who need to go grocery shopping while they are off work have no way to get to the grocery store if they do not have reliable transportation. Therefore, increasing access to healthy foods and improving public transportation is essential to help Tennesseans with lower incomes. Otherwise, most SNAP recipients in Tennessee simply cannot afford the extra transportation time and cost associated with securing adequate food for a healthy diet.

Food Cost

The cost of food plays a significant role in the consumption of healthy nutrition. To elaborate, processed foods often high in unhealthy fats, sweets, carbohydrates, and preservatives cost less than healthier options such as fresh fruit and vegetables. In addition, cost and location studies show that in many low-income neighborhoods, there is a greater number of fast-food outlets and convenience stores than supermarkets. In contrast, many affluent neighborhoods have better access to supermarkets and higher quality produce (Drewnowski, 2009). Furthermore, the research report by Holtzman, Manon, & Treering states: “A growing body of research demonstrates access to supermarkets has a measurable impact on people’s diet and health outcomes” (2011, p.3). This study merely demonstrate that socioeconomic factors play a large role in access to healthy foods and have a profound effect on weight and health. The government created the TFP to prove that low-income Americans on the budget most SNAP recipients receive can afford to eat a balanced diet (See Table 2). Drewnowski & Eichelsdoerfer (2010) indicated, “the lowest-cost Thrifty Food Plan (TFP) was estimated at \$588.30 per month, or around \$20 per day, for a reference family of 4” (p.246). The average monthly SNAP allotment as of 2018, referenced in figure 2, was \$456. Another factor that makes the TFP unrealistic is that the foods needed to make the TFP so affordable do not align with the average Americans diet. According to the TFP, the foods needed to fulfill the nutrition requirements are foods that were rarely consumed by the average American family, let alone SNAP recipients. According to the *Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average* (2018), a family of four using the TFP monthly budget plan to purchase food would cost

between \$560.80 to \$642.40 monthly. Considering the cost, the TFP is well above the SNAP allotment for a family of four. Therefore, according to the TFP, a family cannot afford a balanced nutritious diet using SNAP benefits alone.

The Economic Research Service/U.S. Department of Agriculture (2010) stated that SNAP provided low-income households with sufficient purchasing power to afford healthy diets. However, when the healthy foods were purchased at the lowest quantity, costs exceeded 80% of the family's maximal SNAP benefits for one day (Drewnowski & Eichelsdoerfer, 2010). Furthermore, if SNAP recipients have access to fresh produce at a lower cost provided by a farmer's market, they cannot use their EBT cards because the majority of farmers markets do not accept them. The EBT card adds another barrier to SNAP recipients accessing fresh produce at a lower cost. In today's society, foods that are low-cost and affordable for SNAP recipients contain high trans fats, bad carbohydrates, and excessive sugars (Drewnowski & Eichelsdoerfer, 2010, p.246). In order to help SNAP recipients find local fresh food and learn how to eat a healthier balanced diet, an increase in local education provided through SNAP-Ed on healthy foods should be included in the plan to increase accessibility.

Literacy Through Education

Health literacy is related to an individual's education level, which is associated with one's understanding of a well-balanced diet (Talk Poverty, 2018). Drewnowski (2009), reported populations of the lowest education levels, income, and in the most underserved areas, have the highest rates of non-communicable diseases. Childhood can positively or negatively impact a child's eating habits when they transition into adulthood. Individuals living in poverty may not have the knowledge of how to obtain

and prepare a balanced diet for several reasons. First, individuals that are now receiving SNAP benefits may not have been exposed to fresh, organic food and the health benefits from having a balanced diet. A significant amount of research shows that a lack of education is directly linked to poor diet (Leung et al., 2013; Drewnowski & Eichelsdoerfer, 2010; Holtzman, Mannon, & Treering, 2011). Second, SNAP recipients may not have the tools or knowledge to prepare a healthy meal (OCA, 2008). This is an important reason to increase the participation in SNAP-Ed.

A Look at Tennesseans’ Education Level

The graduation rates in the top 10 counties for educational attainment in Tennessee showed that 12% of Rutherford County students did not graduate high school and only 27% of graduates obtained some college credits (Table 4). Research conducted by the State of Tennessee (2017) indicates that “over a third of Tennessee’s students are economically disadvantaged. Tennessee’s graduation rate is the highest ever, but only 17% of high school graduates are prepared for college level-courses in reading, english, math, and science” (SCORE, 2017). Such low college readiness shows that even students who are graduating high school are still not getting the highest quality of

Table 4. Top 10 Tennessee Counties for Educational Attainment (2009)

County	Did Not Graduate High School	Graduated High School	Graduated College
Williamson	6%	44%	50%
Davidson	15%	51%	34%
Knox	12%	55%	33%
Shelby	15%	57%	28%
Hamilton	15%	58%	27%
Washington	16%	57%	27%
Rutherford	12%	61%	27%
Madison	16%	59%	25%
Wilson	13%	64%	23%
Montgomery	10%	67%	23%

Source: Woods & Poole

education. It is important to be educated that poverty not only presents in finances but also in time.

Time Limitations

Over the past several decades, most American households have included one person with enough time to shop and prepare meals. However, this is not consistent with present day workforce: “The 2006 TFP recognized that workforce demographic shifts necessitated more convenience foods, yet after modifications, the estimated time required to purchase, prepare, and cook the TFP foods is still higher than the American norm” (Drewnowski & Eichelsdoerfer, 2010, p.248). Hypothetically, the TFP healthy diets would be possible if SNAP recipients dramatically shift their eating habits and spend more time in meal preparation. Drewnowski & Eichelsdoerfer (2010), stated that in using the TFP “[p]roduce preparation included washing, trimming, coring, slicing, boiling, and draining while the noodles were boiled” and that the estimated preparation time totaled 40 minutes” (p.247). In 2017, 60% of SNAP recipients were children living in single parent homes (Carlson, Rosenbaum, Keith-Jennings, & Nchako, 2017).

The expectation that a single parent working full time making minimum wage, is able to support their children and take the time necessary to prepare nutritious meals is unrealistic based on the TFP healthy guidelines. Similarly, in the Middle Tennessee area alone, nearly 40% of families are single parent homes (Think Tennessee, 2016).

Drewnowski & Eichelsdoerfer (2010) sum it up perfectly: “working mothers can follow TFP guidelines and prepare low-cost nutritious foods or can have a paying job outside the home but may find it difficult to do both” (p.247). Since many low-income American families and SNAP recipients are not being paid a living wage, they cannot

afford the luxury of a family member staying home to shop and prepare healthy meals. These statistics present a barrier to eating healthy for many working families because there is simply not enough time to shop and cook these meals. The problem is that, as shown in previous sections, SNAP recipients have less access to healthy nutrition due to a lack of supermarkets within a reasonable distance, affordable transportation, ability to use EBT cards at farmer's markets, and even time to prepare healthy and nutritional foods. For SNAP recipients to receive healthy nutrition on a more consistent basis, a solution for access to healthy nutrition must be met with ingenuity. Aquaponics could provide a potential solution while allowing SNAP recipients to more easily access and prepare healthy foods.

Aquaponics

What is it?

Aquaponics is a sustainable aquaculture system combining aquaculture and hydroponics. Aquaculture is the act of farming fish and other water life; hydroponics is growing plants in a system on water without soil. Aquaponics is a sustainable and natural way to produce fresh fruits and vegetables as well as fish. In aquaponics, there are no chemicals involved because farmed fish supply nutrients for plants to grow from their waste. As the plants are being grown hydroponically, the combination purifies the water. Aquaponics uses a fish tank, a grow bed or plot for the produce, two pipes, and a small pump. One of the pipes works to pump old fish water into the grow bed where the plants purify the water. The purified water then is pumped back into the fish tank through the second pipe. The system works because the fish consistently have fresh water, and the plants receive all their nutrients from the fish waste (Palvis, 2018). If the system is used in a green house or temperature regulated space, it will produce fresh fish

and fruits and vegetables year around. For many years aquaponics has been labeled as a hobbyist activity and has not been used on the broader scale to alleviate food deserts. Due to this, there is not a lot of research on large scale aquaponic operations like I am proposing.

Limitations of an Aquaponic System

Despite aquaponics being so advantageous, there are some negative aspects to this farming system. One negative aspect is that the startup cost. It is recommended that the system be professionally installed which can range from \$1,000- \$10,000 depending on the system. However, the system quickly pays for itself through the amount of produce grown.

Aquaponic systems function with pumps and lamps that require a higher amount of energy usage. Renewable energy would be best for a greenhouse in that it would power itself; however, that initial cost can also be expensive. The choices between which systems to use can also be complicated and require extensive research. There are systems that can be flexible in space, the amount of people receiving produce, location etc. Due to the automatic recirculating system, aquaponics does not require a lot of monitoring or measuring. However, to ensure everything is running smoothly, daily checks should be in place. Lastly, it can be more difficult to grow some plants. Root vegetables such as carrots, beets, onions etc. require a little more preparation and maintenance than plants that do not have deep roots (Pavlis, 2018).

Benefits of an Aquaponic System

Aquaponics has several benefits that make it the perfect solution for food deserts. First is the combination of purified water and fish conservation. Fish kept for large scale food production are often held in overpopulated tanks leading to many issues including an over saturation of ammonia. Since ammonia is highly toxic gas, these large-scale tanks of fish require a frequent rotation of the water to prevent toxicity, however, this is a highly inefficient use of water. The ammonia is then converted by bacteria into nitrate decreasing the water quality and potentially harming the fish. Alternatively, nitrate is extremely beneficial for plant growth. Therefore, by combining plants and fish, there would not be a constant need to change the water because the plants would be purifying the water. This has the potential to increase the efficiency of fish farms in addition to potentially reducing the water use by 90%. Aquaponics is sustainable and efficient choice for increasing fresh produce in areas that do not have easy access to a supermarket. The aquaponic system recycles the water which makes it a perfect candidate for areas that suffer from droughts or areas with little water access (Pavlis, 2018).

An aquaponic system is low maintenance because there is little fertilization needed, whereas, it is the opposite in regular gardening beds. Due to the plants being grown with the fish, the fish waste constantly supplies the plants with the proper amount of fertilization. There is also no weeding needed in an aquaponic system because the plants are not grown in soil weeds are not produced (Pavlis, 2018).

Space and growth time are two other benefits of aquaponics. An aquaponic system takes a relatively small amount of space making it a likely candidate for areas

that have poor soil quality or areas such as tight urban communities that do not have land for crops. It also works for food deserts where a greenhouse could be put almost anywhere it is needed. Grow time is another positive aspect to aquaponics. Food in an aquaponic system grows six times more per square foot than traditional farming, and generally grows twice as fast producing a quicker harvest (Pavlis, 2018). Over time, an aquaponic system would produce a large quantity of fresh produce and fish than more traditional approaches. This surplus of crops could be sold at a lower cost to SNAP recipients because fewer resources are required when farming through aquaponics (Elia, Popa & Nicolae, 2014).

Aquaponics can easily be certified organic due to the elimination of pesticides, which could harm the fish. Aquaponic systems mimic the natural symbiotic relationship between fish and plants therefore it is the cleanest way to produce chemical free crops. Most traditional farming methods must supplement their soil with fertilizers that can be bad for the crops and contaminate water sources. The great prospect of an aquaponic greenhouse is that it can be placed wherever it is needed (Pavlis, 2018).

Lastly, aquaponics is simply healthier because fertilizer is coming from cold blooded fish that do not carry common contaminants such as *Escherichia coli* or *Salmonella* mainly found in warm blooded animals. Also, fish are converting plant protein to animal protein faster and have no growth hormones. The produce will taste better overall, because the greenhouses are grown locally and provided on a community need basis. Food is not being shipped and stores for extended periods of time (Pavlis, 2018).

Proposed Usage

Part of the SNAP budget or USDA grants could be used to fund small greenhouses placed throughout Tennessee, where they are needed most. Once a greenhouse is established, a community-led approach would be responsible for running it (Gavin, Seeholzer, Leon, Chappelle & Sehgal, 2015; Bolland, & McCallum, 2002). In cities, greenhouses could be planted inside abandoned warehouses. A study was completed in Chicago in which an abandoned warehouse was bought and converted into an aquaponic greenhouse so people in areas with food deserts could have access to locally grown produce. The study was unsuccessful due to zoning and building codes but demonstrate that the process itself could work if needed and aquaponics can be reproduced in a larger scale operation (Tomlinson, 2015).

Pilot Study

To continue research on this topic, a pilot study would test the use of an aquaponic greenhouse within a community that lacks adequate access to healthy foods. The purpose of the pilot study would be to create an aquaponic greenhouse to grow and distribute healthy foods and serve as a location to educate SNAP recipients on healthy nutrition.

Methodology

To start the process of the pilot study, I would first need to get approval through MTSU's Institutional Review Board (IRB) to conduct the research. The pilot study would take place in Murfreesboro and I would identify and partner with a local non-profit agency such as Second-Hand Harvest or Lane Agriculture Park. I would partner with the local SNAP-Ed office in Murfreesboro to try and increase SNAP-Ed

participation and awareness of the pilot study. I would create incentives for participation and highlight ones already in place. The long-term goal of the pilot study would be to have it completely run by SNAP participants in the local community. In the beginning, I would recruit a few SNAP recipients in the community and have them trained on how to maintain the aquaponic system. This would be a paid position funded through a grant, and the employee would get free fresh produce for themselves. I would recruit participants through the SNAP office in Murfreesboro. SNAP recipients are required to work if able and the local office could assist in locating recipients who are trying to find work. The pilot study would use a PAR design, meaning I would get the community involved with all pieces of the research process: implementation, maintenance, and the steps to full community involvement. I would reach out for volunteers through churches, other SNAP recipients, schools, and other local organizations that serve low-income individuals and families.

A professional company would come and install the aquaponic system on the partnering agency's property location. Upon installation, SNAP recipients employed would be trained on how to properly maintain the system. As the Project Director I would also participate in maintaining the system until the system was completely community led. Aquaponic systems are easy to maintain once installed; I would have the employees maintain harvesting fish and the produce grown. Then through the assistance of volunteers, have the food would be bagged and distributed. I will partner with SNAP recipients to develop a distribution plan unique to the community's needs.

Funding

Funding would be through a USDA grant or multiple grants. There are several USDA grants applicable to this study, such as the FY2018 SNAP Process and Technology Improvement Grants. These grants are currently open for application submission and are designed to help local communities or government organizations develop and implement projects that focus on improving processes for SNAP recipients. Currently “for the 2018 year they are giving out \$5 million dollars split between six to eleven grants” (USDA, 2018). The grant money can be used for three years to fund a study such as the one described in this thesis. If awarded, the grant would give approximately \$400,000 dollars to provide a professional installment of an aquaponic system, money to go towards education, and money towards handling, maintenance, and distribution of the produce (USDA, 2018). I would also go through a USDA program that matches SNAP recipients purchasing power, so that if an individual paid \$20 to purchase crops, they would get \$40 worth of food (Rutherford County Farmers' Market, 2018).

Implementation

SNAP recipients could come to the hosting agency or receive their allotment of produce through the distribution plan created with SNAP recipients. This information would be posted at the SNAP office, as well as distributed due to community programs and organizations. The surplus crops would be donated to the hosting agency or partnering agencies in the community. The goal would be that SNAP recipients can get more fresh produce for their money because of the low cost to produce the food, and that it grows at a quicker rate producing more fresh produce. In the pilot study, testing

would be done to see if an aquaponic approach could produce crops quicker and at a cheaper price, allowing the program to increase the amount of money they match SNAP recipients and their purchasing power.

The pilot study goals would be: (1) To increase accessibility to fresh produce at a fraction of the cost of store-bought produce; (2) to increase SNAP-Ed education in Rutherford County through food incentives or redeemable coupons. If this pilot study was successful it could be replicated in other Tennessee counties. I would measure the pilot study's success through a qualitative method: a satisfaction survey completed by SNAP recipients receiving the fresh produce and fish. When they received their bag of food, I would have them complete the survey. I would keep track of the number of people served through the pilot study to know how many people it has reached over the course of the three years. I would measure of the success of an increase in SNAP-Ed participation by looking at the previous year's participation and doing a comparative analysis. I would also conduct a pre and post test to see if the SNAP-Ed program was successful in increasing their knowledge on a balanced diet and how to achieve it. The evaluation plan would measure and see if there were an increase in participation of SNAP-Ed, as well as if the issues of accessibility addressed throughout this thesis would help bridge the gap of them getting access to healthy foods.

Conclusion

Overall, accessibility to healthy nutrition for SNAP recipients is a complex issue, and the need for more research is evident. Specifically, more research should be conducted on aquaponics being used on a broader scale to help alleviate food insecurity, and lack of access to healthy foods. There is a growing need to in help SNAP recipients

obtain adequate purchasing power to stock their cabinets with fresh local produce. Numbers in Tennessee continue to increase for recipients of SNAP, and the rise of obesity and other noncommunicable diseases. There is a strong case as to why SNAP recipients in Tennessee simply are not equipped with the tools, budget, or education to make healthy diet decisions. Despite this, SNAP is a very effective program that reaches over a million people in Tennessee.

This thesis detailed the various issues faced by SNAP recipients in Tennessee such as access and cost of healthy food, and aquaponics as a solution that was also discussed. The lack of transportation, the cost of food, literacy through education, time, and much more can bring forth a call for intervention. An implemented, community-based aquaponic greenhouse could potentially provide great relief to food insecure SNAP recipients across Tennessee.

The recommendations to increase SNAP-Ed participation, add greenhouses in places where there is limited access to healthy foods, and create community collaborations were formulated from the conclusion that the diet plays a large role in the lives and health of SNAP recipients for better or worse. These recommendations are directed at Middle Tennessee, although they may be applicable to other counties of Tennessee and the U.S. as a whole. The hope of this Author is that the information presented here will bring awareness to the great lack of access to healthy foods for SNAP recipients and will inspire more research and interventions to serve the most vulnerable of the U.S. population.

References

- Bell, J., Mora, G., Hagan, E., Rubin, V., & Karpyn, A. (2017). Access to healthy food and why it matters: A review of research. Retrieved November 25, 2017, from <http://thefoodtrust.org/>
- Bolland, J. M., & McCallum, D. M. (2002). Neighboring and community mobilization in high-poverty inner-city neighborhoods. *Urban Affairs Review*, (1), 42.
- Bruenig, M. (2014). One-third of Americans are in or near poverty. Retrieved from <http://www.demos.org/blog/10/20/14/one-third-americans-are-or-near-poverty>
- Carlson, S., Rosenbaum, D., Keith-Jennings, B., & Nchako, C. (2017). SNAP works for America's children. Retrieved from <https://www.cbpp.org/research/food-assistance/snap-works-for-americas-children>
- Center for American Progress (2016). Think Tennessee. Who needs public transit? Retrieved from <https://thinktennessee.org/research/who-needs-transit/>
- Center on Budget and Policy Priorities. (2018). *Tennessee Supplemental Nutrition Assistance Program*. Retrieved from <https://www.cbpp.org/sites/default/files/atoms/files/sn>
- Center on Budget and Policy Priorities. (2017). Policy Basics:

Introduction to the supplemental nutrition assistance program (SNAP).

Retrieved from: [https://www.cbpp.org/research/policy-basics-](https://www.cbpp.org/research/policy-basics-introduction-to-the-supplemental-nutrition-assistance-program-snap)

[introduction-to-the-supplemental-nutrition-assistance-program-snap](https://www.cbpp.org/research/policy-basics-introduction-to-the-supplemental-nutrition-assistance-program-snap)

Coleman-Jensen, A., Rabbitt, M.P., Gregory, C.A., & Singh, A. (2018). What is food insecurity in America? Retrieved from

<https://hungerandhealth.feedingamerica.org/understand-food-insecurity/>

DiNitto, D. M. & Johnson, D. H. (2016). Ending poverty: Is it an issue anymore?

Social Welfare Politics and Public Policy (8th ed., pp. 129-132). Austin,

Texas: Pearson.

Denton, C. (2016). How Does Food Impact Health? Retrieved from:

<https://www.takingcharge.csh.umn.edu/explore-healing-practices/food-medicine/how-does-food-impact-health>

Drewnowski, A., & Eichelsdoerfer, P. (2010). Can low-income Americans afford a healthy diet? Retrieved from [https://www.ncbi.nlm.nih-](https://www.ncbi.nlm.nih.gov.ezproxy.mtsu.edu/pmc/articles/PMC2847733/)

[gov.ezproxy.mtsu.edu/pmc/articles/PMC2847733/](https://www.ncbi.nlm.nih.gov.ezproxy.mtsu.edu/pmc/articles/PMC2847733/)

Drewnowski, A. (2009), Obesity, diets, and social inequalities. *Nutrition Reviews*,

67: S36-S39. doi:[10.1111/j.1753-4887.2009.00157.x](https://doi.org/10.1111/j.1753-4887.2009.00157.x)

Elia, E., Popa, D. C., & Nicolae, C. G. (2014). Startup stages of a low-tech

aquaponic system. *Scientific Papers: Series D, Animal Science - The*

International Session of Scientific Communications of the Faculty of

Animal Science, 42263-269.

- Fox, M.K., W. Hamilton, and B. Lin. 2004. Effects of Food Assistance and Nutrition Programs on Nutrition and Health: *Volume 3, Literature Review*, 19, 330.
- Gavin, V. R., Seeholzer, E. L., Leon, J. B., Chappelle, S. B., & Sehgal, A. R. (2015). If we build it, we will come: A model for community-led change to transform neighborhood conditions to support healthy eating and active living. *American Journal of Public Health, 105*(6), 1072-1077.
doi:10.2105/AJPH.2015.302599
- Hollenbach, M., & Yosoda, S. (2017). Supplemental nutrition assistance program: Critical analysis. *Social Development Issues, 39*, 50-54.
- Holtzman, E., Manon, M., & Treering, D. (2011). *Food for every child the need for supermarkets in Tennessee* (Rep.). Retrieved http://thefoodtrust.org/uploads/media_items/tennessee-mapping.orginal.pdf
- Leung, C.W., Hoffnagle, E.E, Lindsay, A.C., Lofink, H.E., Hoffman, V.A., Turrell, S., ...Blumenthal, S.J. (2012). A Qualitative Study of Diverse Experts' Views about Barriers and Strategies to Improve the Diets and Health of Supplemental Nutrition Assistance Program (SNAP) Beneficiaries. *Journal of the Academy of Nutrition and Dietetics, 113*,70-76.

Melton, C. (2017). Understanding the Supplemental Nutrition Assistance Program

(SNAP). Retrieved from

<https://www.sycamoreinstituten.org/2017/06/16/supplemental-nutrition-assistance-program/>

Office of Disease Prevention and Health Promotion. (2015). *Nutrition and Health*

Are Closely Related. Retrieved from

<https://health.gov/dietaryguidelines/2015/guidelines/introduction/nutrition-and-health-are-closely-related/>

Roberts, S., & Feld, E. (2008). Top ten barriers to organic and local food access

for low-income individuals. Organic Consumer Association. Retrieved

from: <https://www.organicconsumers.org/news/top-ten-barriers-organic-and-local-food-access-low-income-individuals>

Pavlis, R. (2013). Aquaponics in a natural pond: Take advantage of the nutrients

in your fish pond by floating a vegetable garden on top. *Mother Earth*

News, June 1, 2018. Retrieved from:

<https://www.motherearthnews.com/organic-gardening/gardening-techniques/aquaponics-natural-pond-zm0z18jjzsphe>

Rutherford County Farmers' Market (2018).

Retrieved from <https://www.localharvest.org/rutherford-county-farmers-market-2018-M74584>

Shenkin, J. D., & Jacobson, M. F. (2010). Using the food stamp program and other

methods to promote healthy diets for low-income consumers. *American*

Journal of Public Health, 100(9), 1562-1564.

doi:10.2105/AJPH.2010.198549

Sifferlin, A. (2016, January 07). The U.S. food guidelines have always been controversial. *TIME*. Retrieved from <http://time.com/4125642/dietary-guidelines-history/>

State Collaborative on Reforming Education (SCORE). State of education in Tennessee. (2017). Retrieved from: <https://tnscore.org/research-reports/reports/>

Supplemental nutrition assistance program (SNAP). (2016). Retrieved from <http://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program-snap>

SNAP statistical information. (2018). Retrieved from <https://www.tn.gov/humanservices/for-families/supplemental-nutrition-assistance-program-snap/snap-statistical-information.html>

Tennessee Public Transportation Association. (2018). Transit facts. Retrieved from <http://www.tntransit.org/facts>

Tomlinson, L. (2015). Indoor aquaponics in abandoned building: A potential solution to food deserts. *Sustainable Development Law & Policy, 16(1)*, 16-40.

USDA. (2018). FY2018 SNAP Process and Technology Improvement Grants.

Retrieved from <https://www.fns.usda.gov/snap/fy2018-snap-process-and-technology-improvement-grants>

USDA. (2018). Profile of SNAP households (Rep.). Retrieved from: <https://fns-prod.azureedge.net/sites/default/files/ops/Tennessee.pdf>

USDA defines food deserts. (2018). *American Nutrition Association*, 38

(2). Retrieved from <http://americannutritionassociation.org/newletter/usda-defines-food-deserts>

Vineyard, M.L. (2014). Tennessee Nutrition & Consumer Education Program

SNAP-Ed. *Improving Lives of Supplemental Nutrition Assistance*

Program Families: Executive Summary. Retrieved from

<https://ag.tennessee.edu/fcs/Documents/TNCEPAnnual>

World Health Organization, (2017). Noncommunicable diseases. Retrieved from:

<http://www.who.int/mediacentre/factsheets/fs355/en/>