

## Research Article

# Food Sustainability Knowledge and Its Relationship with Dietary Habits of College Students

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Consumers have power to support food sustainability through dietary choices, but research on how knowledge affects behavior is limited. College students are a significant segment of consumers. Self-report data were collected from a convenience sample of 230 undergraduate students in California. Sustainability knowledge was low. Nutrition and health students had significantly more knowledge than other majors. A significant positive correlation was found between sustainability knowledge and attitudes with probability of supporting a diet that reduces meat/dairy, preference for organic foods, and willingness to pay more for sustainable foods. Thus, knowledge may influence attitudes and dietary behavior of college students.

**Keywords:** Food; Sustainability; Nutrition; Family and consumer science education

**Introduction**

In the setting of population growth, rising obesity levels, climate change, and food system related environmental degradation, 'food sustainability' has become a critical issue impacting agricultural, environmental, and social sciences as well as public health nutrition [1]. The current food industry relies heavily on fossil fuels, depletes non-renewable natural resources (e.g., water), and generates green house gases that contribute to global warming [2,3]. Sustainability of the food system is further threatened by general overconsumption and excessive intake of meat and dairy products, two dietary habits that are associated with negative health consequences as well [4,5].

This certainly makes sustainability of increasing relevance to the consumer. Consumer dietary practices and purchasing behaviors indirectly support farming methods, nutritional standards, and environmental practices [6], and as such, food choice can have a major impact on food production [7,8].

College students represent a generation with increasing awareness of sustainability who will act as future leaders, decision-makers, and influencers [9]. As consumers, they are forming their personal identities, beliefs, and values that will carry them into adulthood [10]. Universities play a pivotal role in developing potential social competencies, communications skills, and community relations, thus sustainability should be included throughout college coursework in order to initiate knowledge, transform behaviors, and motivate lifelong habits.

Several studies have looked at the relationship between consumer behaviors and attitudes towards sustainable products, but the research on how these relate to knowledge is limited. Research has shown that education facilitates a higher degree of understanding of the concept of sustainability, which in turn makes it easier for consumers to convert motivation into actual behavior [11]. Because sustainability is an abstract concept, it is likely to represent several different meanings, and therefore attitudes towards sustainable

practices may vary greatly based on one's own interpretation [12]. These distinctions make knowledge key when designing messages to communicate sustainability.

**Review of literature**

Food sustainability integrates economic, social, and environmental concerns, and throughout the literature, several authors agree that (1) a shift in dietary habits is required and (2) better dietary health and better environmental quality generally go hand-in-hand [5,13,14]. Sustainable food consumption covers a wide variety of topics, including the environment, animal welfare, and fair trade [12]. It applies to awareness about local, seasonal, and organic foods [15], and may also take into consideration 'food-miles,' how far food travels between its production and the final consumer [3], or a preference towards 'eco-labels,' voluntary identifiers that represent ecological or ethical criteria [16]. These issues have all been examined, and are generally favored for making efficient use of natural resources and for being less degrading to the environment [17].

Dietary shifts towards local produce as well as the decrease of meat and dairy are examples of well-researched sustainable diets that have a lower environmental impact and promote health [3,18]. Modern diets, characterized by over consumption, or excessive intake of meat and dairy, and are estimated to have five times the environmental impact compared to a dietary pattern of organically-produced foods or a plant-based diet [19]. This is due to meat and dairy production systems that are both resource-intensive, using large amounts of land, water, and energy, and plant-based diets by comparison, are found to be less taxing on the environment [2,7,20]. As a result, researchers recommend that total dietary elimination or even reduction of meat and dairy foods would have the greatest impact on reducing the environmental impact of the food system, however this dietary shift has nutritional, cultural, and economic implications and will require social acceptance as a dietary norm [5,21].

Attitudes towards sustainable practices as predictors of behavior have been studied, and it has been observed that a positive attitude

**Table 1:** Food sustainability knowledge.

Food Knowledge	Correct Answer	% Correct
When you think about food sustainability, which do you consider most?	Was the food grown without adverse effects on the environment	21%
According to your best estimate, which do you think is the most sustainable practice?	Locally producing organic meat	46%
How much fossil fuel do you think is used by the food industry?	As much as automobiles	14%
Compared to the global average, how much meat do Americans consume?	Twice	25%
Approximately how many calories of fossil fuel does it take to provide one calorie of food energy to an American plate?	7-10 calories	5%
How many kilograms (kg) of plant protein do you think are required to produce 1 kilogram of meat?	About 6 kg	6%
The ingredients for regular American strawberry yogurt (milk, sugar, strawberry) collectively travelled... miles on average.	About 2,200 miles	12%
The production of which of these foods causes the highest level of carbon dioxide (CO <sub>2</sub> ) emissions?	Beef	40%
Recent research suggests that vegetarian diets are more sustainable for the environment. To increase the benefits of a vegetarian diet, food should be...	Produced regionally, consumed seasonally, grown organically	45%
Which of the following diets do you believe is most sustainable?	Lacto-ovo-vegetarian with a small amount of animal protein in the form of fish and/or chicken	38%
Where the most fuel is used in US food production?	Processing	15%
The use of pesticides in American agriculture can cause...?	Cancer, neurological damage, birth defects, decreased fertility	68%

does not always result in the desired behavioral intention. According to Vermeir and Verbeke [10,22], the attitude/behavior gap exists due to factors that interfere with the decision making process such as social influences and perceived effectiveness of the behavior. In addition, conversion of motivation to food choice and consumption is not exact because product features such as price, brand, quantity, and use-by-date and nutrition information compete to influence behavior [11].

In an effort to promote sustainable consumption, retailers and marketers have increased food supply transparency, availability of organic products, or use of eco-labels, however, research indicates that the information provided remains inadequate [23]. Grunert [8] explains, even if consumers are motivated to support sustainability, potential communication barriers may prevent them from using the information to make sustainable choices. This might be due to inadequate background information, and thus educating consumers on benefits of sustainable practices as well as the environmental affect of food choice have been considered paramount to influence behavior and purchasing decisions [22].

Food sustainability is complex and multi-faceted, encompassing nutrition, environmental impacts, cultural preferences, safety, and access; and while consumers appear motivated to make positive choices, their understanding is lacking. In order to expand our knowledge on the topic, research is required to fill in the gap between knowledge, attitudes, and behavior. This cross-sectional study aims to do so by analyzing (1) what is the existing food sustainability knowledge level amongst college students attending a comprehensive university in Southern California; (2) how is food sustainability knowledge related to socio-demographic variables (i.e., age, gender, marital status, and field of study); (3) how is food sustainability knowledge related to students' attitudes towards sustainable practices; (4) does food sustainability knowledge affect usual dietary practices; (5) does food sustainability knowledge affect usual shopping preferences; and (6) do diet-related health concerns affect knowledge.

## Methodology

### Procedures

After receiving approval from the university institutional review board, subjects were recruited from four upper-division classes during a 2009 regular semester schedule. The courses included (1) a business course required of all business, information systems, and accounting majors, (2) a freshmen level kinesiology course, (3) and two sections of an upper-division, general education, Family and Consumer Science course. All participants were informed of the purpose of the research, and participated through voluntary recruitment. The survey was distributed to subjects at the beginning of their normal class time, and they were allowed to complete it without time constraints. The usual survey time lasted approximately 15 minutes. All surveys were anonymous.

### Sample characteristics

Data were collected from 230 participants (18-52 years old,  $M = 23.3$ ,  $SD = 5.0$ ). Most participants (i.e., 63.9%) were women with 36.1% men. The participants' ethnic background follows: 32.6% Latino, 28.7% White, 11.7% Asian, 7.4% African American, and 19.1% mixed or other. The marital status follows: 62.6% single, 3.0% divorced, 6.1% married, 27.0% in a committed relationship, and 1.3% other. Participants reported college majors as follows: 23.0% business, 32.2% kinesiology, 31.7% social sciences, and 13.1% nutrition or health related majors. Also, 3.9% reported they adhere to a vegetarian diet, and 11% reported they grow their own produce.

### Measures

The survey was developed by the researchers and piloted in a diverse population ( $n = 7$ ). After the pilot, the survey was revised to eliminate any questions deemed too complicated. The final survey consisted of 76 items.

Twelve multiple-choice questions assessed food sustainability knowledge. Students were asked to describe food sustainability, identify the most sustainable food practices, evaluate use of fossil fuels in the food industry, compare plant and animal protein production,

**Table 2:** Percentage of students who correctly answered food sustainability knowledge questions.

# Correct	% Correct
0	9.6%
1	10.0%
2	17.0%
3	15.2%
4	17.4%
5	17.8%
6	7.8%
7	2.6%
8	2.2%
9	0.4%

identify benefits of a plant based diet, recognize elements of a sustainable diet, and show awareness of food miles, carbon dioxide emissions, pesticide use and fuel consumption. Responses were coded as follows: 1 = correct, 0 = incorrect or “do not know.”

Dietary preference towards sustainable foods and usual eating habits were assessed with 12 questions. Participants were provided with a “What is a Serving?” handout to support accurate estimates of usual intake. A single item assessed the practice of substituting meat with vegetarian products. Responses were coded as follows: 0 = never, 1 = sometimes, 2 = frequently, and 3 = very frequently. Food frequency questions were used to assess sustainability of usual intake (i.e., less red meat and more fresh fruits and vegetables). Responses were coded as follows: 1 = I do not eat this food, 2 = 1-3 servings per week, 3 = 4-7 servings per week, 4 = 8-11 servings per week and 5 = more than 12 servings per week.

Participants’ attitudes towards sustainable food practices was assessed as the average response to 7 questions in which students were asked how much they agree with the following statements: Sustainability is the major factor in your food choices; Most of the negative dietary impact on the environment from the average person in the US comes from high meat consumption; US commercial livestock production results in increased greenhouse gas emissions that contribute to global warming; Beef production requires the most amount of land and water; A vegetarian diet is more ecologically sustainable to produce than a meat based diet; The use of pesticides in modern agriculture can contaminate water and air; and Supplementing a vegetarian diet with a small amount of poultry and

fish is a sustainable dietary practice. The results were coded as follows: 0 = never, 1 = sometimes, 2 = frequently, and 3 = very frequently.

Diet related health concerns were addressed in three questions that asked how often students check nutritional information when making purchases, and how often they avoid purchasing products that contain high-fructose corn syrup or trans fats.

Additional lifestyle factors were assessed in five questions to evaluate willingness to pay additional costs for sustainable foods as well as other purchasing habits and consumption behaviors. Lastly, the survey assessed demographic variables (e.g., gender, age, health status, ethnicity, marital status, accommodations, and college major).

### Statistical analyses

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS), version 16.0 for Macintosh. Significance was determined at  $p < .05$ . Bivariate correlations were conducted to determine the strength and direction of the relationship between variables. T-tests and one-way ANOVA tests (with Turkey HSD post hoc tests) were performed to calculate any significant difference between groups. Descriptive statistics were used to evaluate students’ knowledge about food sustainability.

## Results

### Knowledge of food sustainability

Descriptive statistics were used to analyze a series of 12 questions that determined students’ food sustainability knowledge (Table 1). Results demonstrated that students possessed some information on the topic, but overall knowledge was low as indicated by the percent of correct responses (Table 2).

Bivariate correlations were used to assess the correlation between age and food sustainability knowledge. Results indicate that age was not significantly associated to the students’ food sustainability knowledge ( $r = .03, p = .31$ ).

Independent t-tests and one-way ANOVAs were used to evaluate the difference in food sustainability knowledge based on students’ demographic characteristics: gender, marital status (i.e., single vs. committed or married), and field of study. Independent samples t-tests indicated no significant difference between men ( $M = 0.31, SD = 0.19$ ), and woman ( $M = 0.26, SD = 0.15$ ) in food sustainability knowledge ( $t = 1.91, p = .06$ ). Nor was there a difference between single students ( $M = 0.28, SD = 0.17$ ), and students who were either committed or married ( $M = 0.28, SD = 0.16$ ) in food sustainability

**Table 3:** Sustainable food shopping behavior.

When shopping for food, how frequently do you do:	Never	Sometimes	Frequently	Very Frequently
Purchase organic produce	22.2%	55.2%	17.0%	5.7%
Purchase organic meat	49.6%	36.5%	9.6%	3.9%
Purchase organic dairy products	33.9%	43.0%	15.2%	7.4%
Purchase sustainable products	19.1%	53.9%	23.0%	3.9%
Purchase locally grown fruits and vegetables	10.4%	50.4%	31.7%	7.0%
Purchase fruits and vegetables that are in season	7.8%	34.8%	42.6%	14.8%
Shop at a local farmers market	28.8%	43.9%	15.2%	10.0%
Substitute meat with more sustainable vegetarian products	43.0%	37.0%	12.6%	6.5%

knowledge ( $t = -0.02, p = .98$ ). A one-way ANOVA did however demonstrate a significant difference between business majors ( $M = 0.31, SD = 0.19$ ), kinesiology majors ( $M = 0.27, SD = 0.16$ ), social science majors ( $M = 0.24, SD = 0.16$ ), or nutrition and health majors ( $M = 0.34, SD = 0.13$ ), and their respective food sustainability knowledge ( $F = 3.05, p = .03$ ). A Turkey HSD post hoc analysis was performed, and indicated that nutrition and health majors had a significantly higher level of food sustainability knowledge than social science majors ( $F = 3.05, p = .03$ ). No other significant differences were found between groups (Table 3).

### Attitude towards sustainable practices

A bivariate correlation indicated that food sustainability knowledge was positively and significantly correlated with attitudes towards sustainable food practices ( $r = .21, p = .001$ ). These findings suggest that students with greater food sustainability knowledge are more likely to possess favorable attitudes towards sustainable food practices.

### Preference for sustainable shopping

A bivariate correlation indicated that food sustainability knowledge was positively and significantly correlated with purchase of both organic foods and locally grown foods ( $r = .23, p < .001$ ). Participants were asked about their willingness to pay higher costs for sustainable food. One third (i.e., 33%) responded they would not pay more for sustainable foods, while 48% responded they would pay up to ten percent more, 13% said they would pay up to twenty percent more, 2% would pay up to thirty percent more, and 4% marked "other". A bivariate correlation found food sustainability knowledge was positively and significantly associated with the reported amount that the students were willing to pay for sustainable foods ( $r = .20, p < .002$ ), which indicates that students with greater food sustainability knowledge are more likely to pay higher prices for purchases perceived as sustainable.

### Usual dietary habits

A bivariate correlation indicated a positive and significant association between food sustainability knowledge and likeliness towards substituting dietary meat with vegetarian products ( $r = .15, p = 0.1$ ). Our findings did not suggest a significant relationship with any other sustainable dietary habits measured ( $r = .09, p = 0.8$ ).

## Discussion

This study was designed to provide insight into students' food sustainability knowledge as it relates to socio-demographic factors (i.e., age, gender, marital status, and field of study), attitudes towards sustainable practices, (i.e., purchasing organic or locally grown foods and willingness to pay higher prices/amount willing to pay), purchasing preferences, and sustainability of current dietary habits.

Results indicate that the majority of students surveyed had some (50.43%) to no (36.52%) knowledge, which suggests low overall knowledge on the topic of food sustainability. The design of this study considered similar work by Koutoubi et al. [24], which covered a smaller population ( $n = 72$ ), but included a pre- and post-test design to examine college nutrition students' knowledge of global warming, genetically modified organisms, sustainable food systems, and organic standards in the United States. In accordance with our findings, low

overall knowledge was initially reported, but the researchers observed a significant increase by the end of year leading them to conclude that a greater emphasis should be placed on promoting environmental knowledge in college curriculums. Further demonstrating the need to integrate food sustainability into curriculums, our study revealed that 69% of respondents reportedly want to learn more, and that 67% currently rely on the media as their best source of information on the topic.

These results are particularly relevant to Family and Consumer Sciences (FCS) because sustainability is a critical element of knowledge that all FCS students are expected to learn, and a large comprehensive FCS unit has previously demonstrated how sustainability can be successfully incorporated into its curriculum and research agenda [25]. Nutrition and health majors demonstrated significantly higher food sustainability knowledge as compared to social sciences, which is imperative, as they play a major role in public health though their influence on food choice and as advocates for change in the food system.

Our findings support the recommendations of previous researchers, that college curriculum should incorporate greater attention to sustainability, especially in practices that apply different forms of knowledge across multidisciplinary fields [26]. Universities have the funding and resources available to lead sustainability research and education, and both interdisciplinary and hands-on sustainability education should be a primary goal of universities [27].

The assessment of attitudes toward sustainability revealed that nearly half of the respondents identified with sustainable statements. We found that 46% of subjects responded correctly that locally produced organic meat is the most sustainable practice; 40% answered that beef production causes the highest CO<sub>2</sub> emissions; and 45% agreed that food should be produced regionally, consumed seasonally, and grown organically. This data indicates that students have positive attitudes towards sustainable dietary practices and supports data elsewhere that have shown increasing interest in alternatives to the conventional food system [16].

With the exception of likeliness of substituting meat and dairy with more plant-based foods, our data did not reveal a significant relationship between dietary habits and knowledge of sustainability, which suggests that attitude and knowledge are independent of consumption and purchasing behaviors. It is generally recognized that health, quality, price and convenience dominate food buyer's decision making [28]. Robinson and Smith [29] also noted that beliefs, attitudes, and confidence level influence intention to purchase sustainably produced foods. These findings indicate that efforts to increase knowledge of sustainable foods should focus on the nutrition, environmental, and economic concerns together in order to instill the confidence and understanding necessary to promote adoption of sustainable dietary habits.

Results showed that most students are willing to pay up to an additional 10% for sustainable foods. The inflated cost of sustainable products is possibly one of the greatest purchasing barriers, and highlights the need to educate consumers about environmental impacts of their purchases in order to increase the perceived value of sustainable products. In agreement, Meise et al. [23] found



that consumers experienced less price aversion when the value of sustainable attributes were clearly understood and differentiated.

Study limitations include that all participants were enrolled in a Southern California university, and unique features of this college may not be applicable in other settings. Furthermore, this study included a relatively low sample percentage of the target population and a disproportionate number of females, which may have influenced the statistical significance of our results. Previous research has demonstrated that women reportedly use sustainability information more than men when shopping, though this may also reflect that women are more likely to be the primary household shoppers [11]; and that men are less willing to reduce meat consumption [18]. One possible explanation for a larger number of female students in our sample is because the classes surveyed were in primarily female dominant fields, especially FCS courses. The inability to randomly select students from a broader range of majors makes it difficult to conclude that the findings are applicable across all fields. Future studies should include a larger percentage of students from an increased variety of majors, and the inclusion of universities from different geographic regions as well.

The self-administered survey also presents a final limitation because it did not account for answering bias, inaccurate intake estimates, or the potential for the participants to be influenced by the questionnaire itself. These factors may have had a potential impact on the results.

## Conclusion

The results of this study have important implications for family and consumer scientists. Despite the positive link established between food sustainability knowledge and attitudes towards sustainable practices, willingness to pay more for sustainable foods, preference for organic and locally grown foods, and likeliness to decrease meat intake, the findings suggest low overall college student food sustainability knowledge, an observation in agreement with previous research on the topic. The research also revealed that nutrition and health majors have greater knowledge when compared to social science majors, which suggests that knowledge of food sustainability increases with application through formal education. Students indicated they were willing to learn how their dietary habits affect the environment, thus further research that pinpoints knowledge needs is warranted to develop targeted programs. Knowledge is a vital link between positive attitudes and behaviors, thus providing the necessary education are of urgent importance. Students are active consumers, and their purchase decisions have the power to improve our food system. Furthermore, education will allow students to integrate sustainability into their understanding of social norms, food security, nutrition, global economics, and public policy. Including a comprehensive emphasis on sustainability in future curriculum is recommended to ensure students are well-educated and prepared to support sustainable practices in the future.

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