



The University as a Site of Food Insecurity: Evaluating the Foodscape of Texas A&M University's Main Campus

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Abstract

This paper evaluates the foodscape of Texas A&M University's main campus in an effort to understand rates of food security as linked to food access at a tier-one university. To do this, we employ two methodological approaches. An ArcGIS analysis documents the physical attributes associated with the foodscape, including nutritional content and affordability of food at on-campus retail food locations. Further, to understand the foodscape from a socio-cultural perspective, we use a qualitative survey to assess food security rates and perceptions of food access among undergraduate students. We conclude that undergraduate students at Texas A&M University experience degrees of food insecurity during the semester at rates of up to two and a half times the Texas average. We situate this finding within our geo-spatial analysis, which underscores that segments of campus lack access to affordable, fresh, or healthy food.

Key Words: Foodscape, Food Insecurity, University, ArcGIS

1. Introduction

Hunger and food insecurity among college students are issues of growing relevance. Recent academic scholarship has demonstrated that incidences of food insecurity among U.S. college students is often more than double the national rate of 15% (Chapparo *et al.*, 2009; Freudenberg *et al.*, 2011; Patton-Lopez *et al.*, 2014). The increased presence of food pantries for students on college campuses (now found at more than 200 U.S. schools) serves as evidence to this (Jordan, 2015). This is a critical topic, because a diet lacking in fresh and healthy food is linked not only to a number of health conditions such as diabetes and

obesity (Yan *et al.*, 2015), but it is also linked to poorer academic performance and poorer psychological development (Alaimo *et al.*, 2001; Patton-Lopez *et al.*, 2014). With over 20 million college students enrolled in U.S. universities in the fall of 2015, the potential size of the population impacted by food options and access on campuses is significant (U.S. Department of Education, 2015).

Previous scholarship on food insecurity among university students correlates hunger with student race and income (Chapparo *et al.*, 2009; Patton-Lopez *et al.*, 2014). This paper adds to discussions concerning food insecurity among college students by investigating the environmental conditions associated with food availability on

campus. We do this by analyzing the campus food environment as a “foodscape.” A foodscape refers to the various spaces and places where a person obtains, prepares, and/or consumes food. Importantly, the term foodscape encompasses both physical material processes, (e.g., the built environment), socio-cultural political and economic processes (e.g., cultural perceptions of food), and the power structures that dictate food provision, which can encompass both the physical and the social attributes (Miewald & McCann 2014). To date, research on the topic of food security at university campuses tends to focus on the socio-economic aspects. For this reason, we employ the concept of the foodscape to link the social and cultural aspects of food access with the built environment. This allows for a more enhanced understanding of what food security rates are on campus among students and how those rates might be linked to food options at campus food establishments. Further, a foodscape framework enables a wide range of future research objectives relevant to food provision issues in the spaces of a college campus. This is a point we address further in our conclusion.

Our investigation focuses on Texas A&M University (TAMU) main campus, a tier-one research university located in College Station, Texas. This college campus offers a unique research space to examine foodscapes, because while grocery stores are often lacking, there are a variety of other food establishments including restaurants, fast-food outlets, cafes, and convenience stores. Further, students who use this foodscape come from diverse backgrounds in terms of both socio-economic and ethnic perspectives. We argue that both the socio-cultural and political contexts of the foodscape as well as the physical material food environment must be considered to fully understand the rises in rates of food insecurity on campuses.

To better understand the TAMU foodscape as it relates to rates of food security among undergraduate students, this study achieves three tasks. First, we establish the degree to which students are food-secure by using the USDA’s Household Food Security Survey Module. Second, the study documents student perceptions of food access and availability on campus using a qualitative survey. Finally, using ArcGIS, the study evaluates the spatial distribution of food establishments across campus. This evaluation of spatial distribution is enhanced through audits of individual stores that evaluated whether the foods offered were healthy, fresh, and/or affordable. In effect, three questions guide the paper. First, what level

of food security or insecurity is experienced by TAMU undergraduate students? Second, what perceptions do TAMU undergraduates have about food access and the food environment on campus? And third, what is the spatial distribution of healthy, fresh, and affordable food on campus? Prior to answering the study’s key questions, we will provide background on TAMU students and the dining services program. We also elaborate on the value of the concept of foodscape for understanding food security on campus. The study’s methodological approach is described. And to conclude, we discuss the link between food security on college campuses and living/studying in campus foodscapes.

2. Background — TAMU & the Campus Food Environment

Located just north of the Houston metropolitan area, College Station, Texas is home to TAMU, one of the state’s two flagship universities. With an undergraduate student population of over 49,000 undergraduate students, the campus spans 5,200 acres, making it one of the largest in the U.S. (TAMU, 2014). The racial and ethnic composition of students includes 66% White, 21% Hispanic, 5% Asian and 3% African American (TAMU, 2014). Approximately 22% of undergraduates come from low-income households, and in an average year, over 80% of students receive financial aid (TAMU, 2014).

On average, 25% of undergraduates live in residential housing on campus (US News & World Report, 2015), including all 2,500 members of the university’s military program, the TAMU Corp of Cadets. Most students living on campus participate in the campus meal plan, a mandatory program for all freshman and Cadet members. The meal plan consists of two components, pre-purchased meals that are used at one of two buffet-style dining halls, and cash or “dining dollars” to be used at all other campus food outlets. The least expensive option available (5 meals per week plus dining dollars) for students is \$1,190 per year, while the most expensive option available (15 meals per week plus dining dollars) is \$2,305 per year (TAMU DineOnCampus, 2015a). Most of the approximately 9,500 students enrolled in the plan are first-year undergraduates and Cadet participants. The remaining third of participants includes on- and off-campus sophomores, juniors, and seniors (TAMU DineOnCampus, 2015a).

The dining-dollar program was privatized in 2012 when the university employed Compass Group,

USA to manage the food-services program. Compass Group, USA uses Chartwells Higher Education (Chartwells), an operating company, to administer dining services in colleges and universities. According to on-campus dining officials, TAMU is Chartwells' largest client. Interestingly, in 2012 the school also instituted mandatory participation into the dining program for all on campus freshman and Cadet members (Reed, 2014). Chartwells is contracted to provide all food that is sold on campus. This includes grab-and-go foods, food concessions at football games, the food in all-you-can-eat dining halls, and food in all campus stores.

When designing menus for on-campus dining, Chartwells relies on a program termed "Balanced U" to provide nutritional guidelines. From a nutritional perspective, Balanced U resembles the FDA's guidelines for selecting healthy foods. For example, a recent Balanced U newsletter advocated for eating whole grains, dark and brightly colored fruits and vegetables, and lean meats (TAMU DineOnCampus, 2015b).

The issue of the privatization of the campus foodscape is important because it enabled Chartwells to play a role in shaping TAMU's food environment. An in-depth discussion of the food-justice issues associated with privatization of dining services, however, is beyond the purview of this study. Instead we focus on a snapshot of the campus foodscape at one moment in time, spring semester 2015 when the Chartwells contract was already in place. The privatization of university dining services is a theme we address briefly in the paper's conclusion.

3. From Food Desert to Foodscape

The genesis of this study emerged from a course on food security and food deserts in College Station. A food desert, as defined by the United States Department of Agriculture (USDA) refers to "urban neighborhoods and rural towns without ready access to fresh, healthy, and affordable food" (USDA, 2015). The course endeavored to critically analyze the notion of a food desert to understand its intellectual value and its use to improve a community's food access. Importantly, according to the USDA Food Access Research Atlas, TAMU's campus had already been classified as a food desert because it was both low-income and more than one mile from a supermarket. With this in mind, students worked through the food desert concept by applying interpretations of the term to the areas in which they lived. In doing this, something unintended happened. Time and again, the students in the class

began to view their immediate surroundings, the campus, as a food desert.

It was this parallel that sparked the idea to study the TAMU campus in light of food access and the food environment. While many previous food-desert studies addressed these phenomena in inner-city, low-income areas (Brown and Comer, 2013; Gordon *et al.*, 2011; Shannon, 2014; Walker *et al.*, 2010; Zenk *et al.*, 2011), the university as a site of investigation of access to food had been neglected. Knowing this, we set out to fill this gap and evaluate the campus as a food desert. In analyzing the scholarship regarding food deserts, one thing became clear: A "food desert," just as the metaphor might suggest, connotes a lack of food (Chavez, 2013; Raja *et al.*, 2008). Overwhelmingly, that lack is understood as a lack of large supermarket access relative to some defined distance (Short, Guthman and Raskin, 2007) or a lack of retail establishments selling healthy food options within a certain spatial area (Wrigley *et al.*, 2002).

This emphasis on 'lack' of food troubled us. In many ways, our food environment was different from those of the food-desert literature. The campus has dozens of small food establishments spread across its 5,000 acres, the student population is diverse in regards to both levels of income and ethnic background, and the food environment is shaped by a single institution, Chartwells. These aspects, as well as others, influence food users interactions with the campus food environment. To capture this diversity, we set out to identify a framework of analysis that could accommodate this. We found that framework in the idea of a "foodscape."

Broadly, a foodscape encompasses "any opportunity to obtain food, and includes physical, socio-cultural, economic, and policy influences at both micro- and macro-levels (Lake *et al.*, 2010: 666). Building on this, Johnston and Baumann (2014: 3) open the term further to suggest a foodscape is a "dynamic social construction that relates food to places, people, meaning, and material processes." Johnston and Baumann include within their foodscape framework theories of discourse, as well as geographical understandings of the term landscape. Working within a similar critical theoretical framework, geographers Miewald and McCann emphasize how power relations in specific food environment contexts structure both food access and the potential for change to expand food access to the food insecure (Miewald and McCann, 2014). In all cases, the emphasis is on physical or material aspects in combination with socio-cultural and political economic influences. We invoke the term

foodscape in this paper because of the dynamism it offers. Specifically, it offers the opportunity to assess material processes (like food-establishment location, prices, and food offerings) with socio-cultural characteristics (such as perceptions of the food environment and rates of food security).

4. Methods

4.1 How food-secure are TAMU undergraduate students?

The depth of previous scholarship addressing food security on-campus is limited (exceptions include Chapparo *et al.*, 2009; Freudenberg *et al.*, 2011; Hughes *et al.*, 2011; and Patton-Lopez *et al.*, 2014). There are no studies that examine this issue among schools in the southwest region of the U.S. Three of the four articles above rely on the U.S. Household Food Security Survey Module as the means to measure food security among students. This module contains standard questions created by the USDA that query behaviors and conditions over the past 12 months in meeting the basic food needs of survey respondents. Researchers can use either a long form (10 questions) or short form (6 questions) (Blumberg *et al.*, 1999). The responses given to survey questions are coded. Each respondent's score determines their classification as either food-secure, low food-secure, or having very low food security (USDA ERS, 2012).

To ensure comparability with the previous research, we used the same survey module to assess student food security. Rather than ask students to consider answers to the questions based on a 12-month period, we shortened the timeline to "during the semester at TAMU." Shortening the timeline for each question was a permitted change made to the form in September 2012 (USDA ERS, 2012). This provides an indication of short-term food insecurity experienced while at school, which is critical to note, because many TAMU students return home during the winter and summer breaks. Previous research has shown that students living at home are less likely to be food-insecure (Chapparo *et al.*, 2009).

Our survey instrument was available to all TAMU undergraduates for a 6-week period during the spring semester of 2015. Respondents were reached through social media, email listservs, and through announcements in classes. Two hundred and sixty three students responded. The sample was uniformly representative of the university population in terms of

grade classification and college enrollment (representatives from 12 of the university's 13 colleges). Females accounted for 62% of responses. Thirty-six percent of respondents participated in the dining dollars program, while the rest of the sample consumed meals both on- and off-campus.

4.2 What are student perceptions about access to healthy, fresh, and/or affordable food on campus?

The same qualitative instrument was used to survey students regarding their perceptions of the food environment on campus. Traditionally, environmental factors, like food access, were considered only objectively, measured in terms of the available food found in a food environment (Beaulac *et al.*, 2009; Freedman and Bell, 2009). Recent research, however, has noted that determining one's perception of a food environment is critical information for understanding food-consuming behaviors (Caspi *et al.*, 2012b; Freedman and Bell, 2009; Giskes *et al.*, 2007; Whelan *et al.*, 2002). In a study undertaken in Boston, Massachusetts, Caspi and colleagues (2012b), found that perceptions of greater access to supermarkets, as opposed to objective measurements of distance to supermarkets, was strongly associated with increased consumption of fruits and vegetables (intake of at least 0.5 serving per day) (Caspi *et al.*, 2012b).

To understand students' perceptions, we asked them to comment on dining-plan participation and the frequency of consuming meals on campus, to report their perceptions of food affordability on campus, and to rate their experiences with accessing fresh, healthy, and affordable food options on campus. As part of this third grouping of questions, students were asked to view a comprehensive list of food options¹ and select which foods they believed to be available on campus. Finally, students selected the factors (from a list of five)² that were most important to them in making on-campus

¹The list of food options used in the survey derives from the Healthy Eating Index (Guenther *et al.*, 2013). It contains 8 food items deemed critical for good health, including skim milk, fruits, vegetables, lean meat, frozen foods, low sodium foods, 100% whole wheat bread and low sugar cereals. The list in the survey also contained foods deemed unhealthy by the USDA and included foods high in added sugars, sodium, solid fats, and refined grains.

²Students could select all that apply among the following five options: price of products, time allotted for food in your schedule, menu selection offered at a location, convenience of location, if product had local ingredients.

dining selections. The responses to these questions informed parameters selected for the study's spatial analysis, particularly the threshold of prices that they felt determined food affordability. The survey was approved by TAMU's Internal Review Board. The results were compiled and analyzed using the Qualtrics survey platform.

4.3 What is the Spatial Distribution of Affordable, Fresh and Healthy Food on Campus?

The final component of this study examines the food environment from a geo-spatial perspective. Scholarship that deals with a communities' abilities to access healthy and affordable food includes the attendant environmental factors in regards to both food deserts and foodscapes. Previous studies have considered numerous factors that influence food access within designated spaces. These factors include but are not limited to: supermarket access (Chung and Myers, 1999), racial and income composition of communities (Brown and Comer, 2013; Moore and Diez-Roux, 2006), negative perceptions of food environments (Freedman and Bell, 2009), access to refrigerators and cooking devices (Shaw, 2006), and food costs (Cummins and Macintyre, 2002; Chung and Myers, 1999). Similarly, food access has been evaluated using several different methodological approaches, including interviews, surveys, store audits, and spatial mapping of distribution of food stores (Walker *et al.*, 2010).

Building from this scholarship, this research evaluates the physical or material characteristics of TAMU's foodscape to determine the nutritional value and cost of foods available to students on campus. Our goal was to conduct a more detailed investigation of the food environment through spatial analysis to better understand the food options available.

We audited all 17 dining locations on the TAMU main campus. Each location was subcategorized as either all-you-can-eat buffet, convenience store, fast food hamburger outlet, small cafe, food court, or Starbucks cafe. Six in-depth analyses were conducted within these separate categories and the results were projected onto the food locations that matched each category as, more often than not, offerings in one dining location on campus were identical to the offerings in the rest of the dining facilities in each category. In-depth store audits included complete listings of every food type, name brand, serving size, and price. This list was then classified according to the degree that each food's

ability meets freshness, healthiness, and/or affordability standards.

There is no preexisting standard for defining food-access indicators. The food indicators we used were informed by our qualitative research (for affordability), the proportion of fresh food available at an establishment (for freshness), and previous scholarship that reflects USDA interpretations of the determinants of healthy food (for healthy measures).

Affordability was graded based on three different price categories: 1) \$0.00-\$4.99, 2) \$5.00-\$9.99, 3) \$10.00-\$15.00. These categories were generated from the results of the student surveys wherein respondents reported that meals in the lowest category were considered "cheap," meals in middle category were "reasonably priced," and meals the highest range were "unaffordable." At each food establishment, we documented all food prices in order to determine the average cost of food at that location. A location's average food cost was used to rate it on a food-affordability scale. Freshness was determined by the proportion of packaged versus freshly or recently prepared meals. Packaged food tended to consist of candy, chips, cookies, frozen meals, and so on. Fresh meals included items, such as salads, sandwiches, wraps, sushi, whole fruit, and fruit cups, that were prepared that day. A freshness rating of 25% indicates that 25% of the food offered at a location were comprised of items that were prepared that day.

Finally, to evaluate the healthiness of food offered at each location we employed the USDA's Healthy Eating Index (HEI), which identifies the food groups valued in a healthy diet (Guenther *et al.*, 2012). According to the HEI, healthy food categories include total fruits, whole fruits, total vegetables, whole vegetables, greens and beans, dairy, total protein, seafood, and fatty acids.³ Each healthy food item that was found in each of the reviewed food locations was categorized into these food groupings. Points were assigned for each group represented. The accumulated points reflected the number of options each food location carried for each specific healthy food group. The points were converted into the percentage of healthy foods found in each of the six locations. The least healthy locations scored 0-30%, meaning they, at most, offered only 30% of the healthy food options listed in the HEI. Locations deemed "healthy" offered more than 60%. We did not compare quantities of

³A whole fruit includes items such as loose bananas, apples and oranges. Examples of total fruit items include a fruit cup, fruit smoothies, and 100% fruit juice.

healthy foods to unhealthy options; the percentages of healthy foods would be far lower than the representation of availability. Unhealthy foods clearly dominated food options in all locations.

A final representation of areas that are lacking in fresh, affordable, and healthy food options on TAMU's campus is the mapping of all three measured parameters using ArcGIS and Map Algebra. A 0.10-mile (the average time one can walk in 2 minutes) buffer was created around each of the 17 food locations. The time-distance limit was based on the length of lines found at most of the food locations and the 20-minute periods between classes. Access-based food purchases are shown to be influenced by convenience and proximity and dictate where people go to purchase their food (Furey *et al.*, 2001; Wrigley *et al.*, 2004). Further, our student-perception survey revealed that convenience of location is a top determinant of the location of dining on campus.

5. Results

5.1 Food security among TAMU undergraduates

According to the short form of the USDA household survey module, respondents are "food-insecure" if they answer affirmatively to at least three of the six questions. Affirmative answers to fewer than three questions indicates the respondent is "food-secure." The outcome of this study are interpreted using these three categories: food-secure, low food-secure, and very low food-secure. The first two classifications should raise concerns about a person's or population's access to healthy, affordable food (Coleman-Jenson, Nord, and Singh, 2013).

Our results reveal that 52% of the surveyed TAMU students are food secure. The remaining 48% are classified as either low food-secure (20%) or very low food-secure (28%) (Table 1). Compared to either the national level of household food insecurity, which is 14% (for low or very low food security), or the Texas rate, 18.4%, TAMU undergraduates are 2.5 to 3 times more food-insecure (Coleman-Jenson, Nord and Singh, 2013).

The results mirror the findings of previous food -security assessments that used the USDA survey module on college campuses. Chapparo and colleagues (2009) found that 20% of students at the University of Hawai'i at Manoa had very low food security and an additional 25% were low food-secure (Chapparo *et al.*, 2009). More recently Patton-Lopez *et al.*, (2014) found

59% of students had low or very low food security on a rural, mid-sized college campus in Oregon.

As our study argues that environmental factors influencing food access on campus as linked to food security, respondents were asked about their meal-plan participation. Meal-plan participation implies that a high percentage of meals are consumed on campus. The results reveal that 42% of meal-plan users have low or very low food-security rates while non-meal-plan users' rates were 50%. Effectively, food security is greater for students who reside on campus. This contradicts the results of previous studies. Chapparo *et al.* (2009)⁴ concluded that the two strongest factors contributing to food insecurity among students were race (Pacific Islanders were more food insecure than other races) and living arrangements (on-campus students had very low food insecurity at 38%, whereas off-campus students reported insecurity rates of less than 20%).

The implications of the level of food security experienced by college students are important. The potential impacts range from long-term health and eating habits to disease susceptibility and effects on social and intellectual development (Deshpande *et al.*, 2009; Patton-Lopez *et al.*, 2014). Most acutely, Patton-Lopez *et al.* (2014) showed that there is a link between food security and academic performance. They found that "students who report experiencing food insecurity are less likely to report a GPA of 3.1 or higher" (Patton-Lopez *et al.*, 2014:210).

While we infer from our results that students who participate in the on-campus meal plan experience greater food security, there is an important caveat: 59% of those who were found to be food secure and also reported accessing campus meal plans indicated that they couldn't afford to eat balanced meals. This suggests that access to balanced meals through on-campus food establishments might be lacking. The final two questions of the survey are focused on the availability of healthy food and its perceived affordability on campus.

5.2 Perceptions of campus food freshness, healthiness and affordability

The second half of the survey was devoted to student perceptions of the on-campus food

⁴Many students who reside off campus in Chapparo *et al.*'s 2009 study live with their families. The authors point out that enrolled students tend to be commuter students, who live at home with parents and drive to campus for class (Chapparo *et al.*, 2009). TAMU is not a commuter campus. Most students living in off campus residences are responsible for cooking their own meals.

Table 1: USDA Household Food Security Module Responses

Question	Response	Meal Plan User %	No Meal Plan %
1. What is the best answer to the following statement? "the food I bought in the last 30 days just did not last and I did not have money to buy more"	Often True	15	13
	Sometimes True	36	39
	Never True	51	43
	Do Not Know	0	7
2. What is the best answer to the following statement? "At any time during the semester as a student at TAMU, I could not afford to eat balanced meals"	Often True	25	23
	Sometimes True	34	36
	Never True	40	41
	Do Not Know	1	1
3. At any time during the semester at TAMU did you cut the size of your meals or skip meals because there was not enough money for food?	Yes	60	58
	No	40	42
	Do Not Know	0	0
4. How often did this happen?	Once a Month	22	19
	Some Months	11	16
	1 or 2 Times in Semester	25	19
	Do Not Know	3	4
	This Did Not Happen	40	42
5. At any time during the semester as a student at TAMU, did you ever eat less than you felt because there wasn't enough money for food?	Yes	33	41
	No	63	55
	Do Not Know	4	4
6. At any time during the semester as a student at TAMU, were you ever hungry but did not eat because there wasn't enough money for food?	Yes	29	37
	No	70	61
	Do Not Know	1	1

environment. Thirty-three percent of respondents eat at least one meal per school day on campus. Another 39% eat 1 to 3 meals per school week on campus. And 28% of respondents do not consume any meals on campus. Their choices of dining on campus were examined relative to their perceptions of freshness, healthiness, and affordability.

Students were asked whether or not the availability of fresh food on-campus affects their dining choices. Seventy-two percent affirmed that it does. Students were also asked to rate the availability of fresh food offered at TAMU on a scale from one (never available) to five (always available). The mean response was 2.9, indicating that students perceive access to fresh food to be slightly above average. Students were also asked about their perceptions of access to healthy food options. The mean response was slightly lower, 2.5.

Students were asked to identify, from a list of both healthy and unhealthy food items, the healthy

foods that they believe are available on campus (Figure 1). About half of the students correctly identified the healthy food options available on campus, except for fruit. The majority, however, correctly identified the available unhealthy food options. Between 93% and 97% of students knew that foods that are high in fat, added sugars, refined grains, and sodium are offered in on-campus food establishments.

Students rated the availability of affordable food on campus on the scale from 1 to 5. The mean response was 2.4, indicating students perceived that affordable foods were not quite as available as healthy (2.5) or fresh (2.9) items. Adding to this, 76% of students believed off-campus food was more affordable than on-campus. These responses were followed up with an objective analysis of the price of 14 items offered at both on-campus establishments and the grocery store nearest TAMU. The items compared included pre-packaged salads, sushi, milk, peanut butter, bread, etc. Our analysis

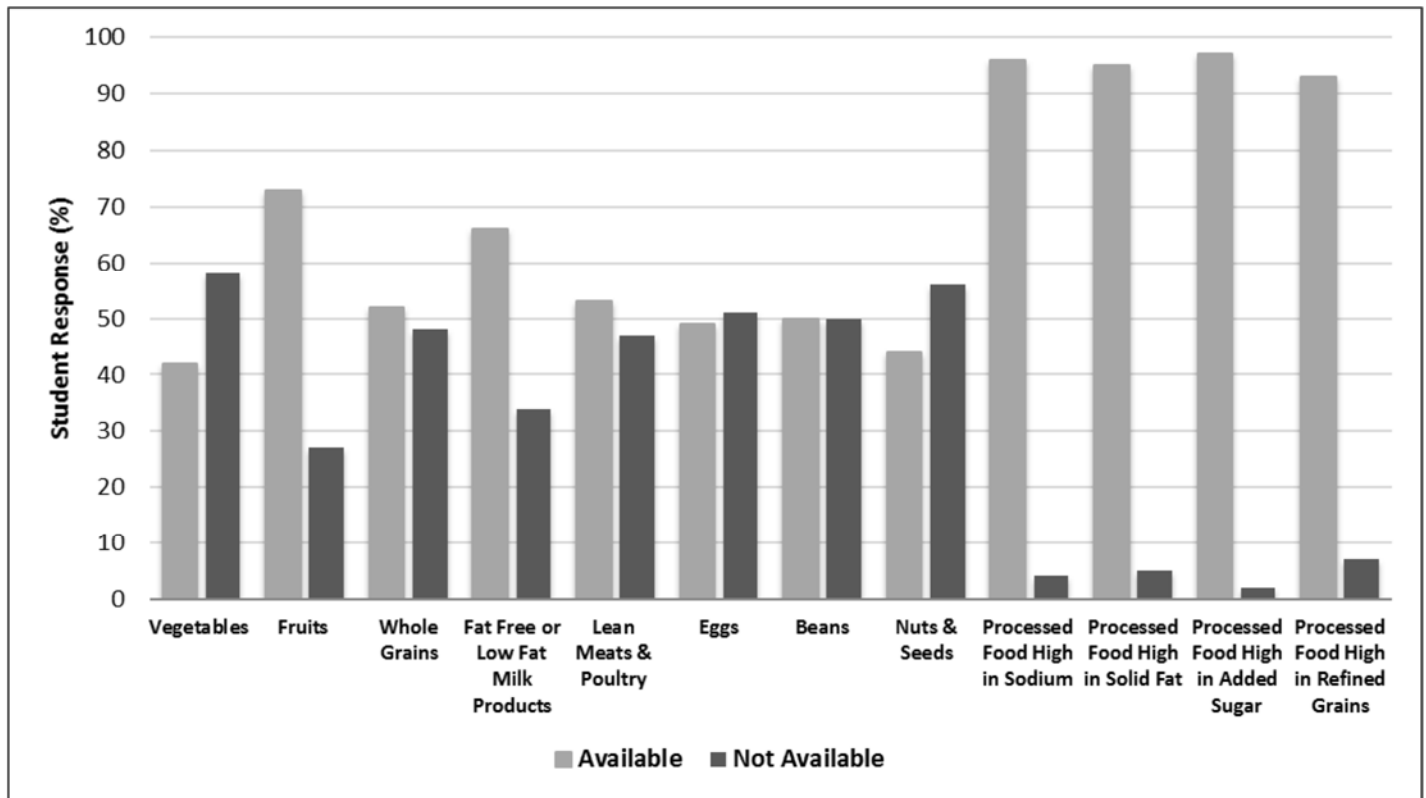


Figure 1: Student Perceptions of Food Option Availability

revealed that, on average, items are 74% more expensive on campus than at the grocery store. The greatest price difference was for pre-made sandwiches which were 140% more expensive on campus.

To understand how students balance their budgets relative to healthy eating, we asked whether they felt they sacrificed health over affordability when making food selections. Half of students indicated that the price of food, not the degree of healthiness, dictated their food choices. Finally, students' responses to possible rationales for their dining decisions considered the menu selections available at an establishment (60%), the price of food (67%), and finally, the convenience of a particular location (76%) to be the most important factors in making their food choices.

On the whole, the assessment of student perceptions of the campus food environment underscores the importance of food affordability. These results clearly demonstrate that overwhelmingly students know that unhealthy food options are available, but they are less sure about the healthy options. And finally, vitally, we find that on a campus where classes are spread across 5,200 acres and students often attend back-to-back class periods with short breaks, location can be a critical element in determining food access.

5.3 Spatial distribution of affordable, fresh, and healthy food on campus

From an affordability standpoint, our fieldwork revealed that convenience stores and small cafes tended to offer the most affordable food on campus (\$1.00 - \$4.99). Mid-priced offerings (\$5.00 - \$9.99) were found in locations that included food courts, fast-food hamburger outlets, and Starbucks Cafes. High-priced meals (\$10.00 and up) were available in all-you-can-eat buffets, which have a base price of \$12.95. The distribution of low-priced food items is uneven compared to higher priced meals. The northern portion of campus has a greater availability of low-priced options compared to the southern part campus (Figure 2). To contextualize this distribution, many dormitories are located in the southern part of the campus, whereas classrooms and libraries make up much of central, eastern, and northern sections campus. West campus is dominated by the business school. This area was excluded from the study due to its geographic distance from main campus and the separation created by an intervening north-south railway line. The all-you-can-eat buffets, fast-food hamburger restaurants, and food courts tended to meet the standards to qualify as offering fresh food and they had the most fresh food available. By comparison, convenience stores on campus were had the fewest fresh

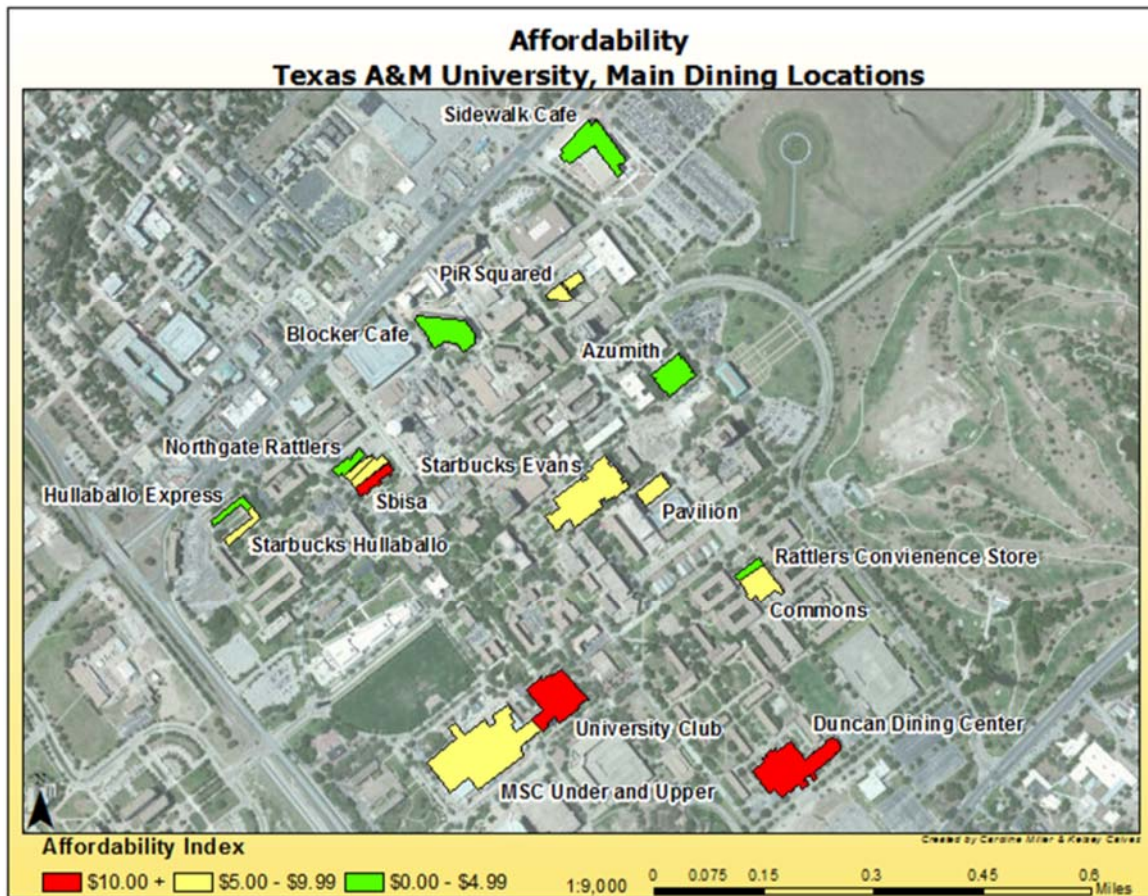


Figure 2: Distribution of Affordability on TAMU Main Campus

options, particularly due to the number of packaged processed snack foods they carried (Figure 3). The least fresh locations on campus are situated next to food outlets that are either high or medium on the freshness scale. This distribution complements our qualitative evidence that students believed that fresh-food options were important and that fresh-food access on campus is above average.

For healthiness (Figure 4), more than half of the dining locations ranked below the 60% healthiness level. This indicates that most of the options available to students at dining locations do not promote a well-balanced, healthy meal. Surprisingly, the convenience stores on campus offered the most healthy options due to the variety of options available. Hamburger establishments tended to be the least healthy locations, with high percentages of protein, but lacking fruits, vegetables, and other HEI items. Our qualitative results also complement these conclusions. Students rated the access to healthy food as average. Further, 59% of students indicated that either “often” or “sometimes” they could not afford to eat balanced meals.

To complete the spatial analysis, all three layers were combined to identify the places on campus that lack access to affordable, fresh, and healthy food (Figure

5). A 0.1-mile buffer was created around each of the 17 food outlets within the map to determine the landscape of food security across campus. The food-security of every building within the buffer was determined based upon its distance to the food establishments.

The results reveal that the northwestern portion of campus is the most food secure, as the most affordable, fresh, and healthy foods are easily accessible in this area. Campus administrators suggest that because this part of campus is the most recently constructed it was designed to house more and more diverse food establishments. As previously noted, affordable food is available in this part of campus. Food options in the northern portion of campus are moderately fresh and moderately healthy. The southernmost part of campus, on the other hand, has the lowest food security.⁵ This area rates low on the affordability and healthy indices, but is high on the freshness index. This area has a

⁵At the time of writing, the south campus food environment had changed. Four food trucks have been permitted to locate in south campus and sell food to students. Future studies should include food trucks as part of the foodscape. The food truck location coincides with an area where major renovations are occurring to a significant food retail zone. Consequently, that zone is closed, further tightening food access in south campus.

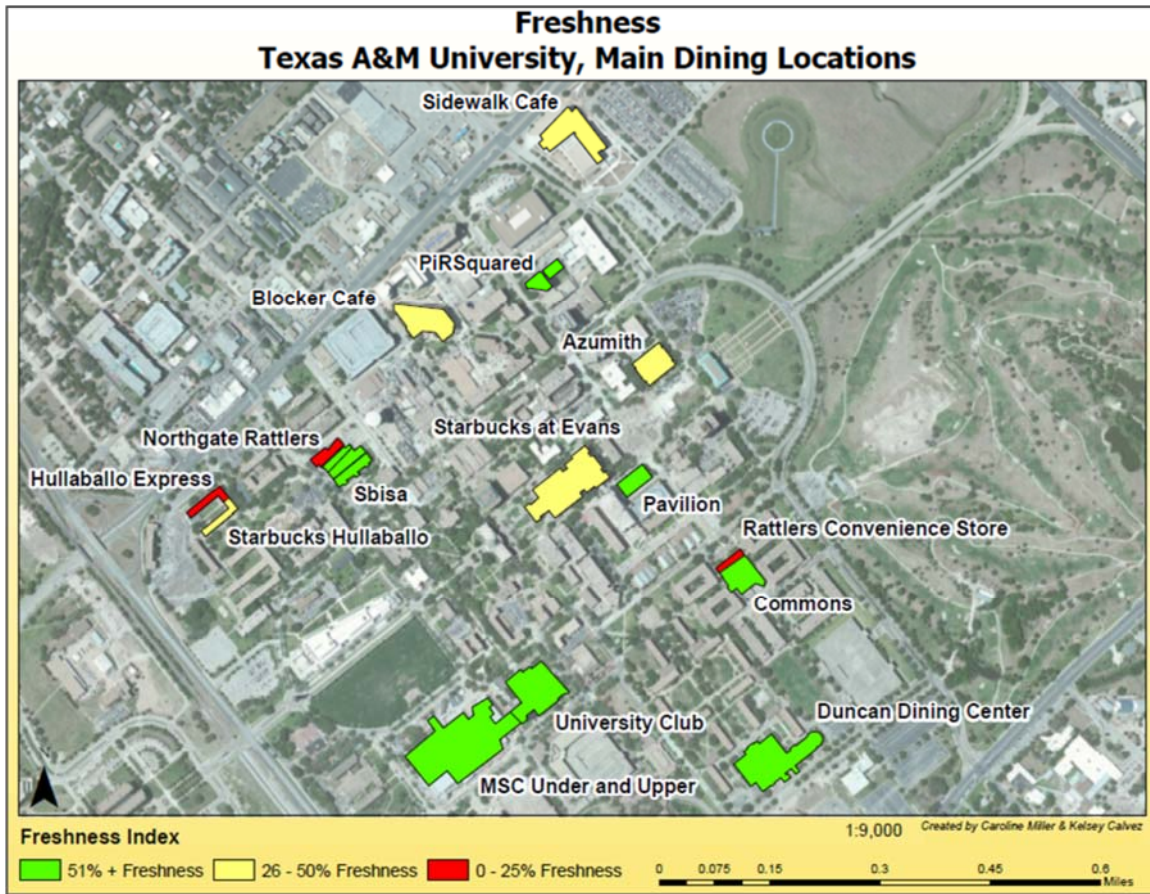


Figure 3: Distribution of Freshness on TAMU Main Campus

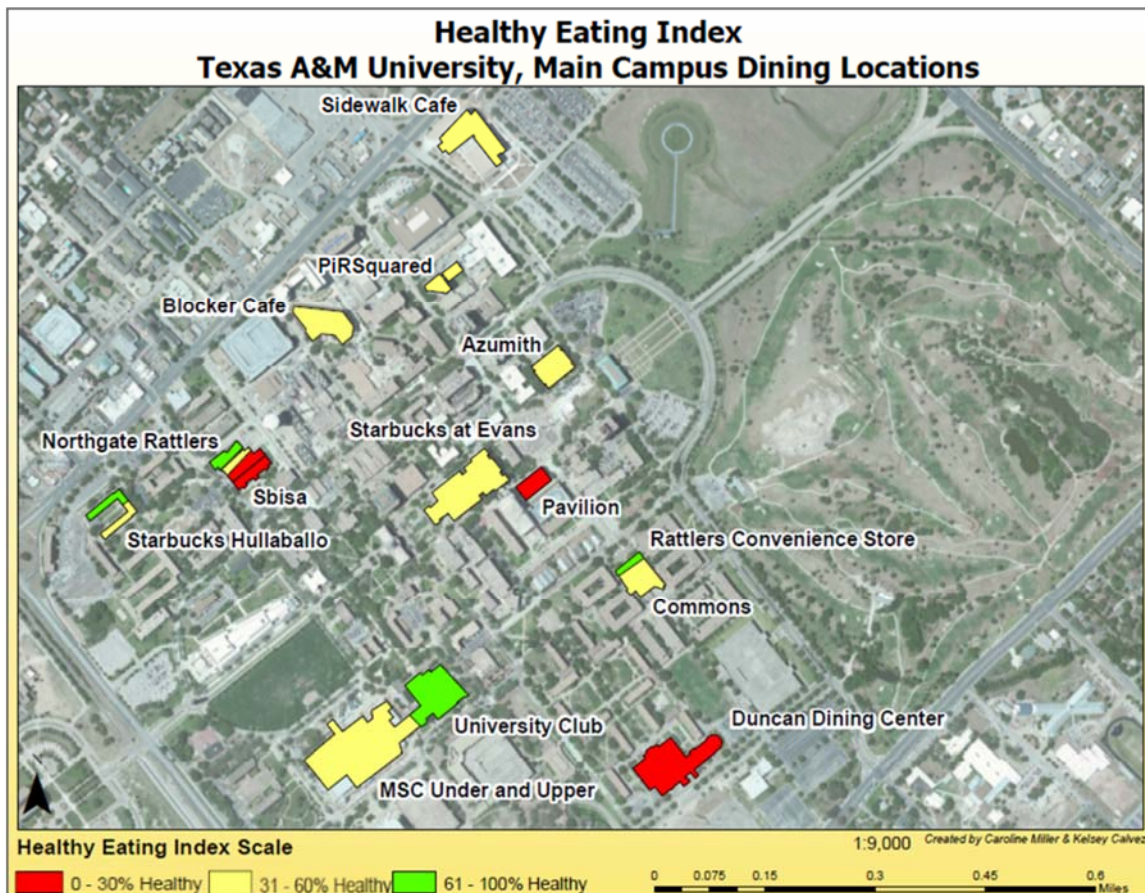


Figure 4: Distribution of Healthy Food on TAMU Campus

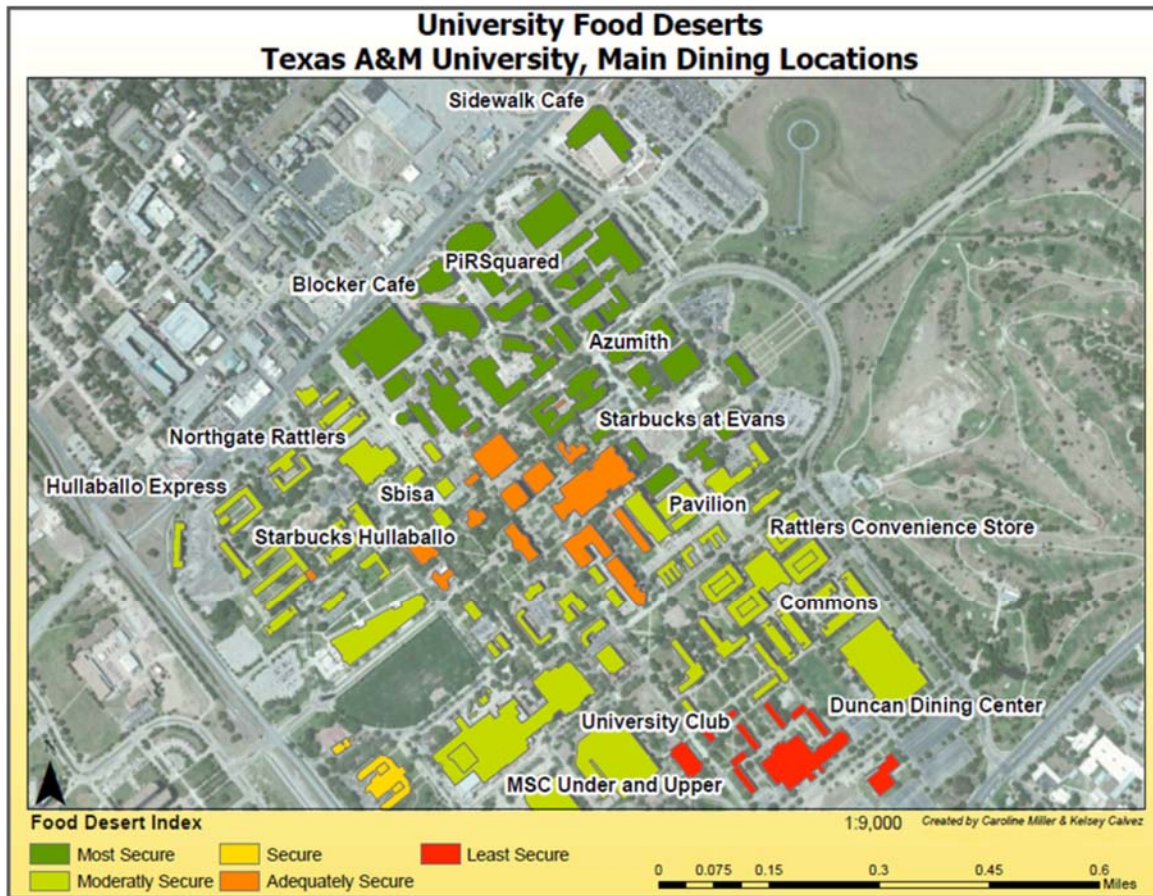


Figure 5: Spatial Distribution of Healthy, Fresh and Affordable Food

sizable portion of TAMU's on-campus student residential housing. Finally, the middle sections of campus, the location of the largest classrooms and location of the main library, was determined to be adequately secure as average amounts of affordable, fresh, and healthy food options are available to students.

Access to a balance of affordable, fresh, and healthy food options on campus depends on students' specific location. Students spending most of their time on the south side are more likely to experience food insecurity. Food will be less affordable there compared to the offerings on the north side of campus. Further research is needed to determine whether there is a link between the spatial mix of the meals consumed on campus and food insecurity rates.

6. Discussion & Conclusions

This paper has argued that to understand the rise in food insecurity rates among university students in the U.S., the built environment of the foodscape must be considered alongside the foodscape's socio-cultural political-economic attributes. The results of this research demonstrate this by linking high food-insecurity rates among TAMU undergraduates to the food environment

on the main campus, and identifies the parts of campus that lack access to fresh, affordable, and/or healthy food options. Investigation of undergraduate access to nutritional, affordable food is a critical topic as studies have shown that food insecurity rates among college students are more than double the national average (Chapparo *et al.*, 2009; Freudenberg *et al.*, 2011; Patton-Lopez *et al.*, 2014). Further, research has linked food insecurity among undergraduates to lower academic performance (Patton-Lopez, *et al.*, 2014) and poorer psychological development (Alaimo *et al.*, 2001; Deshpande *et al.*, 2009).

While our study has limitations, namely that the number of students surveyed relative to the total population of TAMU undergraduates is modest, its strength lies in the mixed-methods approach that we have used to investigate campus foodscapes (advocated by Caspi *et al.*, 2012a and Walker *et al.*, 2010). This approach enables an understanding of the food-security effects of living in particular food environments. More intensive research could examine food security rates at other campuses and might draw correlations between perceptions of the food environment and food consumption habits, health outcomes, or rates of food security (see Caspi *et al.*, 2012a for a comprehensive

review of research linking food environment and dietary outcomes). Additionally, it would be worthwhile to examine the link between the time spent in certain less food-accessible parts of campus and food-security rates. This is particularly important for students at universities that occupy large acreages and are more isolated from metropolitan areas. Identifying these relationships could lead to specific policy recommendations to improve students' food environments.

Finally, we contend that conceptual consideration of the space of the university is a distinct, useful addition to the food security and foodscape literatures because construction of the food landscape is broad and deeper than we currently conceive.

A final note: In the case of TAMU, the food environment is largely shaped by a privatized dining service operated by Chartwells. So, therefore, understanding the impact of privatization on the food environment is an important endeavor. To better understand the role that dining services play in constructing campus food environments, our original project design included interviews with Chartwells staff. In early attempts at engagement of the staff in interviews, we were told that Chartwells employees do not participate in interviews that are reproduced in published research. So that aspect of this research was disabled. But privatization is certainly not isolated to TAMU, but affects many major universities where food sourcing, preparation, delivery, and pricing are increasingly handed over to outside firms (Komisar, 2011). Given the important role afforded to companies like Chartwells in shaping campus foodscapes, we see the investigation of dining services, particularly those which have been privatized, as a critical area in need of future research. In this case, privatized dining service companies should be pressed to contribute to food environment research, particularly because food security rates among undergraduates have been shown to be significantly higher than average national rates.

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