

THE IMPLEMENTATION OF PLANT-BASED DIETS IN
LOWER-INCOME PUBLIC SCHOOLS

by

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CHAPTER ONE

Introduction

Introduction and Project Question

This chapter describes a major problem I have seen: many public school students eat poorly. Chapter 1 begins with my personal observations of this problem and then draws upon medical and environmental research of why poor diets are so detrimental. Finally, chapter 1 concludes with a call to action to adopt a more plant-based diet in public schools. This call to action is motivated by my own personal success, as well as Google's. Ultimately, my capstone project will explore the question: *What are the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title 1) public schools (grades K-12)?*

Personal Observations

Recently as I strolled down the halls of the school where I work, a lower-income high school in a Midwestern city, I saw many students enjoying their breakfast in the hallway before the school day started. My attention was grasped by what students were eating. Students were indulging on what appeared to be a corn dog for breakfast. When I asked a student what he was eating, the student informed me that it was a breakfast sausage on a stick, wrapped in a pancake. The fact that this breakfast item was being served with a side of syrup may not cause alarm for many people, but what should warrant a response is the cinnamon roll, glazed with icing, next to the side of syrup.

As a high school teacher, I see unhealthy food fed to my students on a daily basis. Their weekly lunch menu consists of hamburgers/cheeseburgers, deep fried pork egg rolls, cheese or pepperoni pizza, and cheesy bread with marinara sauce. The breakfast provided by the school is not much better and typically includes a lot more sugar. From cinnamon rolls to french toast sticks, the breakfast offered lacks serious nutritional value, as the only appearance of a fruit is when banana bread is served on Wednesday mornings. Just for safe measure, our school also provides a snack store, open during the school day, so students may purchase homemade cookies and commercial goods (junk food), such as Lays chips, a bottle of Coke or a candy bar. From other educators to who I have spoken, our public high school is not an anomaly. Highly processed meat, dairy, and refined sugars are the staples for many public school cafeterias across the country and this has been a detriment to American health.

Health Issues

Obesity, heart disease, and diabetes are all serious health problems that currently plague the American public. The Trust for America's Health report (2018) states, "Across the United States, more than one in three adults [37.9% from a 2013-2014 report] and one in six children (ages 2-19) are obese — and one in 11 young children (ages 2-5) are obese" (par. 2). According to the report, more than 100,000 premature deaths were associated with obesity from 2013-2014. Furthermore, obesity leads to the risk of developing Type II diabetes, heart disease, liver disease, gallbladder disease, kidney disease, Alzheimer's disease, stroke, and arthritis (The Trust for America's Health, 2018). More than half a million people die every year from heart disease, making it the leading cause of death in the United States (Center for Disease Control [CDC], 2017). In a report published by the *Journal of Geriatric Cardiology*, Michelle McMacken (2011)

states that Type II diabetes is an international epidemic with 422 million cases worldwide, and it affects 12-14% of the U.S. population. Although Type II diabetes is both a preventable and treatable disease, it costs the U.S. \$176 billion in direct medical expenses. As of 2015, diabetes was the 7th leading cause of death in the United States (McMacken & Shah, 2017). Although we have increased our life expectancy over the past decade, the quality of the years we are actually living has decreased (Brown, 2015).

The numerous health diseases we see in the 21st century are propagated by the fact that the average American is not consuming enough fruits and vegetables. The federal guidelines for daily fruit consumption for the average adult are 1 ½ cups to 2 cups per day and 2 to 3 cups per day for vegetables. However, the Center for Disease Control and Prevention (CDC, 2017) reported that only 1 in 10 Americans are meeting their daily requirements for fruits and vegetables. The report also showed consumption was less than average for individuals living in poverty.

In my personal experience, I have found medical health expectations for fruit and vegetable consumption are even worse than what the federal government recommends. When I visited the doctor's office in July of 2018 for an annual check-up, the nurse practitioner inquired about my diet. I was asked how often I consume fruits and vegetables in a given week. My options were: 4-5, 3-4, 1-2 or 0 servings per week. I answered 4 - 5 servings per week and this placed me in the 'very healthy' category. However, if we were going based off of the federal guidelines (CDC, 2017) and if we were a nation focused on health, my options should have been more along the lines of: 30-35, 25-29, 15-24, and 0-14 servings per week. Unfortunately, a poor diet not only negatively affects our health, but it also harms our planet.

Environmental Issues

This is not just a personal health issue; it is an environmental one as well. I initially started out a journey of plant-based eating because of the negative impact the Western diet has on our earth's resources. It is a common misconception to only focus on fossil fuel and energy consumption when discussing greenhouse gas emissions. Although fossil fuels and energy production have a significant contribution to the global emission of carbon (35%), the agriculture industry (specifically agriculture, forestry, and other land use) rivals the emission impact of the energy sector by generating up to 24% of global greenhouse gas emissions. This figure does not account for agriculture's estimated 20% CO₂ deficit that our ecosystems remove from the atmosphere, which is no longer occurring because of the sequestering of biomass, soil, and dead organic matter for the use of agriculture (EPA, 2017). The demand for meat here in America is so large that if the rest of the world, all 7.64 billion people (Worldometer, 2018), ate like we did, we would need four planet earths to support the demand. As Americans, we consume 15% of earth's meat and produce 40% of the overall waste while constituting only 5% of the world's population (Elert, 2012).

The livestock industry is performing some catastrophic assaults to our biosphere. These assaults include deforestation; decreased biodiversity; increased emissions of carbon dioxide, methane, and nitrous oxide into our atmosphere; coral bleaching; and increased global temperature (WWF, 2017). Water consumption is an important characteristic to consider when determining the impact different types of food can have on the environment. From an irrigation standpoint, plants require much less water than livestock and different types of meat require different amounts of water. One pound of chicken requires 1,681 gallons of freshwater (Pimentel

& Berger, 2004), while a pound of beef requires 2,500 gallons of water (Robbins, n.d.). As droughts become more rampant and global temperatures continue to rise (Diffenbaugh, 2015), freshwater availability and usage is going to be a topic of increased interest, and we must consider the burden the livestock industry has on our freshwater resources.

Deforestation is another significant ecological issue, which is occurring as a result of agricultural livestock. Deforestation is occurring at an alarming rate. This is occurring so farmers can plant soy and corn crops to feed their livestock (Smith & Bustamante, 2014). This deforestation is causing a decrease in biodiversity, which leads to unhealthier ecosystems and as a result more species go extinct (McLaughlin & Mineau, 1995). We are undergoing the sixth mass extinction that our planet earth has seen and the main culprit of this current mass extinction is human activity, and more specifically agriculture. Professor Patel (as cited in Johnston, 2017) states, “The footprint of global agriculture is vast. Industrial agriculture is absolutely responsible for driving deforestation, absolutely responsible for pushing industrial monoculture, and that means it is responsible for species loss” (par. 6).

The livestock industry is having a drastic impact on our ecosystems, and it is degrading the ecological health of our biosphere (Machovina, Feeley, & Ripple, 2015). It is time that our society take heed of climate change’s call by moving towards a more evolved, sustainable way of eating. By choosing a plant-based diet, we can not only feel better about our own personal health, but we can also feel better about the earth we are leaving behind for future generations.

Plant-Based Diet

One way to safeguard our planet and personal health is to implement a more plant-based diet. However, this is not a capstone devoted to converting all lower-income public schools into

vegan institutions. From my own personal experience, I know that being a vegan does not mean one is necessarily eating healthier. A vegan could get away with eating doughnuts, Oreos, french fries, and onion rings. It is for this reason I use the term plant-based diet as opposed to saying a vegan diet. The definition of a plant-based diet, according to Robert Ostfeld (2017), a doctor who specializes in plant-based diets in relation to geriatric cardiology, is a “diet [that] consists of all minimally processed fruits, vegetables, whole grains, legumes, nuts and seeds, herbs, and spices and excludes all animal products, including red meat, poultry, fish, eggs, and dairy products” (p. 315). This definition also describes a vegan diet, but it emphasizes integrating more plants into people’s diets and less on excluding animal products.

I made the switch to a plant-based diet in March 2016, and I have been committed to that choice ever since. I originally began my plant-based lifestyle solely for ecological reasons. Now that I understand all of the additional health benefits from eating fruits and vegetables, I have nearly eliminated both meat and dairy from my diet; I am definitely not a vegan, but I am absolutely plant-based.

One problem with changing our dietary choices (especially when talking about switching over to a plant-based diet) is many people have an all-or-nothing approach. If one was told that starting tomorrow, he or she would need to exercise every day for two hours, 365 days of the year, for the rest of one's life, he or she would question it. I believe that the same phenomenon works within our dietary choices. Most people think they can never go all plant-based because when picturing eating their last cheeseburger, they start to cry. Some people believe that since they cannot go completely plant-based, they cannot do anything to eat healthier and more sustainably. This same logic when applied to the exercise analogy would result in an individual

sitting around all day on the couch doing nothing because he or she cannot work out two hours a day every single day. Just because an individual cannot commit two hours a day to exercise does not mean the only other option is sitting around and doing nothing. One can play a sport, take a walk, or work out only three days a week; it is more than just black and white, and we need to realize this with our dietary choices. Just because someone cannot go completely plant-based does not mean he or she should throw out the idea of eating better. We need to inform our society that there are many ways to work towards a more sustainable, healthier diet than just going completely plant-based.

Google is currently implementing an ideal model for the future of plant-based eating at its headquarters, which reflects the aspirations and goals of this capstone. Google recognizes the importance that plant-based diets have on personal and ecological health, and it has envisioned plant-based eating as a continuum along which people move (Oberst, 2018). As a result, it is gradually serving more plant-based meals to its employees, nudging them along the continuum.

Google did not start by switching all of its meal options to vegetarian, as many employees would have voiced their concerns in the same way that parents would complain if schools suddenly went completely vegetarian. Google is slowly introducing and educating its employees on the positive impacts a plant-based diet can have while showing them creative, tasteful meals that are independent of meat. They are changing the culture of eating within their community of employees, and they understand changing behavior takes time. Although the introduction of plant-based meals has been gradual, Google would like its end goal to be completely plant-based at its headquarters (Oberst, 2018). I want Google's approach to be a

model system for this capstone and my strategies for implementing plant-based diets into lower-income schools.

As an environmentalist, I believe our environment's health would be greatly benefited if we integrated more plant-based meals into public schools (grades K-12). As an educator, I have a dire need to advocate for plant-based meals for the sake of my students' personal health. The ongoing climate change issue is a foreboding catastrophe that is going to take many years and many great minds to solve, but improving the diets of lower-income students is a deeply personal and an extremely powerful issue with a lot of unmet potential. In America, we have a reactive medical approach to health, where people become very unhealthy through their dietary choices and we put Band-Aids on people's health by giving them statins, tummy tucks, and insulin shots. What we lack in our western medicine is a proactive approach to health, one where eating healthy takes priority over pharmaceuticals and surgeries.

Summary

I am studying the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title 1) public schools (grades K-12). I want to find out the positive impacts incorporating more plant-based dietary options can have on a school. I will address the realistic challenges that prevent dietary changes from being made in order to help leadership within school districts advocate for dietary choices that are healthier and more sustainable for their students. In chapter 2, my literature review, I will review scientific journals and studies that evaluate the effect a plant-based diet has on personal health. My literature review will also discuss the scientific studies that address the influence a Western diet has on our earth and its resources, and how a cultural adoption of a plant-based diet could alleviate America's overall

carbon footprint. Chapter 2 will address the necessity for providing more plant-based meal options, specifically in lower-income schools because of how impoverished neighborhoods suffer the most from poor dietary choices. Next, I will analyze various schools from around the world that have begun to incorporate more plant-based meal options for their students. Ultimately, chapter 2 will address the significant gap between what we know about plant-based diets and what we are currently doing as a society.

The primary focus of chapter 3 will be detailing the specific measures and actions I will take in order to initiate change within my own school district. My capstone project will be a presentation to district leadership (administration, the superintendent, and school board members) about the first steps that we can take to become a healthier and more sustainable school district. The presentation will include the major benefits for both environmental and personal health, as discussed in chapter 2. The presentation will also display a current weekly menu that is already being served to the students within my school district, along with the recommendations for meal improvements that would be more plant-based. I will discuss the technical challenges of implementing change at a district level, such as evaluating the cost per meal if these changes were made. Chapter 3 will conclude with an appraisal of the proposed changes for our specific school district and the feasibility of implementing more plant-based meal options for our students when all costs and benefits are considered. Finally, the purpose of chapter 4 is not only to reflect on my experience of the capstone project, but also to illustrate any future research, actions or projects I plan to undertake in helping lower-income schools adopt more plant-based meal choices.

The primary reason I have chosen this capstone topic is because our diets are something which we have direct control over. As an adult, one has the choice of what he or she puts into his or her body for every meal throughout the day. As a parent, one has the power to put produce or Pop-Tarts in his or her kitchen. School administrators dictate what fuels the students they serve from 7am to 3pm. What we choose to put in our bodies impacts our health and our biosphere. By choosing a plant-based diet, we are addressing two major calamities that are severely afflicting the United States: public health and climate change. This capstone is intended to improve the dietary options for lower-income public schools, but I also hope that it restores a sense of personal accountability in readers, so they walk away realizing they have a part to play in creating a culture of sustainability

CHAPTER TWO

Literature Review

Introduction

Chapter 2 will review literature relevant to the research question: *What are the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title 1) public schools (grades K-12)?* Before this literature review can discuss the changes lower-income schools should make to offer healthier meals to their students, this chapter will summarize relevant research that supports the notion that a plant-based diet is the healthiest and most sustainable diet. Next it will address the realistic challenges that prevent dietary changes from being made in order to help leadership within school districts advocate for dietary choices that are healthier and more sustainable for their students. From the perspective of health, Chapter 2 will evaluate some of the biggest issues that the American public faces when it comes to personal health such as heart disease, cancer, and Type II diabetes. This chapter will then address the ecological benefits of eating more plants. Evidence will be provided for how climate change and earth's resources are impacted by dietary preferences. Finally, this chapter concludes by providing models of various schools that are beginning to implement a plant-based approach to feeding their students and discussing the success they have had through healthier schools and communities.

Importance of Plant-Based Diets for Personal Health

America's public health is at a state of a crisis, with 59.2% of deaths (1.6 million people) occurring in 2015 due to chronic diseases such as heart disease, cancer, chronic lower respiratory disease, stroke, and diabetes mellitus (Price, 2017). These diseases are caused by the Western diet, which is the most widely adopted diet in the United States. The Western diet consists of a high intake of red meat, junk food, saturated fats, eggs, and sugar, while lacking fresh fruits, vegetables and whole grains. According to Cordain et al. (2005) the American Western diet is comprised of junk food and sugar, and refined vegetable oil, refined grains, and refined sugar alone make up 60.1% of the Western diet's energy intake. Furthermore, Nutritionfacts has reported that the amount of animal product (including dairy) consumed in the average American Western diet is more than 25% of the daily calorie intake, while whole grains, vegetables, fruits, beans, and nuts, when combined, only accounted for 11%. As stated previously in chapter 1, the average American is not consuming enough fruits and vegetables. The federal guidelines for daily fruit consumption for the average adult are 1 ½ cups to 2 cups per day, and for vegetables it is 2 to 3 cups per day. However, the CDC (2017) reported that only 1 in 10 Americans are meeting their daily requirement for fruits and vegetables.

Evidence of how the Western diet has distorted the personal health of America's society is shown through the fact that 16% of United States' GDP is spent on health expenditures. In 2016, a report on health in America compared the U.S. to countries that are a part of the Organisation for Economic Co-operation and Development (OECD). Among the 35 OECD countries, the United States ranked 26th in life expectancy, 29th in infant mortality, and last place in health care expenditures (CDC, 2018). Cordain supports this finding of the CDC by

stating, “In the United States and most Western countries, diet-related chronic diseases represent the single largest cause of morbidity and mortality. These diseases are epidemic in contemporary Westernized populations and typically afflict 50–65% of the adult population” (Cordain et al., 2005, par. 48).

The Western diet has had devastating consequences on the American public. America is currently in a national public health crisis that is corrosive to citizens’ well-being. It is time the country looked at the chronic diseases that have been afflicting the nation, as well as the foods that can lead to the prevention (or even reversal) of developing these diseases. The specific diseases addressed within this literature review are: heart disease, cancer, and Type II diabetes.

Heart disease. Heart disease deserves the most attention when talking about America’s health because heart disease is the nation’s most prominent threat to public safety. Heart disease continues to be the number one killer in the U.S. (CDC, 2017). It claims 630,000 lives annually, meaning that one out of every four Americans will lose his or her life to this chronic and treatable disease.

Heart disease describes any condition that affects the ability of the heart to function properly. Heart disease is most often used in conjunction with the term cardiovascular disease, which describes the narrowing of the blood vessels due to cholesterol (Mayo Clinic, 2018). In the book *How Not to Die*, Greger describes how heart disease is caused by fatty deposits that build up within the walls of arteries making it more difficult for the heart to pump blood. Greger states, “[t]he buildup of plaque, known as atherosclerosis, from the Greek words *athere* (gruel) and *sklerosis* (hardening), is the hardening of the arteries by pockets of cholesterol-rich gunk that builds up within the inner linings of the blood vessels” (2017, p. 17).

The buildup of cholesterol within the arteries can lead to chest pains, heart attacks and/or strokes (Mayo Clinic, 2018). Cardiovascular disease is associated with unhealthy eating, specifically a diet high in salt, fat, sugar, and cholesterol. Luckily, the risk of developing the disease can be mitigated through a healthy diet (WHO, 2018). One of the key measurements for artery health is cholesterol, specifically low-density lipoprotein (LDL), which is closely correlated with atherosclerosis. Greger (2017) states committing to a diet that is high in plants (vegetables, legumes, and fruits) and low in animal products (meat, eggs, milk, and butter) will lead to a decreased risk of developing atherosclerosis.

Studying the relationship between diet and the development of cardiovascular disease has been a topic of interest for a long time within the scientific community. A relationship between vegetarian diets and cardiovascular disease was initially observed in the late 1970s where Seventh-day Adventist, vegetarian, Californian males had significantly lower death rates (specifically cardiovascular mortality) than their non-vegetarian counterparts. The intrigue of vegetarian diets on mortality rates inspired one of the largest dietary studies ever performed in the United Kingdom.

The Oxford Vegetarian Study (Appleby, Thorogood, Mann, & Key, 1999) was focused on the effect a vegetarian diet has on cardiovascular mortality. The study began in 1980 and included 11,140 subjects who were either placed in a meat eater group or vegetarian group (which included vegans). After a 12-year follow-up, standardized-mortality ratios (SMRs) were calculated for both groups. In an SMR reading, a smaller value indicates fewer deaths occurring in relation to the population size. The vegetarian group's SMRs were .46 for all causes of death, and .38 for cardiovascular related deaths, while the meat eaters' group SMR values for all causes

of death were .80 and .72 for cardiovascular related deaths. As predicted, the vegetarian group experienced less cardiovascular mortality

A separate investigation within the study evaluated the effect diet has on total cholesterol. This additional experiment took place from 1984 to 1986 and occurred in tandem with The Oxford Vegetarian Study, through the same research team (Appleby et al., 1999). Of the initial participants 3,773 volunteered for the additional investigation, and the facilitators of the experiment separated the participants into four dietary groups; Vegan, Vegetarian, Fish eaters, and Meat eaters. The study found that vegans had on average both the lowest LDL cholesterol (2.28mmol/L) and the lowest total cholesterol (4.29mmol/L) within the dietary groups. The Vegetarian dietary group had the second lowest overall cholesterol readings, and the Meat eater dietary group was ranked the highest with an average LDL cholesterol at 3.17mmol/L and 5.31mmol/L for total cholesterol. Although antiquated, this study is still relevant today as it led researchers to conclude that vegans have the lowest risk of heart disease when compared to vegetarians, meat-eaters or fish-eaters, due to their overall lower levels of cholesterol.

The Oxford Vegetarian Study has inspired further research into the effects a plant-based diet has on mitigating the development of cardiovascular disease. Alexander, Ostfeld, Allen, and Williams (2017) published an article addressing the question if implementing a plant-based diet reduces the chance of developing hypertension. One of the main studies analyzed three different diets and their effect on hypertension. The first diet was the DASH diet (Dietary Approaches to Stop Hypertension), which mainly consisted of complex carbohydrates and fruit, the next was the Western diet, and the third was the Western diet with supplemental fruits and vegetables. The study found that the DASH diet participants had significantly reduced blood pressure and

cholesterol. The study also found individuals eating the increased vegetable and fruit diet had lower blood pressure as well, but not as much as the DASH group. The study ultimately concluded that fruits, vegetables, whole grains, and nuts were all foods associated with decreased blood pressure.

Alexander et al. is not the only team who has been looking into plant-based diets' effect on heart disease. Scientific studies have been performed for decades analyzing the effect a plant-based diet can have on cardiovascular disease. In *Cardio-Metabolic Benefits of Plant-Based Diets*, Kahleova et al. states, "A recent systematic review and meta-analysis of 86 cross-sectional and 10 cohort prospective studies reported a significant protective effect of a vegetarian diet against the incidence and/or mortality from ischemic heart disease" (2017, par. 8). Research suggests that plant-based diets may result in an estimated 40% reduction in developing cardiovascular disease. Furthermore, plant-based diets have been the only diet, which has led to the reversal of atherosclerotic plaque buildup in the arteries when accompanied with exercise and stress management (Kahleova, Levin, & Barnard, 2017).

A plant-based diet is the solution for alleviating, and hopefully one day eliminating, the devastating impact heart disease has had on the United States. Plant based diets have been shown to decrease the risk of heart disease, but the power of a plant-based diet goes beyond helping the heart and arteries; it has also been shown to combat prostate and digestive cancers (Greger, 2017).

Cancer. There are many different types of cancers, and they are differentiated by their location, growth, and how they spread (American Cancer Society, 2018). Cancer is one of the leading causes of death in the United States as there were over 590,000 cancer-related deaths

reported in 2015, making cancer responsible for 1 in every 4 deaths (CDC, 2018). According to the World Cancer Research Fund (WCRF, n.d.), when compared with the rest of the world, the United States ranks sixth in the highest rates of cancer. In 2018, the CDC reported that for every 100,000 people, there were 438 reported cases in the U.S. Furthermore, the specific cancers with the highest rates of new cases were female breast (124.8 per 100,000 people), male prostate (99.1), lung and bronchus (57.5), and colorectal (38.0).

There is still much that is unknown about how people get cancer, but it is known that external factors such as diet, the environment, and behaviors (such as smoking) combined with an individual's genetic makeup contribute to his or her risk of developing the disease. However, contrary to popular belief, inherited genetic mutations are only responsible for 5-10% of all cancers. This means external factors, such as diet, are having a significant influence on considerably high cancer rates (NCI, 2017). The WCRF (n.d.) has created recommendations for preventing cancer and one of its key endorsements is a plant-based diet. The WCRF states, “[t]here is evidence that eating whole grains, fiber, vegetables and fruit can help protect against certain cancers, as well as against weight gain, overweight and obesity” (n.d., par. 2). Although a plant-based diet is not a scientific ‘cure’ for cancer, it has been shown to reduce the risk of developing cancers and has even been shown to slow the growth of various cancers for individuals who have been diagnosed (Greger, 2017). This section will evaluate current scientific journals and studies that focus on the association between diet and cancer, specifically prostate and colorectal.

Prostate cancer. Prostate cancer is the second most common cancer in American men. The American Cancer Society (2018) estimates there will be 164,690 cases in 2018 and a

predicted 29, 430 deaths will be the result of prostate cancer. This type of cancer is the most prevalent in older men, as 97% of new cases in the United States occurred in men over the age of 50. The following risk factors have been associated with higher rates of prostate cancer: being overweight, a high consumption of dairy products, and diets high in calcium (WCRF, n.d.).

Chan, Stampfer, Ma, Gann, Gaziano, and Giovannucci (2001) investigated the association between prostate cancer rates and the consumption of dairy in the Physicians' Health Study. The purpose of the research was focused on the effects of calcium on the risk of developing prostate cancer. The study included 20,885 men, who received baseline health assessments and were required to complete abbreviated dietary questionnaires throughout an 11-year period. Dietary calcium intakes were assessed through the intake of cold breakfast cereal, skim milk, whole milk, ice cream, and cheese, which were self-reported through the dietary questionnaires given to participants. In the 11-year investigation 1,012 new cases of prostate cancer were reported. Participants were placed into 5 dietary groups, which were based off the daily dairy product intake. Groups were divided by their daily servings of dairy: 0-.5, .51-1.00, 1.01-1.50, 1.51-2.50, and >2.5. Results indicated a positive correlation between dairy product consumption and calcium intake. The data also showed there was a 30% greater risk of prostate cancer for men in the highest dairy consumption group when compared to the men in the lowest dairy consumption group. The results for the study led the researchers to conclude there is a strong association between dairy and calcium intake and the risk of developing prostate cancer.

Bernard (n.d.) published a meta-analysis that included six case-control studies, 11 cohort studies, and the world's largest correlational study focusing on the relationship between dairy consumption and the risk of prostate cancer. The meta-analysis substantiated the conclusions

drawn in the Physicians' Health Study. Evidence from the report concluded that men who avoid dairy completely have a significantly lower risk of prostate cancer incidence and mortality, with a 1.3 to 2.5 greater relative prostate cancer risk for individuals in the highest dairy consumption groups, when compared to the lowest dairy consumption group.

Conversely to dairy's negative impact, plant-based diets have been shown to reduce the risk of developing prostate cancer (Ornish et al., 2005). Through migrant studies and epidemiological evidence, an association between countries and their diet has been established, as countries that have a primarily plant-based diet have overall few incidences of prostate cancer (Ornish et al., 2008).

This has led the scientific community to question whether plant-based diets have lower incidences of prostate cancer because the diet excludes meat or if plants are able to combat cancer growth. For this reason, Ornish et al. (2005) studied whether prostate cancer growth can be halted through a plant-based diet. The purpose of the study was to conclude whether changes to behavior (through a vegan diet, increased exercise, and stress management) could be a valid treatment for patients with early, low-grade, prostate cancer. The study included 93 participants who had early stages of prostate cancer. The research took place over a 12-month period and measured the prostate-specific antigen (PSA) levels of participants to determine cancer growth. PSA are produced by both healthy and malignant prostate cells. Normal levels of PSA would fall near 4.0 ng/mL and higher levels would indicate the presence of cancer (NCI, 2017).

Ornish et al. (2005) split the participants into control (49 participants) and experimental (44 participants) groups. The experimental group was prescribed a vegan diet, moderate exercise and stress management, while the control group received no treatment. After one year, the

research found lower PSA levels and decreased prostate cancer cell growth in the experimental group when compared to the control group. This led Ornish et al. to conclude that intensive lifestyle changes to diet and exercise can lead to a decreased risk of prostate cancer.

Finally, an investigation led by Nguyen, Major, Knott, Freeman, Downs, and Saxe (2006) focused on the adoption of a plant-based diet by patients with recurrent prostate cancer. Ornish's study from above focused on the effect a vegan diet, moderate exercise, and stress management has on PSA levels in early stage prostate cancer patients. Nguyen et al. analyzed the effect legumes, fruits, whole grains, and vegetables have on PSA levels. A meaningful observation made from the research was, "during the first 3 months of the intervention, when the intake of both whole grains and vegetables increased substantially, the median rate of PSA rise not only declined but became negative" (2006, p. 223). This led to the conclusion that prostate cancer growth cannot only be halted by a plant-based diet, but the consumption of vegetables and whole grains can even cause regression in prostate cancer. The data showed an inverse relationship between PSA levels and plant consumption. Ultimately, diets have a significant role in the development of prostate cancer and Nguyen's et al. research concluded that plant-based diets are a way of combating this fatal disease.

Colorectal cancer. Another type of cancer that is greatly influenced by dietary intake is colorectal cancer. Colorectal cancer is any cancer that develops in the rectum or colon and it is the third leading cancer in the United States with an estimated 145,600 new cases in 2019. Colorectal cancer is also the second leading cause of cancer-related deaths (when men and women are combined), resulting in an expected 51,020 death in 2019 (American Cancer Society, 2019).

The direct causes of colorectal cancer are still unknown, but research suggests that diets, specifically diets high in meat, are related to an increased risk of developing this cancer. Inversely, research has also shown the consumption of plants, specifically legumes, fruits and vegetables, has been shown to mitigate the risk of developing colorectal cancer (Greger, 2017). One compelling piece of evidence for plant-based diets is Greger's comparison between cancer rates of the United States and India. Men in the United States displayed 11 times higher rates of colorectal cancer when compared to their Indian male counterparts, while women appeared to have rates that were 10 times greater than women in India. This notable dissimilarity exists between these two countries even though 20% of India's population lives below the poverty line and America's GDP is eight times greater than that of India's. Furthermore, men in the U.S. have greater rates of other types of cancer when compared to Indian men: 23 times more prostate cancer, nine times more kidney cancer, and seven times more bladder cancer, while women in the U.S. express five times more breast cancer, eight times more bladder cancer, and 12 times more kidney cancer compared to women in India. Greger goes on to establish another major difference between the United States and India and that is in dietary preferences. Greger states, "only about 7 percent of the adult population [in India] eats meat on a daily basis. What most of the population does eat every day are dark green, leafy vegetables and legumes, such as beans, split peas, chickpeas and lentils" (2017, p. 64).

Miller et al. (2013) team reported similar findings as Greger in determining the effect a plant-based diet can have on the development of colorectal cancer. Two major contributions which led to this investigation were the national and international cancer organization's diet recommendations and the DASH diet (as described on page 18). Miller observed that both

national and international cancer organizations were recommending diets that were low in processed meat and high in fruits, vegetables, legumes, and whole grains. Furthermore, the findings from The Oxford Vegetarian Study were so compelling that many research teams (such as Miller) went on to ascertain the effect the DASH diet has on other diseases, such as colorectal cancer. The purpose of Miller's et al. experiment was to study the effect that four established DASH diets have on developing colorectal cancer.

In this investigation, Miller's team compared four established DASH diets (Dixon's, Mellen's, Fung's, and Günther's) and examined the association of their index scores to colorectal cancer. Each established diet was generated through various criteria. Dixon's DASH Diet index was created through adherence to the 2005 Dietary Guidelines for America, whereas Mellen's DASH Diet index was established on the basis of target nutrient values; however, each established DASH diet tested was one rich in vegetables, fruits, and low-fat dairy products, and either reduced or eliminated meat consumption.

The study examined diets of 198,593 women and 293,248 men in eight U.S. states. The cohort of participants were followed from 1995 through 2006. The study began by giving participants a questionnaire where they self-reported their current body weight and height, family medical history of cancer, and personal medical history. Next, self-assessed food-frequency questionnaires (FFQ) were sent to participants in order to establish a baseline for dietary intake. The dietary intake of participants was tracked through FFQs throughout an 11-year period. Then, each participant's diet was assessed using one of the four DASH diet indexes. DASH diet index scores (which had already been generated prior to the study using predefined algorithms) were given to each participant. The research team created quantile groups based off of DASH diet

index scores, with Quantile 1 comprising of individuals who received the lowest scores (meaning they did not follow the DASH diet index) and Quantile 5 was made up of participants who received the highest index scores (individuals who adhered strictly to the recommendations made by the DASH diet).

The study found that after smoking, drinking, race, age, gender, and socioeconomic status were considered, participants with the highest DASH diet index scores (individuals in the 5th Quantile) had the lowest rates of colorectal cancer for each of the four DASH diets. The reported cases of colorectal cancer amongst participants for Quantile 1 was 3,584, while Quantile 5 had the lowest rates with only 3,016 cases reported. This led Miller et al. (2013) to the conclusion that any of the four DASH diets significantly reduce the risk of developing colorectal cancer.

Another study, conducted by Figueiredo et al. (2014), observed the intake of fruits, vegetables, meat, and fiber on genetic variants that are linked to the expression of developing colorectal cancer. Figueiredo et al. (2014) examined interactions between approximately 2.7 million genetic variants and disparate dietary factors amongst 9,117 controls and 9,287 controls from 10 different studies. What they found was an association between eating red and processed meats with higher rates of colorectal cancer, while fiber and fruit intake decreased the risk. The study concluded that dietary intake can alter the impact of genetic variants responsible for developing colorectal cancer and the risk of developing colorectal cancer can be mitigated through increased consumption of fruit and fiber.

Other investigations have been performed to assess the effect of meat consumption on colon cancer rates specifically. A study was conducted in California that took place over six years and included over 30,000 participants. The study's main purpose was to determine if

greater meat consumption was associated with greater rates of colon cancer. What the research team found was the consumption of white meat (at least once per week) more than tripled the risk of developing colon cancer. Additionally, individuals who consumed red meat at least once per week had two times greater the risk of developing colon cancer. An unexpected finding from the investigation was that the risk of developing colon cancer could be reduced through the consumption of beans (Singh & Fraser, 1999). The relationship between bean consumption and the risk of colon cancer was further supported by research conducted by The National Cancer Institute's Polyp Prevention Trial. “[The trial] found that those who increased their bean consumption to even less than one-quarter cup a day appeared to cut their odds of precancerous colorectal polyp recurrence by up to 65 percent” (*How Not to Die*, Greger, 2017, p. 67). This goes to show that it is not only the absence of meat in a diet but also the presence of plants (beans, vegetables, and fruit) that influence the risk of colorectal cancer.

Certain types of cancers are greatly influenced by what people choose to eat and some may even be preventable based off dietary preferences. As previously stated, inherited genetic mutations are only responsible for 5-10% in all cancers (NCI, 2017). As with heart disease, when attempting to reduce a person’s risk of developing digestive cancers, specifically prostate and colorectal, it is not only advantageous to consume less meat, but it also beneficial to have a diet rich in fruits, vegetables, legumes, and fiber (Greger, 2017).

Diabetes. In 2016, it was reported that diabetes was the 7th leading cause of death in America, resulting in 80,058 deaths (CDC, 2017). The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK, 2016) defines diabetes as a disease that occurs when cells in the body are either unable to produce or unable to uptake insulin, resulting in abnormal

blood glucose levels. Insulin is a hormone that helps cells in the body uptake glucose that is available in the bloodstream. Glucose is a simple sugar that humans get from the food consumed (through the process of digestion). Cells then use this glucose for energy production in order to perform specific functions within the body. However, when insulin is either not produced or functions improperly, then the cells cannot absorb the glucose. The glucose remains in the bloodstream, resulting in high blood sugar (Berry, 2019). Overtime, the excess level of glucose within the bloodstream can have serious health effects, and although there is no current cure for diabetes, there are actions that one can take to reduce the risk of developing the disease (NIDDK, 2016).

Diabetes is not only a serious health problem; it is quickly becoming a national epidemic. In 2017, the CDC released a report on *Long-term Trends of Diabetes*. The report evaluated the rate of diabetes within the American population from 1958 to 2015. What the report found was the rate of diabetes in the U.S. in 1958 was 0.93%. In 1990, the percentage of Americans who had diabetes increased to 2.52%. However, over the next 25 years, immense growth took place resulting in a staggering rate of 7.4% in 2015. Rowley, Bezold, Arikian, Byrne, and Krohe (2017) used the data provided by the CDC, current rates of diabetes and Census Bureau data to determine the projected growth rate of diabetes in America from 2015 to 2030. Rowley et al. reported that given the current trends, the rate of diabetes will increase by more than 54% by the year 2030, resulting in an estimated 385,800 deaths annually. The investigation concluded “in spite of medical advances and prevention efforts, diabetes presents a major health crisis in terms of prevalence, morbidity, and costs, and that this crisis will worsen significantly over the next 15 years” (Rowley et al., 2017, p. 9).

Type I vs. type II diabetes. There are several forms of diabetes, but the two primary types are Type I diabetes and Type II diabetes. Type I diabetes can occur at any age but usually develops in children and young adults. Type 1 diabetes results when the body's own immune system attacks pancreatic cells, and as a result the cells are no longer able to produce insulin. When the pancreatic cells stop producing insulin, glucose remains in the bloodstream because it is unable to be absorbed by cells in the body. In Type II diabetes, the pancreatic cells are able to produce insulin but either enough insulin is not produced or the other cells in the body are unable to effectively absorb the glucose that is present within the bloodstream (referred to as insulin resistance) (Berry, 2019).

Although both Type I and Type II can greatly impact an individual's personal health, Type II diabetes is much more prevalent. The CDC has reported that of the more than 30 million Americans living with diabetes up to 95% of them have Type II (CDC, 2019). Not only is Type II the predominant form in the United States, but it is also increasing at a faster rate: "The annual relative increase for type 1 diabetes in 2002-2012 in the U.S. was 1.8 percent, but the annual increase for type 2 diabetes was 4.8 percent" (Berry, 2019, par. 33).

The risk factors that make someone susceptible to Type I or Type II diabetes vary as well. Some of the identified risk factors for Type I diabetes are family history, genetic factors, and previous exposure to some types of infections (Nichols & Weatherspoon, 2019). Genetic factors can increase the risk for Type II diabetes as well. However, Type II diabetes is primarily impacted by personal lifestyle choices: poor diet, smoking, lack of exercise, and being obese. Lifestyle choices, such as diet, have been proven to be more influential in the development of

Type II diabetes, which has led many research teams to investigate the role plant-based diets have on the development and management of Type II diabetes.

Plant-based diet's effect on type II diabetes. Insulin resistance is significantly influenced by dietary choices and a plant-based diet has been shown to reduce the risk of developing Type II diabetes. This led Satija et al. (2016) to study the effect plant-based dietary patterns has on the incidence of Type II diabetes in U.S. men and women. For this investigation, Satija used three prospective cohort studies. The first took place from 1986 to 2010 and included 40,539 men from the Health Professionals Follow-Up Study. The second was from the Nurses' Health Study and included 69,949 women (1984-2012). The final prospective study included in this investigation was from the Nurses' Health Study 2, which took place from 1991 to 2011 and included 90,239 women. The data Satija et al. collected from these studies were semi-quantitative FFQ that were given to each of the participants from all three studies once every two to four years. A plant-based dietary index (PDI) was generated by the research team where plant products (fruits, vegetables, legumes, nuts, and whole grains) received a positive score and animal products (meat, eggs, and milk) received a negative score. This means that an individual who received a high PDI would be eating considerably more plant products than meat products. The study found a strong association between PDI and the development of Type II diabetes, where the risk of developing the disease was the lowest when PDI was the greatest. This led Satija et al. to the conclusion that diets that minimize animal product intake and are rich in fruits, vegetables, whole grains, nuts, and legumes substantially decreased a person's risk of developing Type II diabetes.

Tonstad et al. (2013) analyzed different vegetarian diets' effect on the incidence of diabetes. The participants for this study included 26,187 women and 15,200 men; all participants initially were free of diabetes. Participants self-identified their dietary preferences and were grouped accordingly: vegan, lacto-ovo vegetarian, pesco vegetarian, semi-vegetarian or non-vegetarian. A follow up questionnaire was provided to the participants two years after the initial survey. As the investigation reported, "Cases of diabetes developed in 0.54% of vegans, 1.08% of lacto-ovo vegetarians, 1.29% of pesco vegetarians, 0.92% of semi-vegetarians, and 2.12% of non-vegetarians" (p. 292). This study did not differentiate between Type I or Type II, but the results propagated the conclusion that plant-based diets result in lower incidences of diabetes.

The evidence for plant-based diets preventing Type II diabetes has been so abundant that McMacken and Shah (2017) published a meta-analysis on the effects plant-based diets have on preventing Type II. One of the studies described by McMacken and Shah had the same design as the one summarized above. However, in this study, 61,000 participants were included. The participants were placed in the same dietary groups and their incidence of diabetes was determined four years after the initial survey. This investigation found the highest rate of diabetes occurred in the non-vegetarian population with a rate of 7.6%, while the vegan group had the lowest rate at 2.9%. In another study of 4,384 Taiwanese Buddhists, a vegetarian diet was shown to reduce the risk of diabetes by 50% when compared to an omnivore diet. The authors go on to identify specific foods that have been proven to mitigate the risk of Type II diabetes; unsurprisingly, the list is comprised of solely plant products. Nuts, green leafy

vegetables, grapes, apples, blueberries, and root vegetables have all been linked to reducing the risk of diabetes. Additionally, legumes have been shown to protect against insulin-resistance.

Not only is plant intake important for a diet that counteracts diabetes, but the sources of protein also make a difference (McMacken & Shah, 2017). A study found a 13% increased risk of diabetes in the quantile group with the highest meat consumption. The authors of the study noted a 23% reduced risk of Type II diabetes when individuals replaced only 5% of animal product protein with plant product protein. A similar study conducted on an elderly population in Greece had similar findings, where a 5% growth in animal protein increased the risk of developing diabetes by 34%. This led McMacken and Shah to the conclusion that individuals should replace meat-derived protein sources with plant protein. Plant sources of protein, such as legumes, are more beneficial for an individual's health because they provide helpful phytonutrients, as well as a sufficient source of fiber, which the American diet severely lacks.

The meta-analysis examined more than 15 different studies that evaluated the association between the risk of developing diabetes and plant-based diets. They concluded that plant-based diets act as a protective agent against Type II diabetes by not only preventing Type II diabetes but also treating it. A vegan diet has been shown to outperform the American Diabetes Association (ADA) dietary guidelines for treating Type II diabetes. In a 2003 study, a vegan diet was compared to the diet recommended by (ADA) in 99 participants, between the ages of 27 and 82. Of the 99 participants, 49 of them were placed on a vegan diet, while the other 50 followed the dietary guidelines provided by the ADA. After 22 weeks, 43% of the participants in the vegan dietary group and only 26% of the ADA reduced the intake of their diabetes medication. Additionally, the vegan group resulted in weight loss that was nearly double the ADA group.

Importance of Plant-Based Diets for Ecological Health

Unfortunately, the Western diet is not only guilty of wreaking havoc on America's public health, but it is also partially responsible for the destructive anthropogenic activity which has led to the imminent calamity called climate change. Diet's influence on personal health is apparent, but the effects that food choices have on environmental health are not as obvious. The diets to which people subscribe have a significant impact on ecological health, resource availability, and climate change (WWF, 2017). Marlow, Harwatt, Soret, and Sabaté (2015) confirm this claim from the WWF by stating "[t]here is a direct link between dietary preference, agricultural production, resource use and environmental degradation" (p. 2425). The nearly 70 billion animals raised annually for human consumption place an intensive strain on the finite resources the planet has to offer. Climate Nexus (n.d.) estimates that if the American diet was replaced with a plant-based one, then there would be a 90% decrease in cropland usage, a 94% reduction in nitrogen fertilizer application, and one third reduction in the global grain production. Pimentel and Pimentel (2003) found the U.S. food production system used 80% of the freshwater available in America, occupied 50% of U.S land, and was responsible for 17% of fossil energy usage. Their investigation compared the predominant meat-based American diet against a lacto-ovo vegetarian diet and concluded that the meat-based diet required significantly more water, land, and energy, making the lacto-ovo vegetarian diet a more sustainable choice.

Not only is the livestock industry rapidly depleting natural resources, but the immense production of meat for American consumption comes at a steep ecological cost. The global warming epidemic is an issue that has received a lot of attention but little action. Anthropogenic activity is responsible for increased greenhouse gas emissions. The greater concentration of these

greenhouse gases has led to global temperatures rising, resulting in the six hottest years on record occurring in the last nine years (Climate Central, 2019). The anthropogenic activity has had a snowball effect within the biosphere because these rising temperatures have contributed to rising sea levels, more acidic oceans, and increased droughts and wildfires (Denchak, 2016). Of greenhouse gas emissions that are caused by human activity, methane gas is one of the most detrimental because it is 34 times more potent in its ability to trap heat than carbon dioxide. The methane produced from the agriculture industry, through animal manure and enteric fermentation, accounts for a staggering 44% of anthropogenic methane emissions (Climate Nexus, n.d.). Although fossil fuels and energy production have a significant contribution to the global emission of carbon (35%), the agriculture industry rivals the emission impact of the energy sector by generating up to 24% of global greenhouse gas emissions. This figure does not account for agriculture's estimated 20% CO₂ deficit resulting from deforestation (EPA, 2017).

The 222.4 pounds of meat Americans eat annually (Jones, Haley, & Melton, 2019) is costly, and that cost is degrading rainforests at an alarming rate. The conversion of rainforests into cattle ranches is the leading cause for deforestation today. The agriculture industry, specifically livestock, is responsible for 80% of the world's deforestation (WWF, 2019). This deforestation is causing a decrease in biodiversity. This reduction in biodiversity leads to unhealthier ecosystems and as a result more species go extinct (McLaughlin & Mineau, 1995). This phenomenon is classified as an extinction vortex and has currently resulted in earth's sixth mass extinction, formally known as the Anthropocene Extinction (Vince, 2012).

The plant-based diet is not only a solution for creating a healthier United States but also can be the solution for generating a more sustainable world. Depletion of natural resources,

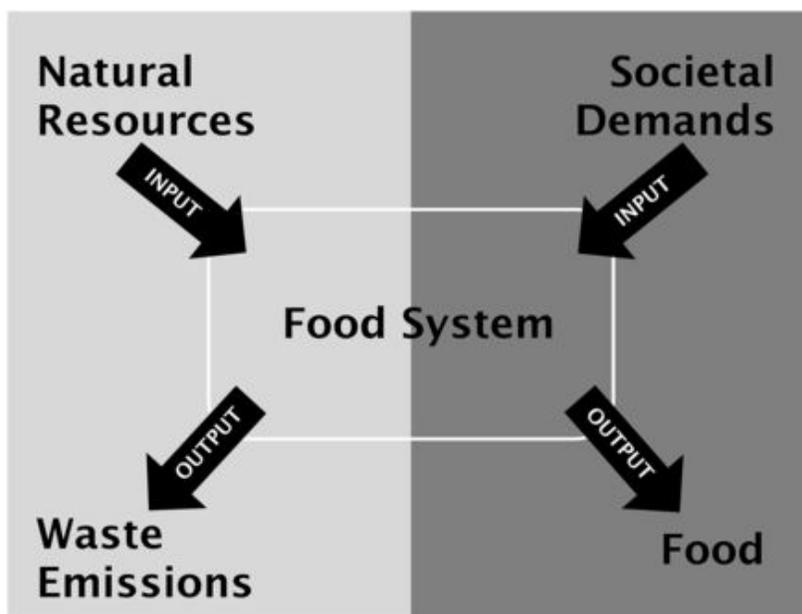
excessive greenhouse gas emissions and the degradation of both forests and species are all environmental factors that have been negatively impacted by the agriculture industry (Pimentel & Pimentel, 2003). Americans could alleviate the strenuous influence on the planet earth by choosing a diet that requires less energy, less land, and less water.

Natural resources. *The Tragedy of the Commons* was an essay written by Garrett Hardin (1968). A simple illustration of Hardin's main idea was that there are two farmers with two plots of land. Each had 3 cows, then one farmer buys another three cows because he has the room for them on his land. As a result, the other farmer buys another three cows as well. The farmers continue to buy more and more cows until they have maximized every square inch of their land. However, in the process these farmers were exploiting common goods (clean water, clean air, fertile soil, and healthy plants) that were shared between the two of them. As a result, both farmers end up with all of their natural resources depleted, not being able to raise any cows because of selfish business practices which exploited all of the natural resources, while not considering the preservation and sustainability of the commons. Essentially, Hardin concludes society lives in a finite world with a finite number of resources and if practices are not altered, common resources will be depleted.

Agriculture is the practice of raising livestock and producing crops. The primary goal, from an ecological standpoint, is to manage and maintain resources that support the energy conversion process of turning sunlight energy into food energy (in the form of plants or animals). Each food product requires necessary inputs: land, water, and minerals. The output is not only a product of an agricultural system, but it is also the waste that is produced through growing or

raising the food source. Sabaté and Soret (2014) give a basic illustration of a standard agricultural (food) system shown in Figure 1.

Figure 1: Major drivers and outcomes of the food system



Sabaté, J. & Soret, S. (2014). Sustainability of plant-based diets: Back to the future. *The American Journal of Clinical Nutrition*, 100, 477. doi:10.3945/ajcn.113.071522

Not only are natural resources a requirement, but societal demands have a monumental contribution to the food that is being produced. Every food source has its own unique demand within a society, as well as a personalized natural resource requirement. An ecological conundrum occurs when a society holds high demands for specific food products (meat and dairy) that require a significant amount of natural resources while also emitting a tremendous amount of waste. This ecological conundrum has been forced upon America through their culturally accepted Western meat-based diet. Essentially, America has been running an agricultural system where it believes natural resources are inexhaustible and that simply is not true. As a result, the United States, and the world at large, is beginning to breach biological capacity.

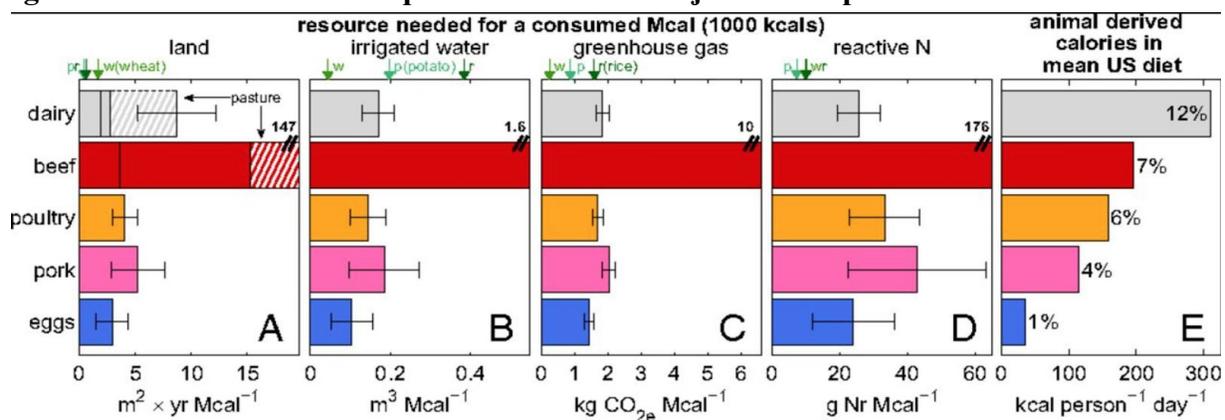
Given each type of food has its own requirements for natural resources and emits a specific, quantifiable amount of waste, then one could conclude that certain types of food are more sustainable and cause less harm to the environment. This conclusion led Sabaté and Soret (2014) to examine the sustainability of plant-based diets. For this investigation, the research team compared plant-based diets with a diet that was rich in animal products, as seen in America. The food sources from each diet were evaluated on two criteria for sustainability: environmental protection and efficiency. Environmental protection was evaluated on the food source's ability to preserve ecological systems (fertilizer usage, soil erosion, and waste production), and efficiency of food source was assessed through the natural resources that were required to grow/raise the food source through a quantifiable ratio of inputs and outputs.

Food conversion ratios are used to determine the agriculture efficiency of animal products by giving a ratio between the amount of feed (in kilograms) necessary to produce one kilogram of meat. Sabaté and Soret (2014) ascertained food ratios for various animal protein and found: eggs had a 11:1 food conversion ratio, chicken - 2.3:1, pork - 5.9:1, and beef was the most inefficient with a ratio of 13:1. Further data suggested that beef was the most unsustainable source of animal protein. Chicken had 4 times greater fossil energy usage when compared to a grain source of protein, whereas beef had fossil fuel usage that was 40 times greater. Furthermore, the amount of water used to produce soy protein compared against the same amount of animal protein was a ratio of 4:26. Not only is water more expensive for raising animal sources of protein, but land also comes at a greater cost. The land needed in order to grow the feed for animal sources of protein was 6-17 (depending on the animal source) times greater than that of soy protein. This led the research team to report that a diet rich in animal products is

ecologically inefficient. Sabaté and Soret (2014) concluded that plant-based diets are more sustainable because they were less taxing on the environment and required fewer natural resources.

Research conducted by Eshel et al. (2014) reported similar findings. Eshel et al. (2014) evaluated the effect that five major animal-based food products (dairy, beef, poultry, pork, and eggs) have on land, irrigation water, greenhouse gas, and reactive nitrogen, in the U.S. The research method used was a top-down approach where data was collected from the USDA and was used to determine the environmental needs (fertilizer, irrigation water, and land) of feed production. The three major feed classes were: pasture, processed roughage (hay and silage), and crops (wheat, corn, soybean, etc.). The environmental needs were then partitioned among the feed-consuming animal categories (dairy, beef, poultry, pork, and eggs) and the distribution was based on the feed ration of each category, as well as the number of animals raised or slaughtered in a given year. Finally, the waste emissions were divided by the caloric mass output for each animal category resulting in the environmental burden per consumed unit. Data from their research is shown in Figure 2.

Figure 2: Natural resource requirement for five major animal products



Eshel, G., Shepon, A., Makov, T., & Milo, R. (2014). Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States. *PNAS*, 111(33), 11998. doi:10.1073/pnas.1402183111

The investigation found relatively comparable environmental burdens for eggs, poultry, pork, and dairy, but a disproportionate impact came from beef, both in resources used and waste produced. The calculations estimated beef production required 28 times more land than other food categories, 11 times the amount of water, and 6 times the amount of reactive nitrogen. The estimated greenhouse gas was also five times greater for beef production when compared against other food categories. The report concludes beef is not a sustainable food source at its current level of demand. The authors emphasize the importance to inform consumers, through the dissemination of numerically accurate data, that there is an environmentally significant difference in choosing to buy chicken over beef at the supermarket.

Marlow et al. (2015) compared the environmental impact different dietary groups have on natural resources. Water, energy, fertilizer, and pesticide usage were the resources evaluated in this investigation. The study gathered ‘real-world’ empirical data from various credible sources. Data from the Adventist Health study was utilized, which took a cohort of 34,198 male participants and tracked their dietary intake. Roughly half of the participants consumed markedly minute portions of meat in their dietary intake. Participants were then placed into one of two dietary groups: lower animal product (LAP) or higher animal product (HAP). Next, natural resource input was calculated through agriculture data sources: Cost and Return Studies (for water and energy usage), US Department of Agriculture (for fertilizer usage), and Summary of Pesticide Use Report Data from 1997.

Major food items were then given Use Efficiency Scores for each of the four natural resource categories. A Use Efficiency Score is demonstrated through a ratio between the amount of natural resources needed and the amount of food produced. The major food items analyzed in

this report were eggs, chicken, beef, peaches, apples, watermelons, oranges, almonds, grapes, and dried beans. The efficiency scores for the natural resources were then applied to the LAP and HAP groups' self-reported dietary surveys and averages were calculated.

The results of the investigation found that in a week's time, the HAP dietary group used 14,226 kJ of energy, 13,545 L of water, 232 g of fertilizer, and 32 g of pesticides. The LAP diet required notably fewer natural resources: 4,317 kJ of energy, 3,293 L of water, 26 g of pesticides, and 46 g of fertilizer. According to Marlow et al. (2015), "[T]he LAP diet required the application of approximately 4·1 times less water, 3·3 times less energy, 5·1 times less fertilizer, and 1·2 times less pesticides compared with the HAP diet" (p. 2438). The researchers pointed out a major contributing factor for HAP group's increased natural resource requirement was because of beef consumption. Beef had the highest Use Efficiency Scores for water, energy, and fertilizer and was considered the least efficient food source. Nevertheless, the report concluded that the LAP diet was more sustainable than the HAP diet because it required significantly less natural resources.

Greenhouse gas emissions. Escalating greenhouse gas emissions (GHGEs) are the prominent cause of global warming (EPA, 2019). The effect these gases have on global warming is determined by their concentration and Global Warming Potential (GWP). The Global Warming Potential measures the energy absorbed by one ton of the emitted gas relative to the energy absorbed by one ton of emitted carbon dioxide (CO₂) (EPA, 2017).

Agricultural systems have a part to play in the global warming problem, as greenhouse gas production is a sizeable aspect of the waste emission output from agricultural practices. Estimating the precise number of greenhouse gas emissions released from agricultural systems is

multifaceted and complex because there are many factors to consider, such as food processing, production methods, and transportation (Sabaté & Soret, 2014). For example, an investigation could evaluate the effect livestock has on GHGEs. If the researchers solely looked at the effect the animals had on GHGEs, then they would conclude that livestock's primary contribution to GHGEs is methane (GWP 25 times greater than CO₂) produced through enteric fermentation and waste production (feces) (EPA, 2019). However, the agricultural system has many more contributors to GHGEs than just chicken poop and cow farts. Carbon dioxide (GWP of 1) and nitrous oxide (GWP of 298) are released in the transportation of livestock to the slaughterhouse, from the slaughterhouse to the packaging factory, from the packaging factory to the grocery store and from the grocery store to the consumer's residence. More nitrous oxide is released in the production and application of fertilizer (EPA, 2019) to grow the estimated 2,700 pounds of feed required to produce one beef-producing cow (Shah, 2010). Additional greenhouse gases are produced through the industrial processes of raising livestock, processing animals for slaughter and then storing them until they are consumed.

It is for this reason why Life Cycle Analysis is used for estimating GHGEs.

Life-cycle analysis (LCA) is an approach used for the estimation of GHGE throughout the stages of production and consumption of a food. A full LCA is complex and involves a very detailed assessment of a product from emissions from agriculture and primary production through processing, transportation, retail, home use, and waste disposal.

(Macdiarmid et al., 2012, p. 633)

Because each factor of the LCA varies depending on location, production methods, and household, determining LCA's for each individual food product has been difficult and the

research has been limited. However, the United Kingdom (U.K.) has done a lot of pioneering work to determine the effect diets have on GHGEs through generating LCAs for specific food products.

Macdiarmid et al. (2012) aimed to create a sustainable diet that met the dietary guidelines of the United Kingdom. An estimated 18-20% of the greenhouse gas emitted in the United Kingdom is due to its food systems. Like the United States, the U.K. operates on a diet which lacks nutritional value and has led to increased rates of obesity. This led Macdiarmid et al. (2012) to develop a realistic, seven-day dietary plan that was healthy and sustainable.

The research team created a database containing 82 food products and determined nutritional values, as well as their GHGEs. Even among the same food source, GHGEs varied greatly not because of transportation but rather from farming practices. The greatest GHGEs were associated with the farms that had the most intensive farming practices. For example, beef consumed in the U.K. had GHGEs as low as 12.1 kg CO₂e/kg edible weight and as high as 32.0 (depending on the farming practices). Macdiarmid et al. (2012) also pointed out that the food consumed in the United Kingdom comes from a variety of countries (including the United Kingdom). Thus, it was crucial to consider the variety of sources for a single food product. Average GHGEs were then calculated for each food product based off of individual GHGEs from each food source. For example, if the cattle that came into the U.K. came from 10 different farming systems, GHGEs were calculated for each individual farming system and then were averaged out to determine the GHGEs of beef in the United Kingdom. The investigation received the data for which farming systems contributed to the UK food consumption from the HM Revenue and Customs UK Trade Statistics. Figure 3 shows the data from their calculations.

Figure 3: Greenhouse gas emissions of different food groups on the basis of food supplied to and produced within the United Kingdom

Low GHGEs (<1.0 kg CO ₂ e/kg edible weight)	Medium GHGEs (1.0 – 4.0 kg CO ₂ e/kg edible weight)	High GHGEs (>4.0 kg CO ₂ e/kg edible weight)
Potatoes	Chicken	Beef
Pasta, noodles	Milk, butter, yogurt	Lamb
Bread	Eggs	Pork
Oats	Rice	Turkey
Vegetables (eg, onions, peas, carrots, sweet corn, brassicas)	Breakfast cereal	Fish
Fruits (eg, apples, pears, citrus fruit, plums, grapes)	Spreads	Cheese
Beans, lentils	Nuts, seeds	
Confectionery, sugar	Biscuits, cakes, desserts	
Savory snacks	Fruits (eg, berries, banana, melons)	
	Salad vegetables	
	Vegetables (eg, mushrooms, green beans, cauliflower, broccoli, squash)	

Macdiarmid, J. I., Kyle, J., Horgan, G. W., Loe, J., Fyfe, C., Johnstone, A., & McNeill, G. (2012). Sustainable diets for the future: Can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *The American Journal of Clinical Nutrition*, 96(3), 634. doi:10.3945/ajcn.112.038729

The investigation set the desired seven-day dietary plan (sustainable diet) against the GHGEs produced from food systems by the United Kingdom in 1990, which was to be used as a baseline for comparison. The average GHGEs from food consumption of someone living in the U.K. in 1990 was 7.28 kg CO₂e per day. The sustainable diet created by Macdiarmid et al. (2012) had a total GHGEs of 2.43 CO₂e per day, which was nearly two times less than the average standard U.K. diet. Additionally, the sustainable diet generated during the investigation was not vegetarian, nor vegan. The sustainable diet did not exclude animal products. However, the diet did limit an individual to only 372 grams (.82 pounds) of meat per week and the report recognized that meat had the highest contribution to GHGEs. Furthermore, the sustainable diet included more fruits, vegetables, and whole grains; met the United Kingdom's requirements for nutrition; and did not impose any increase in cost for the consumer in a week's worth of grocery shopping. The major conclusion from the investigation was dairy and meat products have the

greatest GHGEs. However, a sustainable diet can be achieved without completely eliminating animal products entirely; meat and dairy products just need to be consumed in moderation.

Scarborough et al. (2014) continued their research on diets' effect on GHGEs. This study compared the GHGEs of meat eaters, fish eaters, vegetarians, and vegans. The study included 55,504 participants from the EPIC Oxford study who self-identified their dietary group. In this study there were 29,589 meat eaters, 8,123 fish eaters, 15,751 vegetarians, and 2,041 vegans. Their dietary intake was evaluated through a self-assessed FFQ containing 130 food items over a 12-month period.

Scarborough et al. (2014) applied a source document composed in 2009, which estimated the GHGEs for 94 food commodities that are consumed in the U.K. The research team also calculated the GHGEs for 289 food codes measured in kg CO₂e and weighted by greenhouse gases' GWP. LCAs were utilized when determining GHGEs for each food code and commodity. The investigation then created weighted estimates for each of the 94 food commodities and applied the GHGEs from the 289 food codes in order to analyze the 130 food items reported on the FFQ.

The participants' individual GHGEs were calculated from their FFQ and averages were computed. The research team created quantile groups within the meat-eating participants: high meat eaters (consuming more than 100 grams per day), medium meat eaters (50-99 g/day), and low meat eaters (less than 50 g/day). The data revealed that a vegan diet produced the smallest amount of GHGEs at 2.89 kg CO₂e per day. The high meat eaters group produced the most GHGEs at 7.19 kg CO₂e per day. The results from the other dietary groups follow: medium meat eaters - 5.63 kg CO₂e per day, low meat eaters - 4.67, fish eaters - 3.91, and vegetarians - 3.81.

Researchers concluded that a reduction in meat consumption would lead to an overall decrease in GHGs and would mitigate climate change.

Deforestation and biodiversity. Decreased biodiversity leads to species extinction. Paleontologists define a mass extinction as a geologically short period of time where more than 75% of the earth's species become extinct. Many experts have now concluded that the sixth mass extinction is now underway (Barnosky et al., 2011). Since the rise of humans, earth has lost 83% of mammal wildlife. The domineering presence of humankind, attended by livestock husbandry, now makes up 96% of mammal life on earth, while wildlife mammals make up the remaining 4%. The consternation that accompanies these figures is aggravated by the fact that the human race makes up only .01% of earth's biomass (Carrington, 2018). Experts predict that every year 18,000 to 55,000 more species become extinct (Djoghla, 2007) and there are currently 16,306 species identified as endangered and at risk of extinction (Endangered Earth, 2019).

Biodiversity is declining at the fastest rates ever observed in human history (United Nations, 2019). Geologists have classified this period of time as the Anthropocene (the age of man) which is marked by unprecedented extinction rates caused through hunting, deforestation, pollution, and climate change (Vince, 2012). Deforestation has a significant impact on the decrease of biodiversity which is leading to earth's sixth mass extinction. One of the leading causes of deforestation is agriculture, and more specifically the livestock industry (Veiga, Tourrand, Pocard-Chapuis, & Piketty, 2003). Over 75,000 square kilometers have been destroyed since 1978 (Butler, 2019). Of the 75,000 square acres, 80% has been converted to pasture land for cattle, making the livestock industry the number one cause of deforestation occurring in the Amazon (Veiga et al., 2003). Butler (2009) states, "Since 2006 more than

38,600 square miles has been cleared for pasture, bringing the total area occupied by cattle ranches in the Brazilian Amazon to 214,000 square miles, an open space larger than France” (par. 9).

Diets’ effect on rainforest deforestation is specifically a cattle driven issue. The main reason for this is because cattle themselves are such a resource-intensive food commodity. Eshel et al.’s (2014) report (described on page 41) concluded that the production of beef required 28 times the amount of land when compared to other livestock animal products (2014). In 2017, The Food and Agriculture Organization of the United Nation (2019) registered the world population of cattle at 1,575,042,416. It then should not be surprising that 45% of the global surface is attributed to livestock systems (Thorton, Herrero, & Ericksen, 2011).

The problem arose in the 1960s when the demand for beef in the United States increased past the point of America’s natural resources. The colonization of the Amazon Rainforest was a solution that offered both political and economic incentives: it allowed the American government to secure foreign territories, it exploited the natural resources of non U.S. land, and it provided farmers with pasture land to meet the demands for livestock production. Public investments in the Amazon Rainforest began and through the development of infrastructure and the utilization of tax exemptions which favored livestock production, cattle quickly became the leading cause of deforestation in the Amazon Rainforest (Thorton, Herrero, & Ericksen, 2011). Figure 4 illustrates the increase in cattle production in nine Brazilian states from 1980 to 2001.

The leveling of tropical rainforest for beef production affects biodiversity in a major way. Tropical rainforests maintain a disproportionate amount of earth’s biodiversity (Hedges, Cohen, Timyan, & Yang, 2018). The incredible biodiversity that exists within a tropical rainforest is

revealed through the fact that it covers less than 10% of earth's land surface and yet supports 65% of earth's biodiversity (Giam, 2017). The deforestation caused by agriculture is a greater threat to decreased biodiversity and extinction than climate change, disease, or invasive species (Hedges et al., 2018). Professor Raj Patel, bestselling author of *The Value of Nothing: How to Reshape Market Society and Redefine Democracy*, states, "The footprint of global agriculture is vast. Industrial agriculture is absolutely responsible for driving deforestation, absolutely responsible for pushing industrial monoculture, and that means it is responsible for species loss" (as cited in Johnston, 2017, par. 6).

Figure 4: Bovine herd in legal Brazilian Amazon (x1000 heads)

States	1980	1985	1990	1995	1996	1997	2000*	2001*	Ratio 97/98
Acre	292	334	400	471	854	863	892	902	5.1
Amapá	46	47	70	93	195	205	238	250	13.1
Amazonas	356	425	637	637	771	810	940	988	5.0
Maranhão	2 836	2 973	3 791	4 162	3 992	3 962	3 868	3 838	0.8
Mato Grosso	3 442	6 547	8 815	14 153	15 597	16 363	18 888	19 814	2.5
Pará	2 730	3 479	6 182	8 058	7 198	7 925	10 577	11 645	10.6
Rondônia	251	771	1 719	3 928	3 948	4 342	5 779	6 357	17.9
Roraima	314	306	377	282	400	378	319	301	12.5
Tocantins	1 574	4 199	5 045	5 544	5255	5 363	5 708	5 828	1.7
Amazon	11 841	19 081	27 036	37 328	38 210	40 211	47 209	49 923	8.5

Thornton, P., Herrero, M., & Ericksen, P. (2011). Livestock and climate change.

Importance of Plant-Based Diets for Lower-Income Schools and Communities

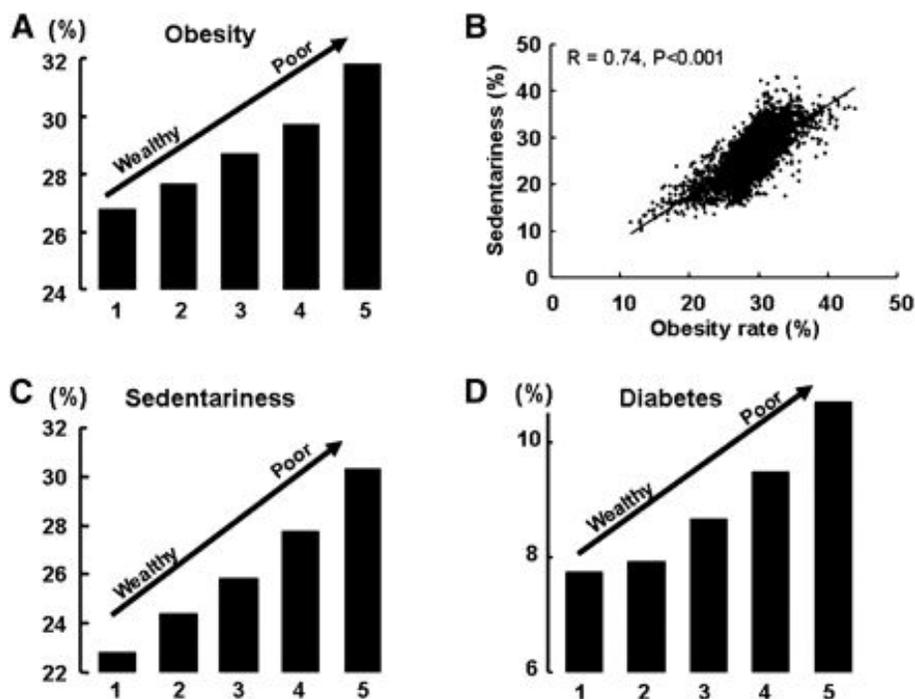
Thus far, chapter 2 has summarized both medical and environmental research concluding that a plant-based diet is not only better for one's health, but it is also more sustainable.

Inversely, the Western diet is detrimental to personal and ecological health. Unfortunately, the adverse health effects of the Western diet have afflicted the nation disproportionately, as rates of cardiovascular disease, Type II diabetes, and certain types of cancer are influenced by socioeconomic status. A positive correlation between socioeconomic status and an individual's

personal health has been established in high-income countries, such as the U.S. (Stronks, Dan De Mheen, & Mackenbach, 1998). This means that impoverished communities are more susceptible to higher rates of diet-related chronic diseases.

Levine (2011), reviewed 3,319 counties in America. The report studied the relationship between a county's rate of obesity and its socioeconomic status, finding that as poverty increases so does obesity. The report concluded that the most impoverished counties had the greatest rates of obesity. Figure 5 displays the data from the report. Quantile groups were created by the conductors of the investigation to characterize socioeconomic classes and are displayed on the x-axis. Quantile 1 was the wealthiest community with a mean county poverty rate of 8.2%. Quantile 5 represented the poorest county with a mean poverty rate of 25%, 629 of the 3,319 countries belonged to this class.

Figure 5: Cohorts of U.S. counties assorted in quantiles and ranked by the percentage of people living with poverty



Levine reported that 43% (of the 3,319 counties surveyed) of households living below the poverty line were food insecure. Food insecurity is defined as a household that is unable or uncertain of acquiring access to sufficient food. This minute fact from the report reveals that many people within lower-income communities are either starving, obese or both. This unique relationship of a population who can be both starving and display disproportionate rates of obesity has led researchers to study the accessibility and affordability of fresh, healthy food in lower-income communities.

Currently in the United States there is a disproportionate number of minority groups living in poverty. The American Psychological Association states “[i]n the United States, 39 percent of African-American children and adolescents and 33 percent of Latino children and adolescents are living in poverty, which is more than double the 14 percent poverty rate for non-Latino, White, and Asian children and adolescents” (2018, par. 4). The disproportionate rates of poverty are represented through the health of these minority groups. A 2016 report published by *The State of Obesity* (2018) found higher rates of obesity in both Latino and black children when compared to white children. The study was conducted through the 2015-2016 National Health and Nutrition Examination Survey and characterized the age of a child as an individual who is between 2 -19 years old. The survey found that the rate of obesity was highest for Latino children at 25.8%. Black children showed an obesity rate of 22%, which was significantly higher than their white counterparts at only 14.1%.

Many experts attribute lower-income communities’ higher rates of obesity, diabetes, and other diet-related diseases to the proximity of healthy food within the community, as well as the

density of fast food restaurants in particular neighborhoods. Hilmers, Hilmers, and Dave (2012) conducted a meta-analysis in 2012, which reviewed 24 studies that focused on the relationship between accessibility of healthy food in relation to a neighborhood's socioeconomic status. One focus of the meta-analysis was on the density of convenience stores within a neighborhood.

Convenience stores are considered to have negative impact on community health because of their disproportionately high selection of fatty, salty, sugary snacks, processed meats, and sugary beverages, accompanied with opportunities to purchase alcohol and tobacco products. The study defined convenience stores as "retail stores that sell a combination of gasoline, fast foods, soft drinks, dairy products, beer, cigarettes, publications, grocery items, snacks, and nonfood items and have a size less than 5000 square feet" (Hilmers, Hilmers, & Dave, 2012, p. 1644). One study within the meta-analysis looked at 4 major metropolitan cities across the United States (Mississippi, North Carolina, Maryland, and Minnesota). The study found there were more convenience stores located in poor neighborhoods than wealthy neighborhoods. The study also found there was a higher proportion of convenience stores in minority neighborhoods than in white neighborhoods.

Another focus of the meta-analysis was evaluating the relationship between fast food restaurant density and income disparities. Fourteen of the 18 studies revealed a relationship between fast food outlet density and neighborhood deprivation. Poorer neighborhoods in South Los Angeles, California, had a greater proportion of fast food outlets when compared to wealthy neighborhoods in West Los Angeles. A study conducted out of King County, Washington, found an inverse relationship with mean neighborhood income and fast food restaurant density. The

meta-analysis concluded there was a greater density of fast food outlets in both lower- and middle-income neighborhoods when compared to wealthy neighborhoods.

Lower-income communities offered greater access to food stores that promote unhealthy eating such as convenience stores and fast food restaurants (Hilmers, et al., 2012). The accessibility of these unhealthy food stores has been linked to the poor health (such as higher rates of heart disease, obesity, and Type II diabetes) of both lower-income communities and minority populations. As Hilmer et al. concluded, “The disproportionate distribution of food sources that contributes to the development of unhealthy behaviors among these communities and the consequent disease burden deeply affect not only individuals and families, but also society as a whole” (Hilmers, et al., 2012, p. 1652).

Neckerman et al. (2010) conducted a study that examined the disparity of food environments amongst New York City Public Schools. The study evaluated all New York City Public schools and their proximity to five major outlets, which were pizzerias, convenience stores, small grocery stores (“bodegas”), and national chain and local fast food restaurants, while considering the schools’ economic and ethnic profiles. The study measured the frequency of the five major food outlets within 400m from each New York City public school. Of the five major food outlets, bodegas were the most frequent, with 92.9% of all students having access to at least one bodega within 400m from their school. 70.6% of all students had access to a pizzeria, and 33.9% of students had access to at least one fast food restaurant. This study notes, “Nearly all New York City public school students have access to inexpensive, energy-dense foods within a 5-minute walk of school. Low-income and Hispanic students had the highest level of exposure to the food outlets studied here” (Neckerman et al., 2010, p. 200). The study concluded that

students from lower-income families and minority groups were more likely to attend schools with greater accessibility to unhealthy food outlets.

Rummo et al. (2016) published a study that propagated conclusions drawn from Hilmers' et al. meta-analysis. The study evaluated four major cities within the U.S. (Oakland, CA; Chicago, IL; Minneapolis, MN; Birmingham, AL), over a period of 25 years (from 1986-2011) and examined the food outlets within real-estate derived neighborhoods. A major finding from the study was that convenience stores had a negative association with neighborhood-level income in all four major cities. The other significant finding was the negative association between the percentage of white people living in a lower-income neighborhood and fast food outlet density. In other words, the more white people there were in lower-income neighborhoods, the fewer fast food restaurants there were. This led the researchers to conclude that socioeconomically disadvantaged neighborhoods with minority populations may “attract” unhealthy fast food outlet vendors over time. The negative health concerns that lower-income and minority neighborhoods are currently dealing with may have less to do with access to healthy food, and more to do with less access to unhealthy food (Rummo et al., 2016).

Not only is there an inverse relationship between unhealthy food outlet density and a neighborhood's socioeconomic status, but there is also a direct relationship between healthy food accessibility and a neighborhood's average household income. A study conducted in Baltimore, Maryland evaluated the effect income and race had on the accessibility of healthy food. The cross-sectional study looked at 226 food stores within 159 contiguous neighborhoods in Baltimore City and Baltimore County. The research team evaluated each store using a healthy food availability index (HFAI) with scores ranging from as low as 0 (no healthy food available)

to as high as 27. When analyzing race, the research team found that 43% of predominantly black neighborhoods fell within the lowest class of the HFAI index, while only 4% of predominantly white neighborhoods were in the same class. 46% of lower-income neighborhoods fell within the lowest class of the HFAI index, versus only 13% in high-income neighborhoods respectively. This led the research team to conclude that both predominantly black and lower-income neighborhoods are disadvantaged because of their lower levels of accessibility to healthier foods according to the HFAI index. The research team suggests this could contribute to the disparities in health in both economic and racial groups within the United States (Franco et al., 2008).

Lower-income communities and minority groups are experiencing disproportionate rates of heart disease, diabetes, and obesity (Levine, 2011). The reason for this disparity in health is because the accessibility of convenience stores and fast food outlets is greater in lower-income neighborhoods than in wealthier, white communities (Hilmers et al., 2012). Access to affordable produce is positively associated with the socioeconomic status of a neighborhood, meaning poorer neighborhoods have less access to healthy food (Franco et al., 2008). This has resulted in children having a 27.4% increased chance of becoming obese if they live below the federal household poverty line (State of Obesity, 2018). A plant-based public school initiative would benefit upper, middle, and lower class communities but society should begin providing access to healthier foods to those who need it most. It is for this reason why this capstone is focusing exclusively on lower-income public schools.

Models of Plant-Based School Systems

The goal for this capstone is to improve the dietary meal options of lower-income schools by providing more plant-based meal options to students. In order to accomplish this goal, it is

important to view plant-based meals as more of a spectrum and less of a black or white issue. The final part of this literature review will outline different plant-based implementation models that have been successful for school districts around the world over the past decade. Unfortunately, many of these plant-based models have only been implemented within the past 10 years so very little analysis has been conducted on the effectiveness of the change on students and their overall health. However, many school districts believe there is enough information upon which to act. The following are reasons why school districts are choosing to include more plant-based meal options in their cafeterias:

- 1) Students do not eat enough fruits and vegetables.
- 2) Lower-income communities are in greater need of healthy food because of the disproportionate rate of unhealthy food outlets within their communities.
- 3) Obesity rates are increasing in the nation and are disproportionate for black and Latino children.
- 4) The excessive demand for meat is inflicting harm on the biosphere.

California school districts. One of the leaders in promoting and serving plant-based meal options is the Santa Barbara Unified School District (SBUSD). One of the most crucial members of this district plant-based initiative is Nancy Weiss, the director of food services. When Weiss started in 2008, she wanted to take a more intentional and ethical approach to providing food for students in her district. Weiss went from taking Santa Barbara's traditional cafeteria of pre-frozen pizza, burgers, and chicken nuggets to offering students locally sourced, fresh food (as described in Murray-Ragg, 2018). Weiss' district states, "[w]e believe that offering protein-rich, plant based options is an important part of our district's food service

initiative, aligning our district's Wellness Policy and our student's health and the health of our planet" (Santa Barbara Unified School District, 2018, par. 13).

What started as an initiative for students to eat more locally sourced fruits and vegetables has now grown into 50% of meals being served in SBUSD are now vegan. These plant-based meal options were served at all grade levels and at all of the schools within SBUSD (Smith, 2018). An important distinction to make about SBUSD's plant-based food initiative is that although it has many vegan and vegetarian meal options within its district, it still offers both dairy and meat products at every meal. However, it now gives students the choice to eat healthier and more sustainably (Murray-Ragg, 2018).

Another pioneer of providing more plant-based meal options out of California is the Los Angeles Unified School District (LAUSD). A pilot program was launched at the beginning of the 2017-18 academic year where the district offered at least one vegan meal daily at seven schools within the district. From this pilot program, 13% of the students at the participating schools were choosing the vegan meal option. The initial success of the pilot program caused the food services director, Joseph Vaughn, to increase the vegan meal options from five meals to ten, and in January of 2018 he expanded the pilot program to 35 other elementary, middle, and high schools within the district. LAUSD and its food servicing team is attempting to become the first public school district in America that serves a vegan meal option to every school within its district. LAUSD is the largest school district in California and the second largest school district in the country, serving lunch to over 650,000 students daily, which makes this plant-based initiative a significant one (Monaco, 2017).

New York school districts. Bob Groff has been a catalyst for change within the public-school system of New York City. Groff is the principal of the Active Learning Elementary School (P.S. 244) in New York City and he turned his school into a 100% vegetarian institution. Groff is the first to admit this conversion to plant-based meals was gradual and slow, and it began in 2008 (Strong, 2014).

The inspiration for this change came from Groff seeing his elementary school students indulge on bright yellow, sugary energy drinks while snacking on cheese puffs, and he thought there had to be a better way to fuel the young minds of tomorrow. "There is a strong correlation between academic achievement and student health and nutrition," said Groff. "I wanted to prove that better nutrition could make a difference to students' lives" (as cited in Strong, 2014, par. 2). Groff began the journey of serving plant-based meals within his elementary school by partnering with New York Coalition for Healthy School Food (NYCHSF), a non-profit that promotes plant-based meals in New York public schools. The first major success between the partnership of P.S. 244 and NYCHSF was receiving approval to serve one vegetarian dish a week. P.S. 244 very quickly became the test subjects for trying out vegetarian meals at the public-school level. Some of the meals include Braised Black Beans with Plantains and Herbed Rice Pilaf, Mexican Bean Chili, Chickpea Falafel with Creamy Tofu Dressing, and Roasted Organic Tofu with Sweet Curry Sauce.

Groff admits a major barrier in becoming a 100% vegetarian school was educating the community on the food that was being served. Groff and his administration routinely invited students' parents over to serve them the vegetarian meals that were being served to their children. This allowed parents to better understand that just because the meals were vegetarian

didn't mean that they couldn't also be delicious. This educational approach took P.S. 244's frequency of vegetarian meals from once a week to three times a week. Groff admits, when looking back at the journey, that it is important to ramp up slowly and to begin the process with education so kids and families can understand the importance of the changes that are being made.

Today, Active Learning Elementary School is a 100% vegetarian-based school and Groff's theory of better nutrition positively influencing students' lives is becoming increasingly supported. Active Learning Elementary School is now ranked 11th in school performance based off of state test scores, and that is without an accelerated/gifted program. Ever since the switch to 100% vegetarian menu, student attendance has steadily increased to the current 96% attendance rate, which significantly outperforms the state average of 85%. Students at Active Learning Elementary School also consume more of their lunch food when compared to the rest of the state, with consumption rates at 77% for P.S. 244 against the city average of 68%. The conversion to a completely vegetarian menu has not only benefited the students of Active Learning Elementary School, but it has also influenced other public schools within New York City.

In 2017, Bergen Elementary School in Brooklyn, New York, converted to an all vegetarian menu. Bergen Elementary works with 1,250 students and was able to partner with NYCSHF to take similar steps that P.S. 244 made to become exclusively vegetarian. Bergen Elementary is taking it one step further by serving vegan dishes around 50% of the time (Putinja, 2018). As previously stated, Groff has been a catalyst for change. Because of the success of Active Learning Elementary School and the new-found success of Bergen Elementary School, 1,200 New York City Public schools are adding a vegan lunch option to their menus. This New

York City plant-based initiative is through continued partnership with NYCSHF and began in 2018 (Neff, 2017).

Brazil. The plant-based movement is not only a change that is being made by schools in America; the demand for healthier and more sustainable food choices is occurring across the world. One country that is leading this movement is Brazil. Humane Society has partnered with four major cities in Bahia, Brazil, Serrinha, Barroca, Teofilândia, and Biritinga, to offer all vegan meals at their public schools by 2019 (Humane Society International, 2018). Leticia Baird, the environment's public prosecutor in the state of Bahia, stated, "Providing our school districts with plant-based meals will help save environmental and public financial resources, allow for a future of healthy adults, and build a fair world for the animals" (as cited in Chow, 2018, par. 8).

The project is called "Escola Sustentável (Sustainable School)," and began with a two-year trial period. The trial period was initiated with four days of training for all of the public schools' cooks. Chef André Vieland taught the schools' cooks how to make nutritious, savory and cost-effective vegan meals (HSI, 2018). Traditional school meals in these cities before project Escola Sustentável included lamb, poultry, beef, fish, milk, and eggs. Throughout the four-day training, the cooks learned how to make meals using soy, rice milk, vegetables, grains, and peanut butter, while excluding all animal products.

A major benefit of this trial period is school districts are gathering student data to assess whether a vegan diet does have a positive effect on student health. During these two years, the schools will periodically be testing weight, height, body composition, as well as several blood tests that measure vitamin B12, triglycerides, blood glucose levels, and total cholesterol. The

preliminary student health data will either support or delay definitive implementation of vegan school meals by 2019.

This Bahia plant-based initiative is the first to offer exclusively vegan meals within a public school. Baird stated that if families do not believe or support the schools' newly imposed diet, then they are able to send their students with packed lunches from home (Chow, 2018). The four cities implementing project Escola Sustentável will serve more than 23 million meals annually to over 30,000 students (HSI, 2018).

Enlisted below are the facts, given by Humane Society International, which motivated project Escola Sustentável:

- The São Paulo city school district, Brazil's largest school district, has participated in Meatless Monday since 2009, serving more than half a million plant-based meals every two weeks. According to the Food and Agriculture Organization of the United Nations, animal agriculture is one of the greatest contributors to the most serious environmental issues, like global warming, and is a major consumer of scarce water resources.
- Choosing plant-based foods helps human health. Many of the chronic diseases plaguing the world, including obesity, heart disease, diabetes and high blood pressure, can be prevented, treated and, in some cases, even reversed with a plant-based diet.
- According to the Brazilian Ministry of Health, Brazil is currently facing a new obesity and overweight epidemic, which is affecting over half of the population,

including children. One in three Brazilian children between the ages of 5 and 9 is obese or overweight and face health risks as a result.

- Shifting to plant-based foods reduces animal suffering. Tens of millions of animals in food production in Brazil, like egg-laying hens and breeding sows, are intensively confined and spend their whole lives in cages so small they can barely even move (HSI, 2018, par. 5).

Common themes of each successful plant-based implementation are partnerships, education, and leadership. Ultimately, many schools are discovering the positive effects plant-based diets have on both sustainability and their students' health. As stated previously, the implementation of a plant-based diet does not need to be black or white, rather a spectrum that schools can move along as they try to provide their students with more sustainable and healthier meal choices. Giving more plant-based variety to students, as Santa Barbara has done, is a great initial step for any school starting from square one. A gradual change from vegetarian lunches being the minority to having them become the majority is another approach that has been taken by Active Learning Elementary School in New York City. A drastic approach for plant-based meal implementation, as seen in Brazil, is converting to a 100% vegan menu through a two-year trial period. Every school will be different by how fast it moves along the spectrum, but what is important is that schools are at least moving in the right direction by providing healthy, sustainable meals for their students.

Summary

Chapter 2 explores the question: *What are the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title 1) public schools (grades K-12)?*

Plant-based diets address two pertinent issues that confront the United States: public health and climate change. This literature review summarizes relevant research that supports the notion that a plant-based diet is the healthiest and most sustainable diet.

Plant-based diets promote better health by preventing chronic diseases. The copious consumption of animal products and the negligent intake of plant products have led to a chronically ill nation afflicted with diseases that can be prevented and treated with a plant-based diet. Plant-based diets have been proven to reduce the risk of heart disease (Kahleova et al., 2017), decrease the incidence of both prostate (Nguyen et al., 2006) and colorectal cancers (Figueiredo et al., 2014) and prevent and treat Type II diabetes (McMacken & Shah, 2017).

Not only can a plant-based diet be the solution for the American public health crisis, but it can also contribute to alleviating humans' impact on climate change. There is a consensus among scientific literature that diets rich in meat are environmentally inefficient and unsustainable. Beef specifically is the most ecologically expensive animal protein source and emits the most waste when compared to all other animal protein sources (Sabaté & Soret, 2014). As Eshel et al. (2014) argued, "Livestock-based food production is an important and pervasive way humans impact the environment. It causes about one-fifth of global greenhouse gas emissions and is the key land user and source of water pollution by nutrient overabundance. It also competes with biodiversity, and promotes species extinctions" (p. 11996). Ultimately, plant-based diets are more sustainable because they require fewer natural resources (water, energy, fertilizers, etc.) (Marlow et al., 2015) and they cause less harm to the environment (Sabaté & Soret, 2014). However, if a person desires to eat more sustainably but is not able to eliminate all animal products from his or her diet, then just eliminate one: beef.

Plant-based diets would benefit many, but the necessity for implementing plant-based diets is especially great for those in lower-income schools and communities. The adverse health effects of the Western diet have afflicted the nation disproportionately, as rates of cardiovascular disease, Type II diabetes, and certain types of cancer are influenced by socioeconomic status. A positive correlation between socioeconomic status and an individual's personal health has been established in high-income countries, such as the U.S. (Stronks, Dan De Mheen, & Mackenbach, 1998). This means that impoverished communities are more susceptible to higher rates of diet-related chronic diseases. Experts have identified that lower-income communities have greater access to unhealthy food outlets (such as bodegas and fast food restaurants) (Hilmers et al., 2012), while having less access to healthy food and fresh produce (Franco et al., 2008). A plant-based public school initiative would benefit upper, middle, and lower class communities, but society should begin providing access to healthier foods to those who need it most. It is for this reason why this capstone is focusing exclusively on lower-income public schools.

Schools are realizing the impact plant-based diets can have on their students, and this is why so many schools are switching over to plant-based diets. Schools in California, New York, and Brazil have initiated the process of implementing more plant-based dietary meal options within their schools. The purpose of this capstone project is to begin a similar process in the state of Minnesota.

The goal of this project is not to turn every public school vegan. Rather, the goal is to incorporate more plant-based meal options into lower-income public schools, promoting more opportunities for children to consume more fruits, vegetables, nuts, whole grains, and legumes. Chapter 3 (project description) will address the realistic challenges that prevent dietary changes

from being made in order to help leadership within school districts advocate for dietary choices that are healthier and more sustainable for their students. The primary focus of chapter 3 will be detailing specific measures and actions that will be taken in order to initiate change within an urban school district. The project will be a presentation to district leadership (administration, the superintendent, and school board members) about the first steps that can be taken in order to become a healthier and more sustainable school district. The presentation will include the major benefits for both personal and environmental health, as discussed in chapter 2. The presentation will also display a current weekly menu that is already being served within the school district, along with the recommendations for plant-based meal improvements. The project description will discuss the technical challenges of implementing change at a district level, such as evaluating the cost per meal if these changes were made. Chapter 3 will conclude with an appraisal of the proposed changes for the urban school district and the feasibility of implementing more plant-based meal options for students when all costs and benefits are considered.

CHAPTER THREE

Project Description

Introduction

This capstone project explored the question: *What are the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title I) public schools (grades K-12)?* The purpose of this project was to propose a plant-based initiative to district leadership to begin the process of implementing more plant-based dietary meal options for students (K-12) in an urban school district for the 2020-21 academic year.

The Western diet consists of a high intake of red meat, junk food, saturated fats, eggs, and sugar, while lacking fresh fruits, vegetables, and whole grains, and it is the most widely accepted diet in the United States (Cordain et al., 2005). Whole grains, vegetables, fruits, beans, and nuts only make up 11% of the Western American diet (Nutritionfacts, 2018), and poor dietary choices have led to more than half of the nation afflicted with chronic illnesses, such as heart disease, various cancers, and Type II diabetes (Cordain et al., 2005).

The Western diet has not only had a devastating impact on public health, but it has also been detrimental to the biosphere (Machovina et.al, 2015). The agriculture industry is responsible for making up 24% of global carbon emissions (EPA, 2017). Society's demand for meat and dairy products severely diminishes its freshwater supply (Robbins, n.d.), and the clearing of forests to provide space for livestock feed and grazing (Smith & Bustamante, 2014) is

a primary cause for the decrease in biodiversity (McLaughlin & Mineau, 1995), leading to the sixth mass extinction (Johnston, 2017).

One way to safeguard the planet and personal health is to implement a more plant-based diet. However, this is not a capstone devoted to converting all lower-income public schools into vegan institutions. A plant-based diet is defined as a, “diet [that] consists of all minimally processed fruits, vegetables, whole grains, legumes, nuts and seeds, herbs, and spices and excludes all animal products, including red meat, poultry, fish, eggs, and dairy products” (Ostfeld, 2017, p. 315). Plant-based diets have been proven to lower the risk of heart disease (Kahleova, Levin, & Barnard, 2017), the first leading cause of death in the U.S. claiming 630,000 lives annually, by reducing cholesterol and lowering blood pressure (Alexander et al., 2017). Plant-based diets have also been proven to mitigate the risk of developing both colorectal (Figueiredo et al., 2014) and prostate cancer (Nguyen et al., 2006), as well as preventing and treating Type II Diabetes (McMacken & Shah, 2017). Plant-based diets are not only healthier, but they are also more sustainable. Plant-based diets use fewer natural resources (land, water, & fertilizer) and emit less greenhouse gases (Sabaté & Soret, 2014).

This capstone explored the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title 1) elementary schools (grades K-6). Chapter 1 illustrated the personal observations I made within the high school where I teach, which led me to develop this capstone project. Chapter 1 then went on to describe the influence diet has on public health and the environment. Finally, chapter 1 detailed the importance of making incremental changes to dietary patterns and how a plant-based diet should be viewed more as a continuum and less of a black and white decision.

The literature review (chapter 2) analyzed scientific journals and studies that evaluated the effect a plant-based diet has on personal health. Chapter 2 also discussed the scientific studies that address the influence a Western diet has on earth and its resources, and how a cultural adoption of a plant-based diet could alleviate America's overall carbon footprint. The literature review then emphasized the importance for providing more plant-based meal options, specifically in lower-income schools, because of how impoverished neighborhoods have the least amount of access to fresh, healthy food. Chapter 2 concluded by providing examples of schools from around the world that have begun to incorporate more plant-based meal options for their students.

Chapter 3 outlines my capstone project, detailing the purpose and form in which it is to be presented. Several research theories have influenced my approach in developing this project, which will also be discussed. Next, I will describe the intended setting and audience for the presentation of my project. Justification for using the mediums I selected will be articulated when describing my project format. Finally, this chapter will conclude with a detailed analysis of how my project will be executed in relation to the intended purpose of my capstone.

Project Overview

My capstone project is to be completed August of 2019. The project consisted of a PowerPoint presentation and a formal proposal to begin a plant-based initiative, which was to be presented to district leadership of an urban, lower-income school. The first section of the proposal was a project description, which highlighted the specific health benefits of a plant-based diet, while addressing the negative impact the Western diet has on ecosystems. Next, the proposal clearly defined one plant-based meal substitution that should be made across the whole

district. The final section of the proposal included an estimated cost-analysis of the recommended changes.

The second aspect of my project was a PowerPoint presentation. The presentation began with the goals and objectives of the plant-based initiative. Next, a summary of the scientific studies that evaluate the effect a plant-based diet has on personal health was given. The presentation outlined the research that addresses the influence a Western diet has on earth and its resources, and how a district-wide adoption of a plant-based diet could alleviate cities' overall carbon footprint. A variety of plant-based schools from around the world were evaluated to show the audience there are different options when beginning a plant-based initiative. This also informed the audience there are many school districts that have already made significant changes to more sustainable, healthier eating. The presentation concluded with an appraisal of district-wide dietary changes in order to determine the feasibility of the plant-based initiative.

Research Framework

The research design I have selected for my project is a mixed methods approach. This approach is a type of research that incorporates both qualitative and quantitative data (J.W. Creswell & Creswell, 2018). For my project, I will not be collecting my own data. Rather, the information to be included in my presentation is based on both quantitative and qualitative studies summarized in my literature review. The quantitative studies focused on the effect a plant-based diet can have on personal and ecological health, whereas the qualitative studies came from the interviews and viewpoints of people who work at plant-based schools. In *Research and Design*, J.W. Creswell and Creswell (2018) define triangulating data sources as “a means for seeking convergence across qualitative and quantitative methods” (p. 14). My project includes a

triangulated approach in order to create a purposeful and academically sound proposal for my district.

Project Description

This project was a proposal and presentation for the district leadership of an urban school in order to begin a plant-based initiative for the 2020-2021 academic year. The goal of the plant-based initiative is to begin the process of implementing more plant-based dietary meal options for students (K-12) in an urban school district. The proposal was conveyed using a Word document and the presentation was communicated through a PowerPoint. The proposal detailed the goals and objectives of the plant-based initiative, as well as the recommended plant-based meal substitution. The PowerPoint presentation described the major strengths of plant-based diets, as well as provided models of different school districts that have begun similar initiatives. Figure 6 displays the meals served to urban elementary level students in May of 2018 (SSPPS, 2018). Although menus do change from week to week, I believe this menu is a realistic snapshot of the food provided at the elementary school throughout the academic year.

This menu is reflective of the American Western diet. For students who choose to eat their breakfast at school, the only option they have is refined sugar and the only aspect of their breakfast that changes throughout the week is the form in which sugar manifests (maple pancakes, mini-cinnamon roll and a slice of banana bread). Although the district does offer salads for lunch every day, the nutritional makeup of the salads are composed primarily of dairy (through cheeses and dressings), and some type of meat, while iceberg lettuce is the main, and sometimes only, vegetable found within them.

Figure 6: Lincoln Center Elementary School Weekly Menu for May 14-18, 2018

MON	TUE	WED	THU	FRI
14	15	16	17	18
BREAKFAST Mini Maple Pancakes	BREAKFAST Cereal Bar & Cheese	BREAKFAST Mini Cinni	BREAKFAST Banana Bread Slice	BREAKFAST Mini Maple Waffles
LUNCH Mini Corn Dogs or Chicken Tenders w/ Dinner Roll or Ham & Turkey Sub With Romaine & Spinach Salad Pasta Salad Garden Patch Varieties Or Sesame Salad Lunch	LUNCH Ham & Turkey Sub or Beef Softshell Tacos or Beef Hard Shell Tacos with Tator Tots Sub & Taco Fixings Garden Patch Varieties Or Southwest Chicken Salad Lunch	LUNCH Shrimp Poppers or Chicken Nuggets or Turkey Sandwich with Macaroni & Cheese Seasoned Peas Garden Patch Varieties Or Italian Salad Lunch	LUNCH Chicken & Gravy or Rotisserie Chicken Drumstick or Italian Sub with Mashed Potatoes Dinner Roll Glazed Carrots Garden Patch Varieties Or Taco Salad Lunch	LUNCH Sloppy Joe or Chicken Patty Sandwich or PBJ & String Cheese with Salad Garden Patch Varieties Or Chicken Caesar Salad Lunch

South St. Paul Public Schools. (2018). South Saint Paul Lincoln Menu of May 2018.

Each day there are three main meal choices offered. Thus, there is a total of 15 different lunch meals prepared and served to the students in a given week. Of the 15 meals prepared this particular week, 14 of them have meat as a central part of the meal. One out of three of the main meal choices served are deep fried, and there is only one main vegetarian meal. Thankfully, a whole vegetable is offered as a side item each day of the week. However, the side item only makes up a small fraction of the total calories (and nutrition) offered for each meal.

At this point, it is important to reiterate the idea of a plant-based meal. The purpose of this project is to promote more opportunities for students to consume more fruits, vegetables, nuts, and legumes. A plant-based meal is not necessarily a vegetarian meal. An example of this

would be how a peanut butter and jelly sandwich, spaghetti with marinara sauce and a slice of cheese pizza could all be classified as vegetarian, but they are certainly not plant-based.

The initial recommendation for a plant-based initiative was to substitute the beef hard shell tacos meal option for black bean empanadas. The black bean empanada recipe was provided by The Lunch Box, which is a food resource provided by the Chef Ann Foundation. The Lunch Box is a resource intended for school districts to help them transition from processed, frozen lunches to fresh, healthy meal options. The recipes are in compliance with USDA federal public school nutritional requirements. Furthermore, The Lunch Box provides schools with implementation strategies, financial calculators, marketing materials, and menu cycles (Cooper, 2019). The cost analysis revealed that if the urban school chose to begin a plant-based initiative and started with the recommended substitution, then the school district would save an estimated 20 cents per meal served.

Setting and Audience

The intended audience for my project was my district leadership, which includes principals of the respective schools, the superintendent, and school board members. The reason why I chose this audience was because they have the greatest influence in determining the implementation of district-wide changes.

The setting for this was an urban, lower-income school district, where I currently teach. The schools (one secondary and two elementary buildings) reside in a small urban city, with a population of over 20,000 people (City-data, 2018). All schools within the district are considered lower-income as more than 30% of the student population receives free or reduced lunch (FSA,

n.d.). The proposal and presentation for plant-based dietary changes will be held at the school district's office.

Innovative dietary changes are being made within the district because leadership realizes the impact quality food and nourishment have on the student population. In the 2017-2018 academic school year, this urban district offered two supplemental food services to its students. For example, Second Harvest Heartland is a food program that collects food from local grocery stores, brings it to the school and offers it to the community for free (Second Harvest Heartland, 2018). This program has provided food access (specifically produce) to lower-income families. The second supplemental food program my school has provided is Second Chance Breakfast. Second Chance Breakfast offers students breakfast after their first period of the day for free. This has been an excellent program within the district, which has resulted in an additional 22,846 breakfasts being served to students within the 2017-2018 academic year (SSPPS, 2018). The district has been progressive when it comes to providing food for students, and I believe now is a crucial time to take another step in the right direction.

Project Format

The two deliverable mediums I selected for this project are a formal proposal in the form of a Word document and a visual PowerPoint presentation. The proposal is to be printed off so every member who attends the presentation will have his or her own copy. The reason why I chose to use a Word document is because I wanted the information to be straightforward and neatly presented. My audience will be district leadership, and they are constantly inundated with questions and requests. Because of this, I want to be sure my objective is clear, and they know the exact benefits and costs associated with my proposal.

The visual PowerPoint presentation was intended to corroborate the claims and recommendations made in my proposal. I will integrate the presentation principles created by Knowles (1992) in order to engage adult learners within the audience. My presentation will begin with the goals and objectives of the project and lead into an outline of the main topics that will be covered. These two strategies will orient the learning for my audience and will contextualize my proposal (Palis & Quiros, 2014). I chose a PowerPoint presentation because it easily allows me to display graphs and data from scientific studies. Through PowerPoint, I will also be able to show images of the plant-based meals served in other school districts, which will help my audience envision future meals for our students.

Project Timeline

My capstone project is to be completed August of 2019. The proposal and presentation will be given to district leadership November of 2019. The reason I chose this time of year was because it is during this time when new district-wide improvements and changes are proposed for the upcoming academic year. If the proposal is accepted, then with the help of district leaders, I would create a one-, two- and five-year plan by March of 2020, with changes to be implemented for the 2020-2021 academic year.

Summary

The purpose of this project was to improve the dietary options being offered within an urban school district by offering more plant-based meals. A formal proposal and presentation will be given to district leadership in November of 2019. The initial recommendation for a plant-based initiative was to substitute the beef hard shell tacos meal option for black bean empanadas. The black bean empanada recipe was provided by The Lunch Box. A detailed cost

analysis, along with a list of plant-based meal options will be discussed during the presentation. Pending the approval of the proposal, the changes are to be implemented district-wide during the 2020-2021 academic year.

This capstone will conclude with chapter 4, which not only reflects on my experience with the capstone project but will illustrate major learnings that took place. Chapter 4 also discusses the broader implications of this project, as well as the limitations in research and the project itself. Next, Chapter 4 illustrates the future research and projects for this capstone, and finally concludes with professional applications of my capstone project by describing the expected benefits this capstone project will bring to an urban school district.

CHAPTER FOUR

Conclusions

Introduction

The central question of this capstone was, *What are the problems and solutions of adopting a plant-based diet into lower-income (as defined by Title I) public schools (grades K-12)?* The purpose of this capstone was to begin a plant-based initiative within an urban school district which would provide low-income students with the opportunity to consume more fruits, vegetables, whole grains, nuts, and legumes. Chapter 2 drew the conclusion that most Americans subscribe to a Western diet, which is high in refined sugar, meat, and dairy and is deprived of plant consumption. Through my literature review I provided evidence that plant-based diets are not only healthier but are also more sustainable. This evidence led me to develop a presentation that advocates for more plant-based diets in lower-income public schools. The intended audience for this presentation was district leadership of an urban school in order to begin a plant-based initiative within the district. Initiatives such as this have begun to take place in California, New York, and Brazil and I hope my capstone begins the process in Minnesota.

Chapter 4 discusses the major learnings that took place while completing this capstone project. Through this capstone I have learned about the close association between public health and poverty. Educational systems have the subtle but important role of dictating the nutrition they provide to their students, and this role can be a key feature in providing better health in lower-income neighborhoods. This chapter will then revisit the literature review to discuss the

major findings that supported this capstone's development. Next, I will discuss the broader implications of this project, as well as the limitations in research and the project itself. Chapter 4 will then describe the future research and projects for this capstone. There are two major directions I would like to see this project move towards after it is approved by the school district. The first is to begin the process of collecting student data on test scores and attendance to determine the effect plant-based diets have on academic performance. The second is to develop a project that details a one-, two- and five-year plan for successfully integrating a plant-based diet into a school district. This plan would include educational resources for parents and students, recommended plant-based meal substitutions, and further research on the effect plant-based diets have on health and sustainability. This chapter concludes with professional applications of my capstone project by explaining how I plan on communicating my project out to my professional community, as well as describing the expected benefits this capstone project will bring to the school district.

Major Learnings

I have learned a lot about large, systemic issues such as poverty, public health, and environmental stewardship since beginning this capstone. Poverty and public health are systemic issues I have explored deeply over these past 12 months, and I have begun to see the interrelatedness between the two topics. Inaccessibility to fresh food and produce, fast food availability, quality of school systems, and recreational park density are all factors that negatively influence the health and development of individuals living in lower-income neighborhoods. Renowned author Robert Sapolsky (2004) states it best in his novel *Why Zebras Don't Get Ulcers*,

The health risk of poverty turns out to be a huge effect, the biggest risk factor there is in all of behavioral medicine—in other words, if you have a bunch of people of the same gender, age, and ethnicity and you want to make some predictions about who is going to live how long, the single most useful fact to know is each person’s SES [Socio Economic Status]. If you want to increase the odds of living a long and healthy life, don’t be poor. Poverty is associated with increased risks of cardiovascular disease, respiratory disease, ulcers, rheumatoid disorders, psychiatric diseases, and a number of types of cancer, just to name a few. (p. 366)

Poverty is a larger-than-life issue that can at times seem overwhelming and unsolvable. However, the development of my capstone project has inspired me to address poverty and public health on a personal and community-based level. The capstone process has distilled my locus of control and has changed my question from “How can I help fight poverty?” to “What can I do within the school community to provide more opportunities for healthier eating?”

Over the last four years I have seen some outstanding colleagues make impressive changes for our school that greatly benefit students' health. Second Harvest Heartland food shelf (as mentioned in chapter 3) is an amazing resource that provides students with free access to fresh produce, while alleviating the amount of food wasted in the Twin Cities. Connecting the Second Harvest resource to the school district would not have been possible if it were not thanks to Connie Garling-Squire. Second Chance Breakfast is another great example of one individual making extraordinary change happen within a school district. Second Chance Breakfast provides low-income students with the opportunity to eat breakfast after their first period of the day. It gives students who show up as the school day begins the chance to eat breakfast before waiting

another four hours until lunch. In the 2017-2018 academic year, Second Chance Breakfast provided 22,846 breakfast to secondary (grades 6-12) students (SSPPS, 2018). The initiation and continued success of this program is attributed to the Food Service director Glen Ritter. I have observed individual colleagues make monumental changes within our school district and this capstone project has inspired me to want to be a catalyst for change in a similar way. My capstone project has taught me that providing access to healthy food is one way to address poverty within my own local community.

The next major area of learning for me during the development of my capstone was through gaining a better understanding of environmental stewardship. When researching the environmental impacts of Western and plant-based diets I could not help but ask myself, “Why would someone care about the impacts a diet has on our planet earth?” Mackawa and Macer (n.d.) categorize three major worldviews for why individuals would care about ethical environmental issues. These three views are anthropocentrism, biocentrism, and ecocentrism.

Anthropocentrism is a worldview that focuses on humans and it considers human needs as the greatest priority. Biocentrism focuses on the well-being of all other living organisms, and ecocentrism focuses on the health and longevity of ecosystems. The ecocentric and biocentric are often rivaled by anthropocentric views because the latter is concerned with the success of humans and the former views are concerned with everything else that is non-human (Mackawa & Macer, n.d.). Unfortunately, the United States, along with many other countries, live in an anthropocentric society, where human success is the forerunner of values. This prioritization of the human experience is admirable because it focuses on the improvement of engineering, science, and business. However, anthropocentric societies cultivate anthropocentric citizens, and

as a result biocentrism and ecocentrism are forgotten (Mackawa & Macer, n.d.). Applying anthropocentric views to ethical environmental issues is more likely to be the reason why people would alter their dietary preferences rather than have everyone adopt an ecocentric state of mind. It is for this reason why the United States should take plant-based diets into consideration. If we are indeed anthropocentric as a culture, then we should care about our personal health.

This concept was crucial in orienting my capstone project and was why I chose to lead my project with the health benefits of a plant-based diet. I predicted district leadership would be more willing to buy into the idea of creating a menu that is healthier for its students over a menu that is better for the planet. I believe the average American is going to operate in his or her best interest so in order to generate meaningful, sustainable change, we need to show people why environmental stewardship is in their best interest and how it directly benefits them individually.

The final area where the majority of my learning took place was through my literature review. A major contribution from my literature review that allowed me to learn more about public health was the book *How Not to Die* by (Greger, 2018). Greger (2017) analyzes the scientific literature on how both the Western diet and a plant-based diet impact personal health. The investigation I found to be the most effective in conveying food systems' influence on the degradation of the environment was Sabaté and Soret's 2014 meta-analysis. The meta-analysis broke food systems down into two major criteria for sustainability: environmental protection and efficiency. Environmental protection was evaluated on the food source's ability to preserve ecological systems (fertilizer usage, soil erosion, and waste production) and efficiency of food source was assessed through the natural resources that were required to grow/raise the food source through a quantifiable ratio of inputs and outputs. This simplified model of food systems

gives the reader a comprehensive understanding of the negative impacts meat-based food products have on the planet. The final aspect of my literature review that gave me insight into developing my capstone project was the handful of plant-based initiatives that have already begun to take place in other states and countries. Studying the models from the Active Learning Elementary in New York (Neff, 2017), the Santa Barbara Unified School district (Murray-Ragg, 2018), and the “Escola Sustentável (Sustainable School)” project from Brazil (HSI, 2018) allowed me to generate a plant-based proposal that will be successful.

I feel my capstone has been about tackling larger-than-life problems. Poverty, public health, and environmental stewardship are all issues that appear to be insurmountable, but these issues need to be addressed in the U.S. Through witnessing colleagues implement substantial change, exploring the worldviews of environmental stewardship, and learning about scientific literature, I believe change in these areas is possible. This capstone has helped me distill my locus of control within my own school district by inspiring me to encourage incremental changes that will positively impact my students’ health.

Implications

The implications of this capstone project are very much dependent on whether district leadership wants to begin a plant-based initiative after being presented with the proposal. If the district leadership decides to vote against the plant-based proposal, then I will identify what specific issues were barriers for their approval. If this is the case, then I may need to provide additional research, modify the proposal, or address barriers before starting a plant-based initiative in an urban, lower-income school. However, if the district leadership votes to support the plant-based proposal, then many steps of action will need to be taken. First, as a district, we

will question what the healthiest, most sustainable and affordable plant-based options are for our students. Then we will choose the plant-based meal that will replace the meat-based meal option for the academic year of 2020-2021. Next, cooks from the school district will need to be trained and educated from food services about new meal preparations. Finally, the district will create a one-, two-, and five-year plan in order to continue the implementation of plant-based dietary meal options. This plan would need to include education for the students, parents, and community of why our district is choosing to implement a plant-based initiative, as well as generate an implementation strategy for plant-based meal substitutions.

Limitations

I encountered two major limitations through completing this capstone. The first limitation was lack of research for how a plant-based diet affects students' academic achievement. Many plant-based models discussed in the literature review have only been implemented within the last decade. As a result, there was no research on how those changes have affected students' attendance, test scores, or behavior. Although many of the models are currently studying these correlations, no research has been published stating the effect plant-based diets have on academic performance.

The second major limitation experienced during my capstone was the development of my project. When I began my capstone during the summer of 2018, I imagined my project was going to be an in-depth plan about the education, communication, and specific strategies of how to implement a plant-based initiative into an urban school district. However, I learned that before I can even begin to give a proposal, I need district leadership to see why a plant-based initiative would be beneficial for our school district. Additionally, I wanted to give districts ownership of

choosing their own implementation strategy so they would feel involved and connected to the process. The main goal for this capstone project turned out to be getting a school district to say yes to a plant-based proposal. Ideally, there is enough reason and evidence within the project to persuade district leadership to approve a plant-based proposal, and then it would be up to the school district to dictate the intensity of how it implements plant-based meal substitutions. In this way, I believe providing different models within the presentation is a major benefit for this capstone project because it allows leadership to pick and choose models and strategies that would be successful within its own school district.

Future Research/Projects

Limitations for this capstone have led me to consider future research and projects that would perpetuate the success of future plant-based initiatives. The primary area of research that should be conducted after the completion of this capstone is to study the effect plant-based diets have on students' academic achievement. If the district is to begin a plant-based initiative, then supplemental research on attendance and test scores should be conducted within the sixth-grade cohort and followed through the students' 12th grade year. The research design would be based on separating the sixth-grade students into two groups: those who take the plant-based meal option and those who choose the traditional meal option. Self-assessed food-frequency questionnaires will be given to students who are willing to participate in order to assess their dietary intake when they are outside of school. Next, a plant-based dietary index (PDI) will be generated for the students where plant products (fruits, vegetables, legumes, nuts, and whole grains) receive a positive score and animal products (meat, eggs, and milk) receive a negative score. This means a student who receives a high PDI would be eating considerably more plant

products than meat products (Satija et al., 2016). Then all students will be placed into three quantiles: low plant intake (PDI less than -4), medium plant intake (PDI between -3 and 3), and high plant intake (PDI greater than 4). Students' attendance and state test scores will be tracked throughout the six-year period and data will be analyzed to determine the correlation between PDI and academic achievement. If a positive correlation is established between a high PDI and increased academic achievement, then it will be much easier to persuade school districts to begin their own plant-based initiative.

The secondary extension for this capstone would be to develop a project that provides an in-depth plant-based initiative plan, which could be used as a guide for other school districts. This plan would include educational resources within the school (specifically cafeterias and classroom). It would provide infographics for parents and community members (presenting the major benefits of a plant-based diet), training resources for food service personnel, and menu cycles with cost effective plant-based meal substitutions. This plan would also include recorded qualitative data with notes, suggestions, and critiques about the plant-based implementation process (how it was received by the students), as well as quantitative data on meals served and the amount of food wasted. Ultimately, this project would create an easy-to-use detailed guide for other school districts to follow if they wanted to begin their own plant-based initiative.

Professional Applications

I will be communicating the results of my capstone project through a district presentation. The proposal and presentation will be given to district leadership (principals of the respective schools, the superintendent, and school board members) November of 2019. The reason I chose this time of year was because it is during this time when new district-wide improvements and

changes are proposed for the upcoming academic year. If the proposal is accepted, then the first plant-based meal substitution will be implemented into the urban school district in the 2020-2021 academic year.

This capstone project was not only created for an urban school district; it is also intended to be a beneficial resource for educational institutions that intend to improve the health of their students or that are working towards more sustainable practices. An additional purpose of this capstone project was to offer a resource for teachers, food service directors, and administration who want to begin a similar plant-based initiative within their own district. The presentation and proposal provide sufficient evidence to begin a plant-based initiative in any school district. As awareness of plant-based schools increases, I hope others within the profession will be able to use my project to advocate for promoting more opportunities for children to consume more fruits, vegetables, nuts, whole grains, and legumes.

Summary

The purpose of my project was to create a presentation and proposal for district leadership to begin a plant-based initiative. Chapter 4 described how the development and completion of my project has taught me a lot about public health, poverty and environmental stewardship. I have gained a better understanding of the interrelatedness between health and poverty, as well as how to advocate for environmental stewardship. My colleagues have taught me how one individual can have a powerful impact, and my research has shown me that a plant-based diet is not only the healthier option for students, but a more sustainable one. Next, chapter 4 discussed the limitations of this project: lack of research stating the relationship between plant-based intake and academic achievement and an in-depth plan for plant-based meal

implementation. The future research and projects of this capstone would explore these limitations and ultimately make it easier for school districts to begin their own plant-based initiatives. Finally, chapter 4 explained how the results of my capstone project are going to be communicated to my school district, as well as detailing the benefit this capstone will bring to other school districts.

This project began with a personal observation: many public school students eat poorly. As a high school teacher, I have grown tired of seeing my students indulge on cheeseburgers, deep fried pork egg rolls, cinnamon rolls, cookies, and pizza. I dream of a day when my students will be fueled with healthy, nutritional food that provides them with lasting energy - a day when schools realize the important role they play in our environment's health. This capstone is intended to make this dream a reality by providing healthier and more sustainable plant-based food options to an urban, lower-income school district.

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