Do Dalhousie Students *Carrot All*?
A Comparative Study of Food Waste Patterns

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ABSTRACT

Food waste poses a major global challenge in terms of environmental and economic impacts. Within this context, higher education institutions play a pivotal role in fostering sustainability awareness and cultivating lifelong habits. This prompts an inquiry into the behaviours surrounding students' adherence to preventative food waste measures. This comparative study aimed to explore the food waste behaviours among undergraduate students studying Environmental Science or Sustainability (ENVS/SUST) and those studying other programs at Dalhousie University. The goal is a greater understanding of potential contributors to food waste quantities generated and to pinpoint any gaps in the environmental education of Dalhousie students regarding this topic. This study utilized a survey to collect quantitative data on students' habits, perceptions, and intentions regarding food waste. After the ten days of data collection, there were 138 respondents, excluding 5 non-target respondents. No significant difference in food waste habits was found between ENVS/SUST and other majors, however they both showed moderate adherence to waste reduction practices. Perceptions of food waste were very good across both majors, with no significant difference. There was a weak positive correlation between food waste habits and perceptions. Saving money and environmental concern were the most important factors driving food waste reduction for both groups. Course content significantly influenced ENVS/SUST majors in awareness of the concerns of food waste. The main barriers to waste reduction were found to be time and economic constraints. In light of these findings, this study recommends that higher education institutions emphasise strategies to translate this awareness into actual action when raising students' understanding of the food waste problem. To this end, it is recommended that more targeted intervention strategies and educational programs be developed to promote students' adoption of sustainable food consumption and food waste reduction behaviours in their daily lives.

KEYWORDS

Food waste, undergraduate students, environmental science, sustainability, educational influence.

INTRODUCTION

Food waste is a growing concern. The definition of food waste used in this report is as follows: edible food that is available for human consumption but is not consumed for any reason; it includes plate waste at the end of meals and food discarded due to missed expiration dates. This study is only concerned with personal food waste, not overall household waste.

Background & Rationale

Globally, it is estimated that one-third of all food produced, equating to approximately 1.3 billion tonnes is wasted (Morone, 2019). Food waste is a persistent issue, giving rise to global environmental concerns and contributing to resource scarcity, unnecessary waste production, and food shortages (Morone, 2019). Furthermore, the US Environmental Protection Agency (EPA) has stated that food waste is the most significant waste, by mass, entering landfills (Morone, 2019). It is estimated that 97% of all food waste ends up in landfills while a mere 3% is recovered and composted (Ziolkowska, 2017). This is problematic as decomposing food waste within landfills emits methane and carbon dioxide, further contributing to climate change (Morone, 2019). Organic waste within landfills is the largest source of methane emissions, generating roughly 18% of all total methane emissions in the US between 1990-2013 (Ziolkowska, 2017). While external factors throughout the food production cycle contribute to the overall impact of food waste, approximately 60% of all environmental effects are directly associated with consumers (Alattar, 2020). The production of food is resource-intensive and is directly associated with global environmental issues such as soil erosion, deforestation, water and air pollution, and greenhouse gas emissions (Schanes, 2018). While some of these environmental issues are influenced more by the food production cycle, since the product is being wasted, these problems are being caused for no apparent reason.

When taking into account the global goals for food accessibility and daily recommended nutritional intake, food waste also has significant consequences. Due to consumer and retail losses, approximately 31% of available food remains uneaten in the US (Chen, 2020). This equates to approximately 1249 calories per capita per day of losses (Chen, 2020). Furthermore, it is estimated that 40 million tonnes of food is wasted by US households, retailers, and food

services each year (Chen, 2020). This quantity of food waste alone would be sufficient to feed the 815 million hungry people, who are considered malnourished and lacking essential macronutrients and micronutrients (Blas, 2018) (Chen, 2020). Moreover, it has been shown that fruits and vegetables are among the most commonly wasted food items due to their natural perishability (Chen, 2020). It is interesting to note that in America approximately 80% of children, 80% of adolescents, and 68% of adults do not meet their required fruit/vegetable intake recommendations (Ames, 2006). A study performed in 2019 analysing determinants of household food waste and its associated caloric and nutrient losses concluded that nutrient-dense foods such as fruits and vegetables were wasted at disproportionately higher rates and may have a significant impact on essential nutrient supply (Chalak, 2019). Although more research is needed to understand the relationship between nutrient deficiencies and food waste, uncovering more on this topic may reveal implications regarding food waste management and nutrient-related illnesses.

While food waste clearly has been shown to have negative impacts on both the environment and human health, we must also consider the associated economic losses. The economic burden concerning wasted food equates to approximately $990 billion with industrialised countries being responsible for $680 billion and $310 billion from developing countries (FAO, 2019). Moreover, the value of a four-person household's average annual food waste in the US ranges from $589 to $1,600 (Ziolkowska, 2017). While quantifying food waste on an international or global scale is rather difficult, prior research suggests that in economically prosperous countries, food demand, consumption, and waste have increased, while showing a positive correlation with population size (Hall, 2009). Yet with current trajectories and statistical population projections, there will be an increased demand for food supply within the next three decades as we're on track to reach a global population of 9.6 billion by 2050 (Morone, 2019). This will only add more stress and pressure onto agricultural grounds while simultaneously causing prices to rise thereby reducing the financial accessibility to food for the public.

Psychological Drivers

There is a vast range of factors related to habits that contribute to consumer food waste, many of which have been previously researched and documented. Previous research suggests that cost and convenience significantly influence habitual decisions concerning food waste generation (Alattar, 2020). Other studies have noted that socio-demographic factors such as

family size, level of education, type of employment, age, and race also influence the amount of food waste produced by a household (Jeswani, 2021). For example, it has been shown that in the US Hispanic households generate on average 25% less food waste (Jeswani, 2021). Furthermore, in the UK adults over the age of 65 produce less waste compared to the remaining population (Jeswani, 2021). Household food waste can also be attributed to poor at-home decision-making. One study analysing the main causes of food waste determined that approximately 8% of avoidable food waste is disposed of due to not being used in time, 31% is thrown away because of large servings/leftovers, 14% due to personal dislikes for certain foods and 4% due to accidents, such as freezer failure (WRAP, 2013).

On the other hand, it is shown that psychology and consumer behaviour play a detrimental role in food waste-based decision-making (Alattar, 2020). It has been shown that a variety of behaviours such as consumer perceptions, influences, and intentions affect how much food waste is produced on an individual scale (Alattar, 2020). Intention to not waste food or having consumers become aware on a psychological level regarding their food selection habits has been shown to decrease the amount of food waste produced (Alattar, 2020). In other words, consumers who actively acknowledged methods of food-waste dispersion ultimately reduced the amount of food waste that was produced. Similarly, consumers who engaged in sustainable food-related practices such as the reuse of leftovers, shopping on a plan, and cooking on a plan showed to produce less food waste (Stancu, 2016). Intention can often be influenced by external emotions such that intent to act is often given a white or black notion. Prior research suggests that the frequency of intentionally engaging in a certain behaviour is affected by personal conception of the behaviour (Russell, 2017). This means that consumers who have a positive outlook or believe that managing food waste is important intend to be more resourceful and will engage in sustainable food waste management practices.

It has been demonstrated that people's perceptions of information and themselves affect how much food waste they produce. Evidence suggests that there is a decrease in food waste among consumers who self-reflect, have moral attitudes, or consider food waste to be a problem (Aydin, 2021). Furthermore, consumers who engaged in any of these three habits thought it was improper and inconsistent with their self-image to waste food (Aydin, 2021). This demonstrates that individualistic perception of food waste plays a significant role in food waste production. In addition to this, consumer emotion can largely influence individual perceptions of wasting food

(Schanes, 2018). Other studies have shown that households often associate wasting food with the emotions of ‘disgust’, ‘hate’, ‘frustration’, and ’annoyance’ (Schanes, 2018). Moreover, households often express a high sense of guilt when throwing food away (Schanes, 2018). This demonstrates that perceptions of food waste are often highly influenced by feelings of guilt and that negative emotions motivate food waste reduction (Schanes, 2018). Environmental impacts associated with food waste are an ever-growing concern that must be accounted for as our global population increases. However, it is interesting to note that environmental impacts regarding food waste have been noted as a minor motive behind reducing food waste behavior (Schanes, 2018). Interestingly, studies have shown that the degree of environmental concern about food waste is positively correlated with social-demographic factors such as education (Schanes, 2018). This shows that being able to educate consumers, households, and the general public on the importance of proper food waste management and disposal methods is key to developing strategies to reduce food waste.

Influence, a habit-based implication, has been shown to have an impact on food waste production. As with many social situations, a surrounding environment can influence one's personal decisions which may not align with one's true beliefs or morals. A study measuring social influence on food waste production in Italian students found that students' food waste was found to align with those in their surrounding environment (Piras, 2023). Furthermore, plate waste is also influenced by social interaction as consumers believed they felt more comfortable or accepted in social settings when their remaining food matched their surroundings (Alattar, 2020). Outside of social interaction, food-related habits are largely influenced by confidence and skills that consumers inherently possess (Stancu, 2016). Research suggests that consumer's confidence in their ability to effectively cook and shop strongly influences the amount of food they waste (Stancu, 2016). Furthermore, it was discovered that shopping frequency influences food waste production in households as they are positively correlated (Schanes, 2018). Lastly, the methods used to dispose of waste have been recognized as an influencing factor regarding the amount of food waste produced. It has been shown that consumers are more likely to incorrectly dispose of food rather than give into wasteful consumption (Schanes, 2018). This suggests that guilt and emotion concerning over consuming may influence disposal methods of food waste.

Education and Awareness

Individual's perceptions, intentions, and habits are often driven by educational factors, like awareness. This pertains to student access to education, as well as but also its quality, reliability, and relevance of it. Relative to the challenges associated with food waste, many institutions have recognized a lack of education and awareness among students, particularly with respect to food waste. University efforts to enhance sustainability and environmental literacy are being developed through research initiatives and academic practices (Msengi et al., 2019). Erin and Aaron Redman's (2014) study on transformative measures for sustainable food waste behaviours in education systems highlights the value of using different knowledge domains. The integration of cognitive, affective, and psychomotor educational frameworks correlates with positive changes in environmental behaviour; which is also achieved with increased environmental knowledge (Redman, 2014). Further reviews and discussions identified significant and practicable recommendations for institutions to integrate into their curriculum. These applications include training individuals to acquire more responsible and motivated approaches that manage food waste behaviours.

There are challenges presented when addressing food waste among older populations. Older individuals have developed habits and perceptions that are rigid and difficult to change, which comes with their hesitancy (Wojciechowska-Solis & Smiglak-Krajewska, 2020). However, there is hope among younger individuals. As most undergraduate students are starting to live off campus and begin their adulthood living experience, integrating food waste awareness is crucial in mitigating these challenges. Education is a practical learning experience, used as an advantageous platform that facilitates food waste initiatives and awareness campaigns. This approach targets students, with the objective of developing deeper insight into food waste production averages and the overall environmental impact it has. While also, student's engagement and awareness encourage a growth mindset which elaborates on the notion that intelligence has potential for personal change (Devries, n.d.). The evidence we aim to gather from this study may address environmental education barriers and, therefore, should evoke heightened student engagement and a responsible body of undergraduate students.

Research Objectives

Considering the persistent rise in annual food waste and impact education has on creating awareness and changing behavioural patterns, it urges us to question how and why students may

or may not adhere to preventative food waste measures. As such, our study surrounds food waste challenges among Dalhousie undergraduate students. We are motivated to examine food waste patterns, pertaining to perceptions, intentions, and habits, while drawing any significant links to the role and influence of education. This comparative analysis will be performed between students in ENVS/SUST and individuals enrolled in other programs. The goal is to gather a greater understanding of potential contributors to the amount of food waste undergraduate students generate. The outcomes of these results may help foster a culture that incorporates sustainable applications, promotes responsible consumption patterns through positive change; and pinpoints any gaps in the awareness and education spectrum at Dalhousie University that require attention.

METHODS

Population and Target Sample Size

The sample population is undergraduate students studying at Dalhousie's Halifax campuses (Studley, Carleton, and Sexton) and living off-campus (i.e. not in residence buildings). Students studying at the Truro campus were excluded due to logistical constraints, such as physical survey distribution. Students living on campus were excluded due to the different factors influencing food waste within meal halls, which fall outside the scope of our research. Our survey questions were tailored to individuals who purchase and prepare their food, thus necessitating the exclusion of meal hall users.

The target sample size was 375 individuals, based on a 95% confidence level and a 5% margin of error. This comes from the Dalhousie 2023/2024 enrollment data, which we used to estimate the total population of undergraduate students studying at the Studley, Sexton, and Carleton campuses to be 15,484 and adjusted to 13,470 after the exclusion of students living in university residence buildings.

Survey Design

To engage a large number of Dalhousie undergraduate students, we designed a concise five-minute survey comprising of five sections:

1. Survey consent.
2. General demographics.
3. Food waste habits.

4. Food waste perceptions.
5. Food waste intentions.

Instead of opting for interviews, we opted for surveys to expedite data collection and achieve a more comprehensive overview of the population, avoiding potential biases introduced by individual representation from different academic majors. Additionally, the anonymity of surveys may encourage more truthful responses, especially when addressing sensitive topics such as food waste behaviours. Interviews, while advantageous in many aspects, are limited in their ability to ensure anonymity, potentially leading to respondents only revealing what they are comfortable disclosing, which could be influenced by what they believe the interviewer wants to hear (Alshenqeeti, 2014).

The survey, titled "To Waste or not to Waste? That is the Question", was created using Google Forms (Appendix A). The research ethics application was approved by the Department of Earth and Environmental Sciences (Appendix B).

The section asked a screening question to confirm participants' eligibility as members of our target population (i.e. undergraduate students at a Dalhousie Halifax campus and residing off-campus). Following this, participants were asked to provide details regarding their program of study and current year of study, facilitating the separation of data for statistical analysis.

Subsequent sections utilised a range of question formats, including Likert scale questions, rank style questions, and multiple-choice categorical questions, to explore participants' habits, perceptions, and intentions regarding food waste.

Data Collection

Printed posters featuring Quick Response (QR) codes and website URLs connected to our Google Forms survey were distributed around different locations on Studley, Carleton, and Sexton campuses (Appendix C). Additional posters were placed in various cafes around the city and at the serving counters of the Loaded Ladle on Studley and Sexton campus. Promotion of the survey extended to social media platforms (where an online graphic and easily accessible links were posted), including the team's personal accounts and the Loadle Ladle's Instagram account. Further, the survey was shared by professors across different degree programs, enhancing its visibility within the university community.

To encourage participation, respondents were offered a chance to win a $25 Trail Shop gift card. Monetary incentives have been recognized as effective tools for engaging

individuals who may not have intrinsic motivation to participate in surveys (Singer & Ye, 2012). By offering this incentive, the aim was to diversify the respondent pool and mitigate the risk of sampling bias towards individuals already interested in food waste and environmental issues.

Data Analysis

Data analysis and statistical testing were conducted using Microsoft Excel and R Studios. For all data analyses, the significance threshold was set at 0.05.

Food Waste Habits

A Mann-Whitney U test was used to compare food waste habits between students studying ENVS/SUST and those in other programs. The 6 Likert scale questions in this section were structured with five options, each corresponding to a numeric value ranging from 0 for "always" to 4 for "never". This allowed for the calculation of a total score out of 24, where a higher score indicates better food waste habits. This is common practice when measuring abstract concepts through Likert scales (Sullivan & Artino, 2013; Harpe, 2015). A Cronbach's alpha test was conducted to ensure the reliability of the scale. It indicated moderate internal consistency reliability ($\alpha = 0.75$), suggesting that the six subscales within the habits section are reasonably reliable measures of the underlying food waste habits being assessed.

Before conducting the Mann-Whitney U test, the normality of the response distributions we tested using the Shapiro-Wilk test, revealing a significant departure from normality (p-value < 0.05) for both the ENVS/SUST and Other groups. The Mann-Whitney U test was chosen due to its robustness in handling ordinal data, such as Likert scale responses, and because the data were not normally distributed (Harpe, 2015). By focusing on median scores rather than means, the Mann-Whitney U test allowed for an assessment of central tendencies while accommodating potential skewness or outliers within the dataset (Sullivan & Artino, 2013; Harpe, 2015).

A Mann-Whitney U test was also performed to assess potential significant differences regarding the estimated quantity of food wasted during a standard meal between ENVS/SUST students and other students. This test was chosen due to the non-normal distribution of data, as revealed by the Shapiro-Wilk test results for both the ENVS/SUST major group ($W = 0.5479$, p-value = 1.672e-09) and other majors ($W = 0.6729$, p-value = 5.532e-10).

- $H0_1$: The difference between the median scores of food waste habits between ENVS/SUST majors and other majors is equal to zero.

- HA_1: The difference between the median scores of food waste habits between ENVS/SUST majors and other majors is not equal to zero.
- $H0_2$: The difference between the median estimated amount of food waste between ENVS/SUST majors and other majors is equal to zero.
- HA_2: The difference between the median estimated amount of food waste between ENVS/SUST majors and other majors is not equal to zero.

Food Waste Perceptions

The analytical process applied to the Likert scale data concerning food waste behaviours was replicated for the assessment of food waste perceptions. This involved utilizing a Mann-Whitney U test to compare responses between the two major groups. The Likert scale responses were first translated into numerical values, ranging from 0 for "strongly disagree" to 4 for "strongly agree," enabling the calculation of a composite score out of 20 across the five questions. A higher score indicates stronger alignment with positive attitudes towards food waste. Additionally, a Cronbach's alpha test was used to assess the scale's reliability, revealing a high level of internal consistency among the questionnaire items ($\alpha = 0.88$).

To test whether individuals who reported certain food waste habits were more likely to hold specific perceptions about food waste, a correlation analysis was run. The data was found not to be normally distributed so the nonparametric Spearman rank-order test was used to assess the strength and direction of the association between food waste habits scores and food waste perceptions scores.

- $H0_3$: The difference between the median scores of food waste perceptions between ENVS/SUST majors and other majors is equal to zero.
- HA_3: The difference between the median scores of food waste perceptions between ENVS/SUST majors and other majors is not equal to zero.
- $H0_4$: The Spearman correlation coefficient between the scores on the food waste habits section and the scores on the food waste perceptions section is equal to zero.
- HA_4: The Spearman correlation coefficient between the scores on the food waste habits section and the scores on the food waste perceptions section is not equal to zero.

Food Waste Intentions

For the first question in this section, the frequency of each factor within each rank level was calculated and used to generate a visual representation of how each major group ranks the

importance of different factors influencing their food waste reduction. For the remaining three questions, no statistical analysis was conducted. Instead, plots depicting the distribution of responses were generated.

RESULTS

The data collection period spanned ten days, from March 6th to March 21st. By the end of the collection period, 138 individuals participated in the survey. 5 responses were not included due to respondents not being members of our target population. 37 respondents were studying ENVS/SUST and 96 were in other programs.

Food Waste Habits

In examining the food waste habits among students across different academic disciplines, the Mann-Whitney U test revealed no statistically significant difference in median scores (W = 1819, p = 0.8303; Fig. 1), suggesting a lack of variance in food waste practices between students majoring in ENVS/SUST and those in other fields. Therefore we fail to reject $H0_1$. Both ENVS/SUST majors and other majors demonstrated a median total score of 17 out of a total possible score of 24. This reflects a moderate level of adherence to food waste reduction practices among both groups of students (Figure 2).

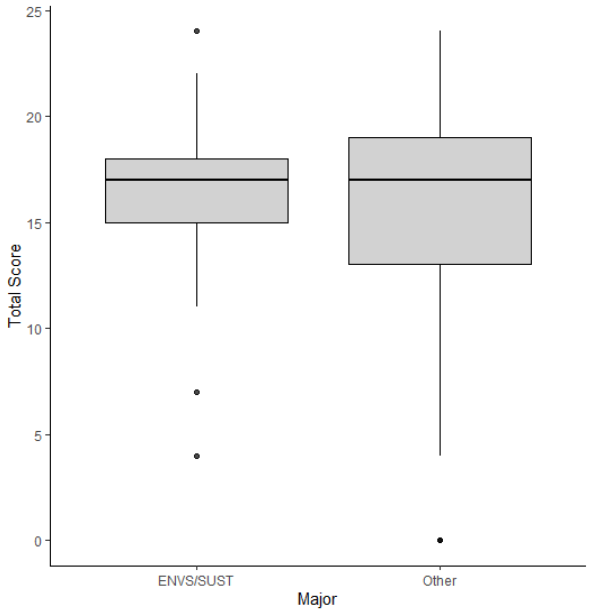

Figure 1. Boxplot illustrating the distribution of total scores representing food waste habits among participants, grouped by major (37 ENVS/SUST respondents and 96 other). Total scores were derived from responses to six Likert-scale questions, with each answer corresponding to a

numerical value between 0 and 4. The maximum achievable score was 24, with higher scores indicating better food waste habits.

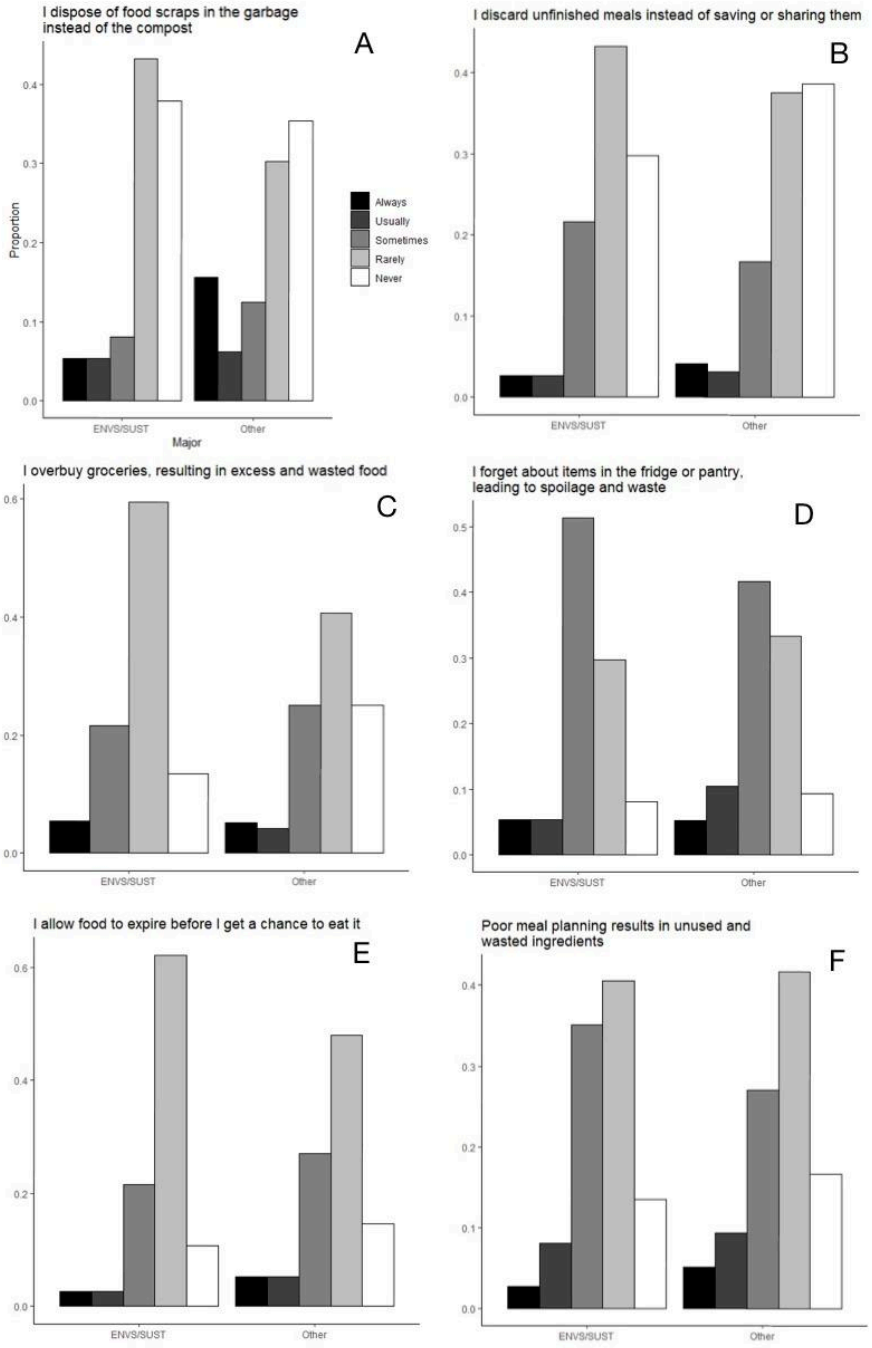

Figure 2. Proportions of responses to statements related to food waste habits among various majors. Each subplot represents a different statement and the proportions are calculated based on survey responses, with bars representing the distribution of responses ("Always" to "Never") within each major (37 ENVS/SUST respondents and 96 other).

The median estimated food waste during a typical meal for ENVS/SUST majors was 12.5% and it was 0% for students in other majors. However, the Mann-Whitney U test revealed that this difference was not significantly different (W = 1939, p = 0.2599; Fig. 3). Therefore we fail to reject $H0_2$.

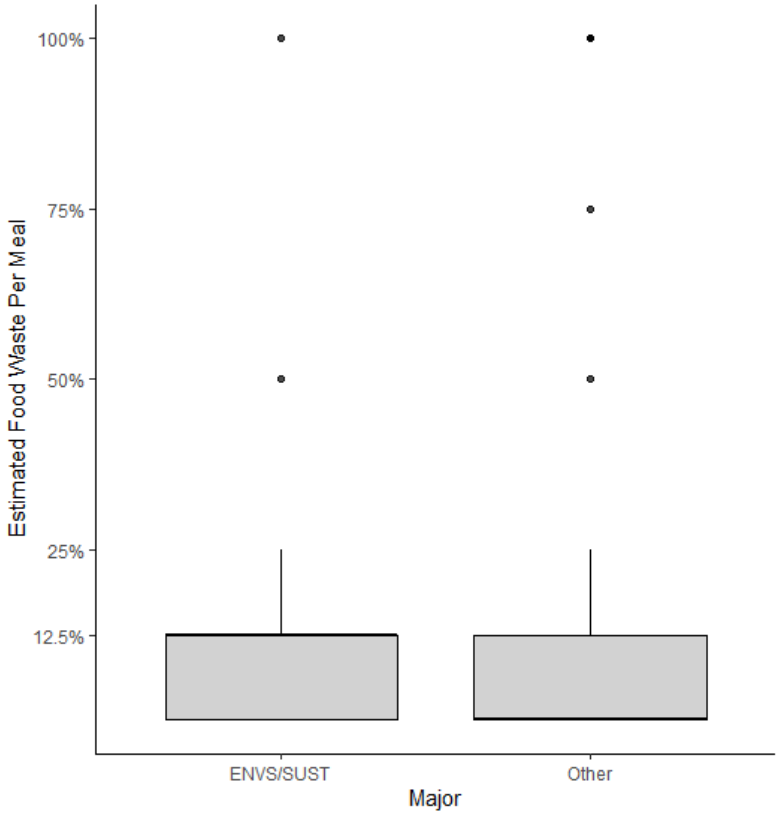

Figure 3. Boxplot of the estimated percentage of food waste per meal (excluding any portion saved for leftovers or shared with others, but including any food disposed of or composted) among students majoring in ENVS/SUST and those in other majors. The 37 ENVS/SUST respondents reported a median waste percentage of 12.5%, while the 94 other respondents reported a median of 0%.

Food Waste Perceptions

The analysis of students' perceptions regarding food waste utilised a Likert scale-based questionnaire, asking their agreement or disagreement with statements concerning food waste consciousness and environmental concerns, duties, etc. Results indicated a median score of 19 for students majoring ENVS/SUST and 18 for those in other majors, showcasing a slightly higher perception score among ENVS students. However, the Mann-Whitney U test did not reveal a significant difference in perceptions between ENVS majors and students in other disciplines (W = 2066, p-value = 0.1385; Fig. 4). Therefore we fail to reject $H0_3$. Both groups exhibited high scores, suggesting a generally high awareness and concern for food waste among the student population regardless of major (Figure 5).

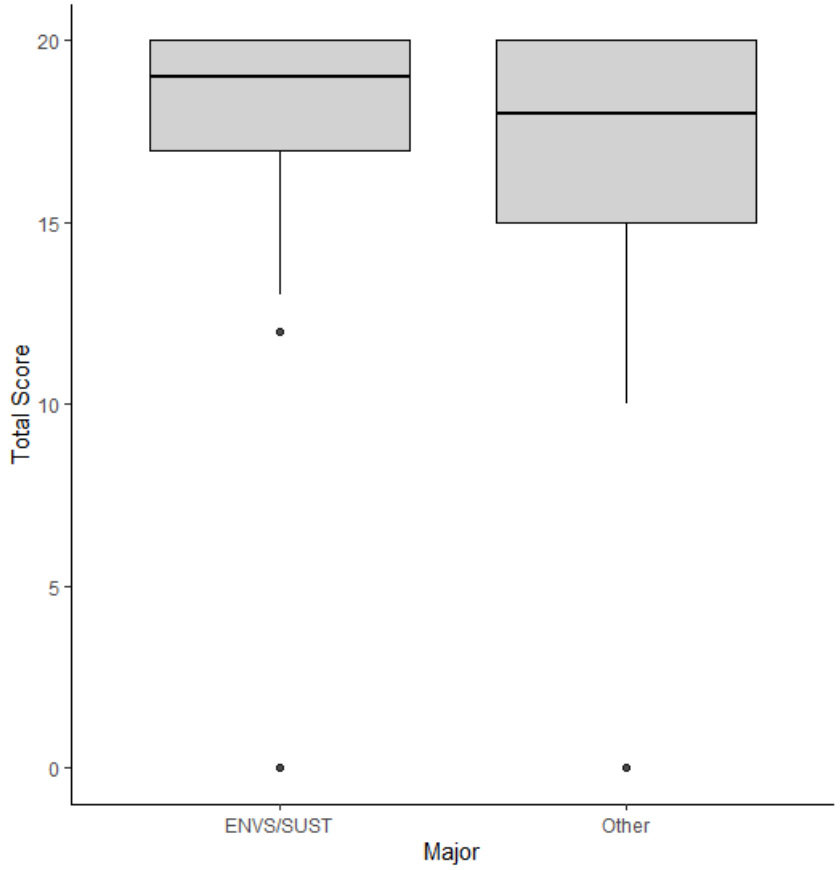

Figure 4. Boxplot of the distribution of students' perceptions of food waste across different majors. The median perception score for ENVS/SUST majors was 19, while it was 18 for students in other majors. There were 37 ENVS/SUST respondents and 96 others.

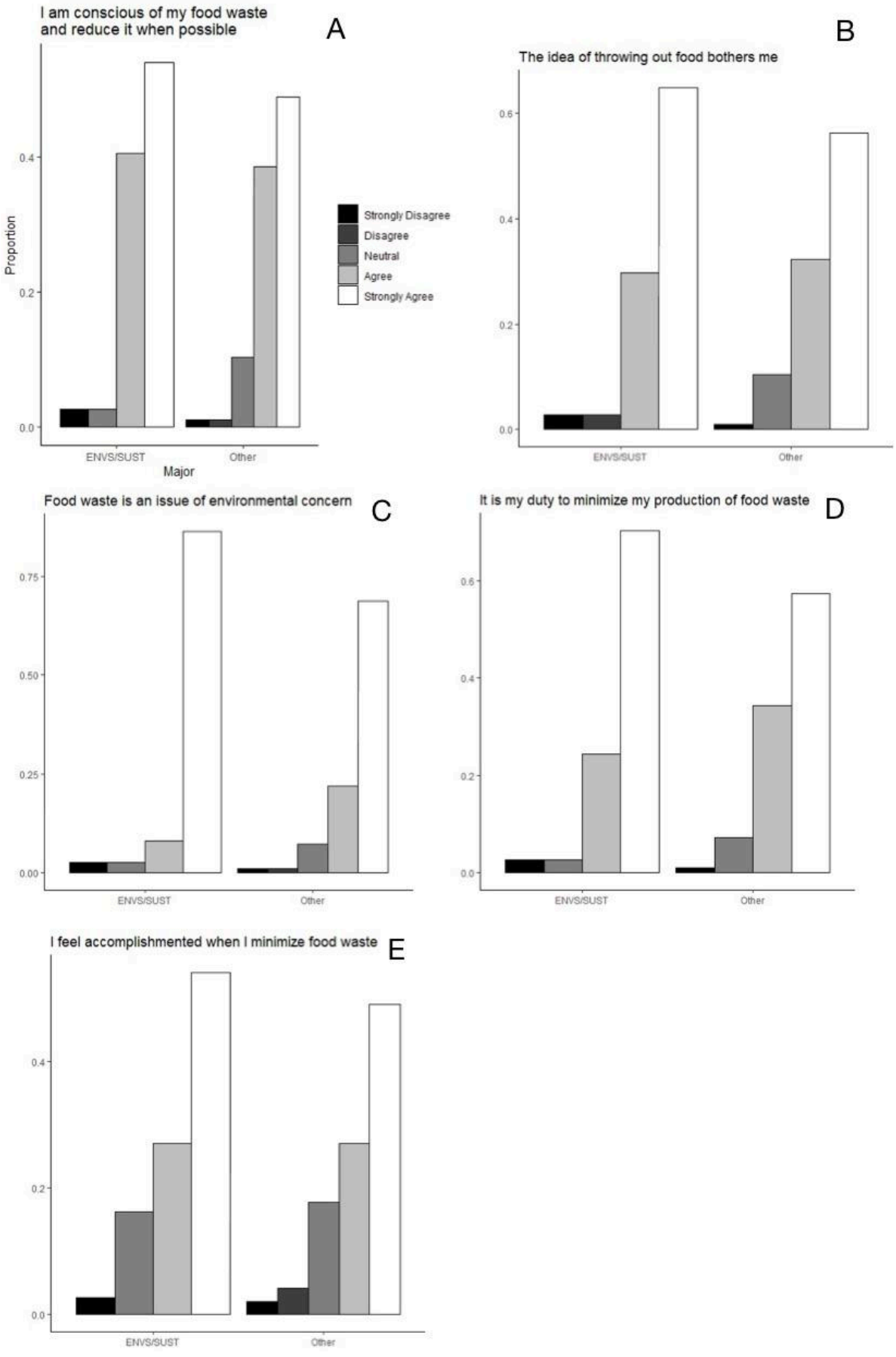
I am conscious of my food waste and reduce it when possible
A
Proportion
0.0
0.2
0.4
ENVS/SUST
Other
Major
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
The idea of throwing out food bothers me
B
0.0
0.2
0.4
0.6
ENVS/SUST
Other
Food waste is an issue of environmental concern
C
0.00
0.25
0.50
0.75
ENVS/SUST
Other
It is my duty to minimize my production of food waste
D
0.0
0.2
0.4
0.6
ENVS/SUST
Other
I feel accomplishmented when I minimize food waste
E
0.0
0.2
0.4
ENVS/SUST
Other

Figure 5. Proportions of responses to statements related to food waste reduction among various majors. Each subplot represents a different statement and the proportions are calculated based on survey responses, with bars representing the distribution of responses ("Strongly Disagree" to "Strongly Agree") within each major. There were 37 ENVS/SUST respondents and 96 other.

The results of the correlation analysis revealed a significant weak positive correlation between habits and perceptions scores related to food waste ($\rho = 0.32$, p-value = 0.0002; Fig. 6). Therefore, we reject $H0_4$. This indicates that individuals with better perceptions of food waste tend to have slightly better food waste habits

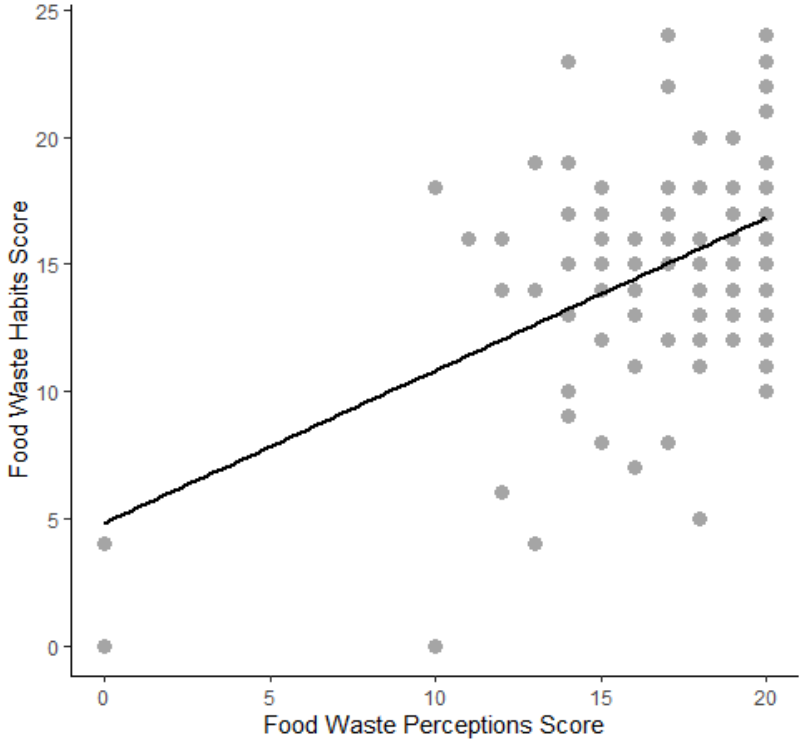

Figure 6 Scatter plot of the relationship between habits and perceptions scores related to food waste. The line represents the linear trend line fitted to the data. The Spearman correlation coefficient between habits and perceptions is 0.32, indicating a weak positive correlation.

Food Waste Intentions

The analysis of factors influencing respondents' intentions to reduce food waste reveals nearly identical trends across both majors (Fig. 7). Saving money was the most important factor, with ~41% of ENVS/SUST students and ~58% of other students ranking it as number one. Environmental concern followed closely as the second most important factor (~41% for ENVS/SUST students, ~36% for other students). In third place was regret about time spent

shopping and preparing food (~63% for ENVS/SUST, ~60% for others). Concerns about how others will perceive them if they waste was regarded as the least important factor (~73% for ENVS/SUST, ~72% for others).

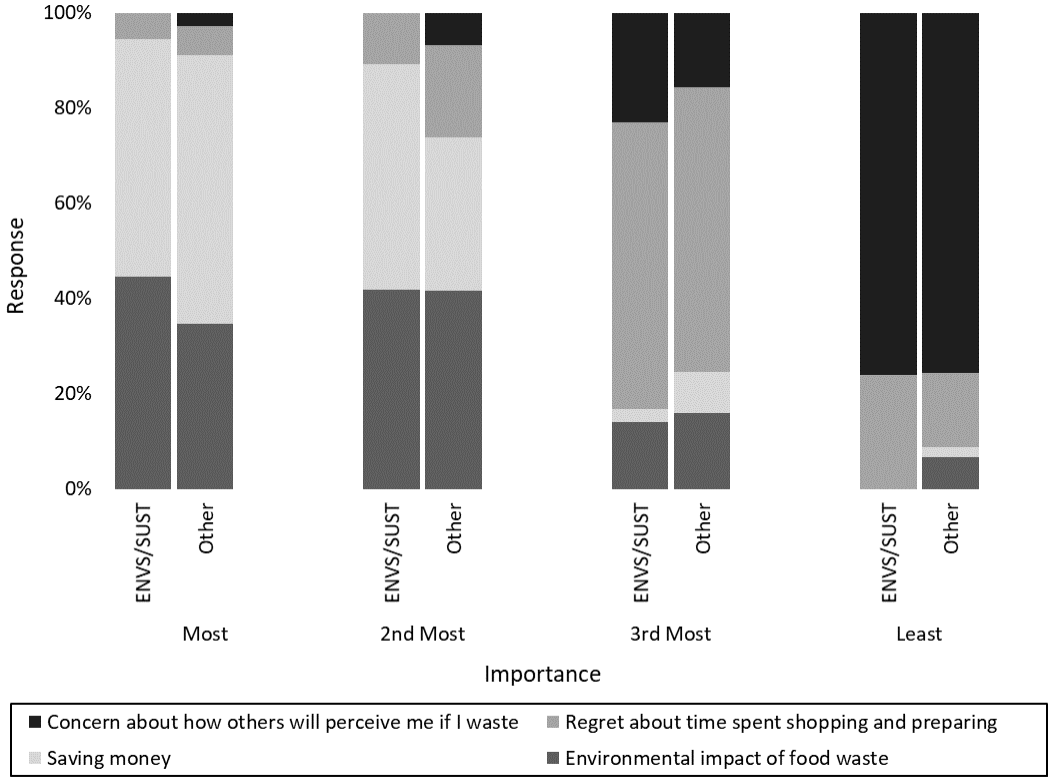

Figure 7. The most to least important factors influencing respondents' intentions to reduce food waste, categorised by major type (37 ENVS/SUST respondents and 96 others).

Looking at the distribution of agreement among ENVS/SUST majors on influences from their courses towards personal food waste reduction, it is evident that courses did have an influence, as only one respondent said their courses had no influence (Fig. 8). The most influential factor, with ~97% of agreement, was that course content increased awareness of the environmental consequences of food waste.

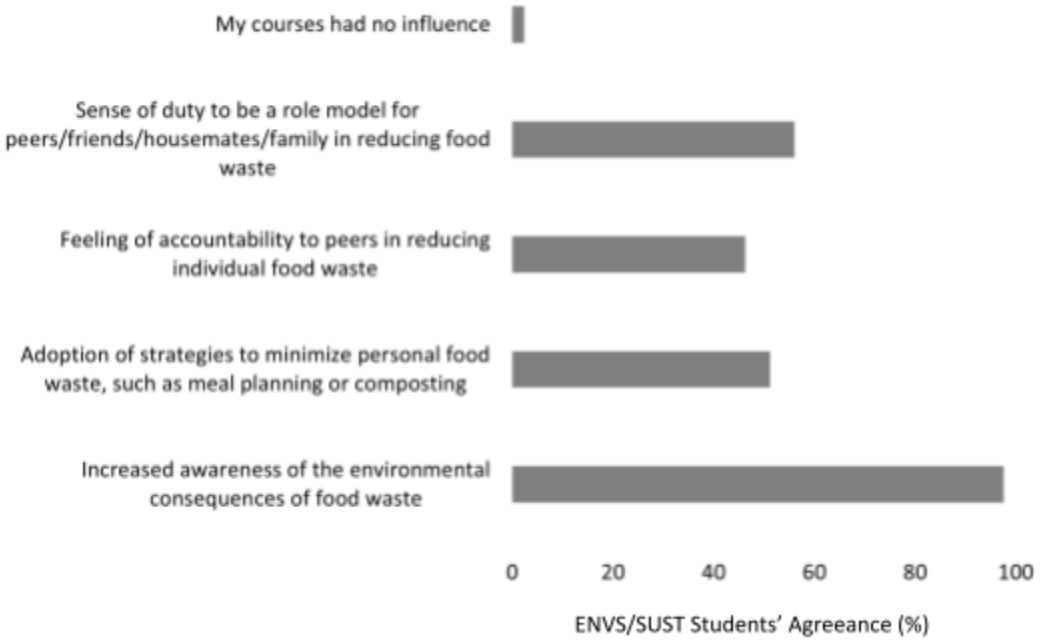

Figure 8. Distribution of agreement among ENVS/SUST majors on various influences from their courses towards food waste reduction. The percentages represent the proportion of the 37 ENVS/SUST respondents expressing agreement with each factor.

The distribution of agreement from other majors on influences on their reduction of food waste revealed the most common influence was the influence of peers or household members with 50% of respondents selecting this (Fig. 9). Some respondents provided additional reasons beyond the listed options. Ten respondents attributed their conscientiousness towards food waste to their upbringing, mentioning the influence of their parent's practices and family values. Others mention the financial aspect, religious influences, or experiences working in restaurants or managing the Dalhousie urban garden.

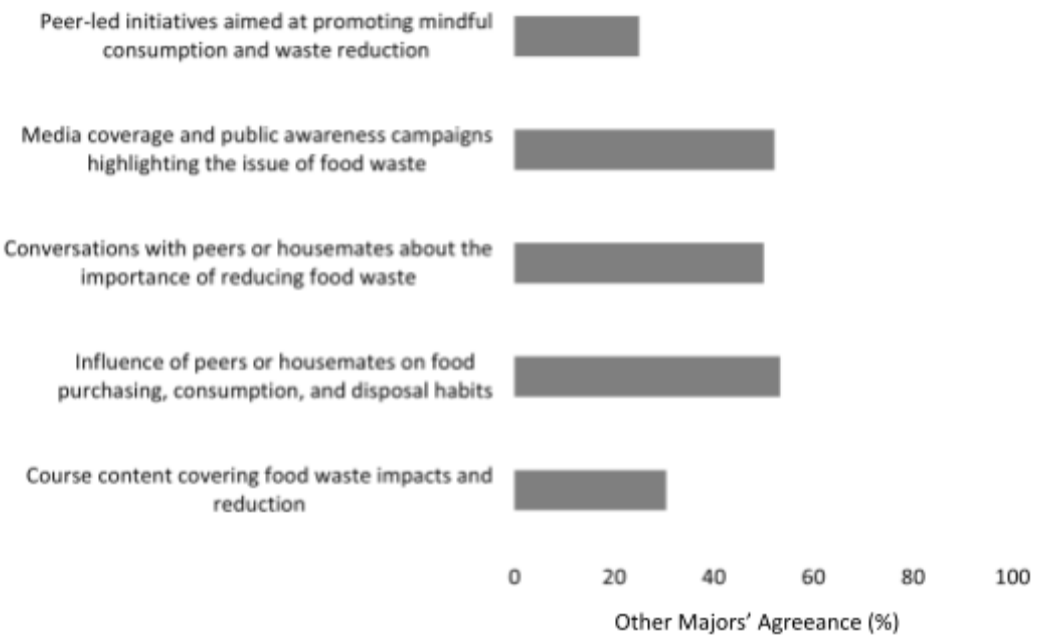

Figure 9. Distribution of agreement among other majors on various influences on their reduction of food waste (of the 93 respondents who *do* intentionally reduce their food waste). The percentages represent the proportion of other majors expressing agreement with each factor.

Among students who do not reduce their food waste, the predominant barrier was time or economic contractions, with ~62% of respondents indicating this (Fig. 10).

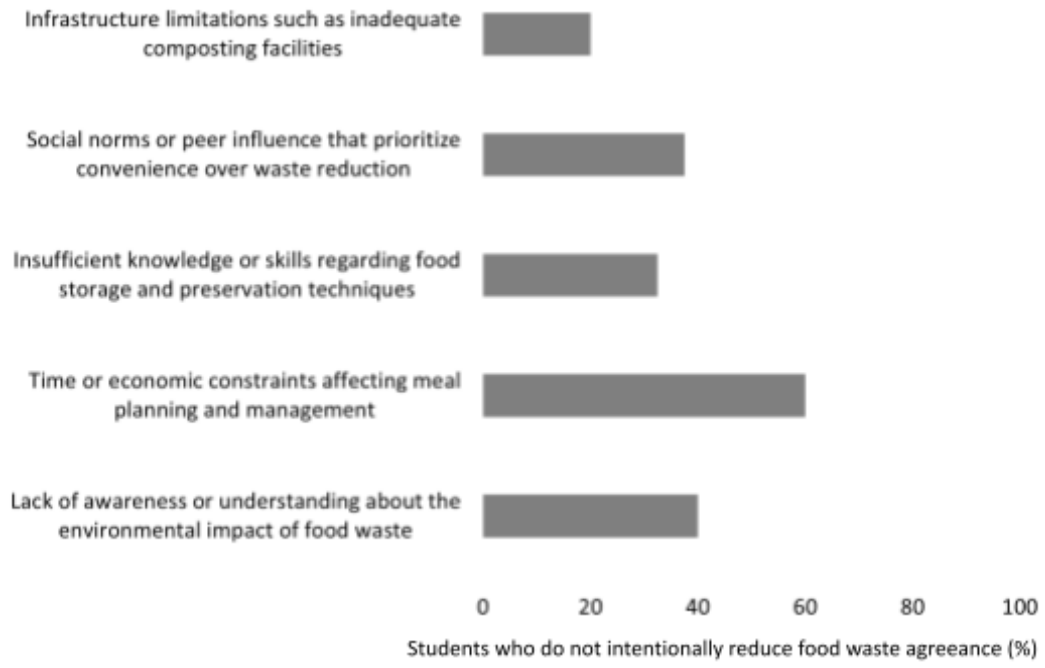

Figure 10. Distribution of agreement among all students who do not intentionally reduce their food waste on the barriers to this. The percentages represent the proportion of agreement with each factor.

DISCUSSION

Purpose

The purpose of this research project was to determine if there are any differences between the habits, intentions, and perceptions of food waste between Dalhousie students enrolled in an Environmental Science/Sustainability program compared to students enrolled in other programs. Food waste can occur for multiple different reasons such as behavioural and psychological reasons, lack of education surrounding food waste, as well as social influences encouraging individuals to waste (Kim, 2019). An influencing factor that comes with the amount of food waste generated stems from a lack of education or knowledge surrounding the importance of food waste and as an educational institution. Dalhousie has a responsibility to the students as well as staff, to provide a clean campus and a large part of that comes from the amount of students' waste. This being said, by investigating the major differences between students, we

aimed to determine where the most prevalent issues arise to facilitate recommendations to enhance Dalhousie food waste education and by doing this, educational programs surrounding food waste can be created and cater most to the areas students struggle with. Establishing an environment on campus where students are actively reducing their waste not only fosters activism toward the importance of food waste but also creates a cleaner and more sustainable campus for students, staff, and faculty.

Significant Findings

Key findings from the food waste intention analysis found that ENVS/SUST students who took courses geared towards personal food waste reduction had an impact on the amount an individual wastes, leading to a reduction in overall waste, as opposed to students in other majors who intentionally reduce their waste, reported that influence from peers and and housemates has the largest impact in the amount of waste they reduce. Students who responded that they do not intentionally reduce their waste reported that the main constraint in regards to food waste is the economic constraints preventing students from meal planning and management. This being said, a correlation between the amount of food waste generated and the level of education an individual has concerning food waste emerges, which provides a helpful framework for creating solutions geared towards food was reduction and educational initiatives.

Interpretations of Findings

Throughout the process of our analysis, our findings show that there was generally not a significant difference between food waste habits between students in ENVS/SUST compared to students enrolled in other majors. The analysis revealed that students with better perceptions towards food waste tend to have better food waste habits, leading to the notion that an increased level of education towards food waste leads to a reduction of overall food waste which is not surprising. Although, this shows that Dalhouise is lacking in the food waste education sector and students do not have enough access to food waste reduction resources, or not making food waste education accessible enough for all students. Within the survey participants were asked whether or not they dispose of food scraps in the garbage instead of the compost in which a portion of students in both categories answered either always, ususally, or sometimes, showing a disparity in food waste knowledge as food waste should never go in the garbage (HRM, 2023). This is a common trend in higher education institutions and shows that there is a further need to improve and enhance food waste education initiatives (Filho et al., 2020). In a study published by the

University of Bari Aldo Moro, Bari, Italy it found that education was the best measure for reducing food waste and bringing increased food waste education concerning social, economic, and environmental consequences of food waste was found to provide the best results (Amicarelli et al., 2021). In a report by HRM it stated that food waste is equivalent to 140 kg of wasted food per household but was projected to have had a 13% increase after Covid-19, suggesting that food waste is continuing to increase (Dalhousie University, 2020). Food waste will continue to persist unless action is taken which gives Dal an opportunity to create environmental initiatives to reduce overall food waste and allow for a cleaner campus to emerge.

Another factor to take into consideration is the connection between food waste and the amount an individual spends on food. Past studies indicate that people who minimise food waste do so primarily due to cost implications and financial considerations (Alattar, 2020). Both ENVS/SUST students and students in other majors reported that the primary reason for reducing their food waste is because of financial reasons, with the secondary reason being environmental concern, and the third reason being regret about time spent shopping and preparing food. With food cost being the primary reason for food waste reduction, additional issues arise as the implications it has on social and economic factors as it causes disruptions in the food supply chain (Ghosh, 2016). This shows that food waste is not just an issue on the individual level but also on a larger scale which demonstrates the severity and impact of food waste on social, economic, and environmental factors.

Limitations

Most notably, the main limitation concerned our data collection methods – the process and decision of statistical measures. Our data were collected via a self-reported, Likert-style survey questionnaire. Anonymous respondents read the questions and selected their answers based on personal desire or psychological pressures. In most cases, self-reported surveys are affected by bias or a respondent's desire to answer questions in a way that satisfies what the researchers are looking for (Brenner & DeLamater, 2016). Furthermore, the response options: *neutral*, *unsure*, or *not applicable*, are an easy way for individuals to answer survey questions without overthinking or spending an "excessive" amount of time. These options can contribute to skewed data. Although a Likert-style survey was the most efficient method of data analysis, it may have impacted the reliability and validity of our results due to a decrease in respondent's honest behaviour while completing the survey.

An additional limitation of our study pertained to experimental design faults. The challenges in achieving the full potential and reliability of our data also came from not meeting our target sample size. Effective flyer distribution was a factor that may have contributed to the gap between the total sampled individuals and the target sample size. Realistically, this was also unattainable based on time constraints, which is another limiting factor to our study results. Lack of flyer distribution that targets all student-dense buildings on campus, even off-campus. An article on the impacts of flyer effectiveness suggests that based on the volume of completed surveys, the number of flyers distributed, the location, and the format of the attributes to the survey response rate (Perks, 2013). Analyzing the impacts of adequate and effective flyer distribution forced us to question whether we were able to successfully market our survey to the undergraduate student population at Dalhousie.

As previously mentioned, the duration of survey availability to undergraduate students was only accepting responses for 10 days. This time frame was a barrier to receiving a suitable number of respondents that satisfies our target sample population of 375. We were able to gather 138 responses and acknowledge that this will not match the 95% confidence interval; therefore, it compromises the validity of our research findings, accuracy, and feasibility of concluding. Our small sample population posed a challenge when examining a high cluster of results regarding awareness and concern for food waste. This limitation suggested insignificant differences between students majoring in ENVS/SUST and students enrolled in other disciplines, where nearly 100% of students already cared about the environment. As such, it is inferable that respondents took the survey because of shared interests in food waste concerns. Therefore, the results do not analyze the student population who may not have concern towards the environment; which may pose different reasons behind personal food waste production intentions and habits.

Suggestions for Future Research

This study involved a comprehensive and critical evaluation of a relevant environmental concern – food waste production. Dalhousie University offers ENVS/SUST undergraduate programs that include an in-depth curriculum regarding environmental problems and solutions on both a global and local scale. Our study revealed current student food waste intentions, perceptions, and habits; and what factors may drive these three domains. In focus, we aimed to draw significant conclusions between students majoring/minoring in ENVS/SUST and students

enrolled in alternative programs. Building on our research analyses opens many doors regarding food waste concerns on municipal and institutional levels (universities, colleges), while also in the environmental science field and sustainable management world. Additionally, our findings have benefits for future psychological reports. Expanding on our conceptual framework, suggestions to analyze the urgency of food waste production perceptions, intentions, and habits. Based on our limitations, future researchers could address the challenge of self-reported surveys, and implement interviews, considering that a longer study period would be required. Our results suggest that there is not a significant difference between students enrolled in ENVS/SUST and students enrolled in other majors; however, these findings did reveal that some scores in the food waste perceptions domain indicated a small link between positive food waste perceptions and behaviours concerning general environmental knowledge and awareness. As such, we suggest evaluating this research topic with a bottom-up approach. The bottom-up approach effectively addresses environmental policies or challenges and has the potential to determine any barriers. This approach is a motivating factor, comparable to a ripple effect (Gallup, 2018). When individual efforts are combined with group initiatives, it amplifies the impacts of these actions. Furthermore, implementing the ENVS/SUST curriculum into a section of all courses could be of consideration for further research; how might this impact food waste perceptions and habits? In conclusion, there are many possibilities and experimental routes to take based on the outcomes of our research. As such, future researchers can use our experimental limitations, theory framework, and findings to further expand on this concept, perform a re-evaluation, or apply the hypothesis to a different context, like demographics.

Examination of Findings

The results of the analysis conclude that although students were found to have an adequate knowledge surrounding food waste, there continues to be a gap regarding the impacts and the severity of food waste and the level of education provided concerning food waste. Within the survey participants were asked whether or not they dispose of food scraps in the garbage instead of the compost in which a large percent of students in both categories answered either always, usually, or sometimes, showing a disparity in food waste knowledge as food waste should never go in the garbage (HRM, 2023). Another factor to take into consideration is the correlation between student perception and food waste, as results from the analysis yielded that individuals with better perceptions of food waste tend to have slightly better food waste habits.

This is an important factor to take into consideration as Dalhousie has a responsibility as an academic institution to educate students and provide a clean and safe campus, which is threatened by an abundance of food waste generated. In a report by HRM it stated that food waste is equivalent to 140 kg of wasted food per household but was projected to have had a 13% increase after Covid-19, suggesting that food waste is continuing to increase (HRM, 2023). If students are not aware of the impact and severity of food waste then food waste levels will continue to increase, which is why an educational approach, especially in Dalhousie's situation can provide a potential solution. Food waste plays a major role in affecting social, economic and environmental aspects which is why it is such an essential issue to tackle, especially since the results of our analysis revealed that an increase in education leads to better food waste habits.

Study Improvements

Based on our limitations and concluded outcomes, study improvements include changes in methodology approaches, adjusting the scope of our research; including food waste practices and policies enriched among the university population. Our methodology was selected based on several variables; one, being practicality and effectiveness; two, including ethical considerations; and three, being feasibility based on available resources. Based on these exclusions and the limitations that were experienced, diversifying our sample scope would enhance the generalizability and significance of our findings. This change could entail analysing a broader range of students, like all Dalhousie University students living off-campus (both undergraduate, PhD, masters). This would also help address the challenge of reaching target sample size. Additionally, the use of self-report surveys, though efficient for our short study period, poses a challenge in the reliability and validity of our findings. A controlled experiment would engage individuals through different interactions and interventions that allow us to analyse their honest behaviours. The promotability of our research and the survey lacked effort. Although the flyers were distributed around campus, social media platforms should have been used on a larger scale to further engage the public. These improvements would help with the performance efficiency and result accuracy of our study. With these practical and methodological improvements considered, practices and routines that university students should adopt. The nature is that food waste will occur. Procedures like planning, proper storing, management of leftovers, and shopping can help mitigate this with the use of helpful apps like AnyList available on Apple and GooglePlay. This electronic application helps individuals create grocery lists, keep track of the

food in their fridge or pantry, and organize recipes based on ingredients currently at home. The most prominent form of marketing typically reigns from social media and influencers. There are many producers and organizations, like PlantYou (Carleigh Bodrug), that provide encouraging, reliable, and informative platforms regarding initiatives that assist the development of food waste knowledge and skills.

CONCLUSION

Key Findings

The results of the analysis conclude that although students were found to have an adequate knowledge surrounding food waste, there continues to be a gap regarding the impacts and the severity of food waste and the level of education provided concerning food waste. If students are not aware of the impact and severity of food waste impacts then food waste levels will continue to increase, which is why an educational approach, especially in Dalhousie's situation is a feasible solution. Food waste plays a major role in affecting social, economic and environmental aspects which is why it is such an essential issue to tackle, especially with the results of the analysis revealing that an increase in education leads to better food waste habits.

Recommendations

While this study did not have significant differences in values between programs, it remains unquestionable that food waste is a problem within society. Given the vast quantity of research and data suggesting that education level and food waste production are directly correlated, it is difficult to discount recommending increasing food waste education. The University setting provides an appropriate environment to introduce food waste programming as it is an educational setting and can be easily implemented on campus. Some examples of educational programs include lectures/presentations at large auditoriums on campus, organising smaller interventions and group discussions, and implementing a mandatory food waste module for students to complete. Furthermore, teaching young adults how to properly cook and manage food-related factors (shopping, expiry dates, meal planning/budgeting, etc.) will help reduce food waste among University students. To facilitate this, the distribution of a small handbook discussing shopping tips, how to store food properly, and recipes upon entering the University lifestyle may help reduce food waste. By doing this students can not only reduce their food waste but also simultaneously save money, a large concern for University Students. Lastly, it is

well-understood that social influence affects food waste decision-making in that individual behaviour is often influenced by their surrounding environment. Encouraging a positive perspective on food waste could inspire your peers to reconsider their behaviour and heighten awareness of their habits related to food wastage.

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APPENDIX A

Survey Questions

General Demographics

1. Are you currently an undergraduate student studying at Dalhousie University and living off-campus? (not in residence halls)
   - ☐ Yes
   - ☐ No
2. What is your major?
   - ☐ ENVS/SUST (including if you are a double major in one of these)
   - ☐ Other
3. What is your current year of study at Dalhousie University?
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5+

Food Waste Habits

4. The definition of food waste that will be used for this project is as follows: edible food that is available for human consumption but is not consumed for any reason; it includes plate waste at the end of meals and food discarded due to missed expiration dates. We are only concerned with personal food waste, not overall household waste.

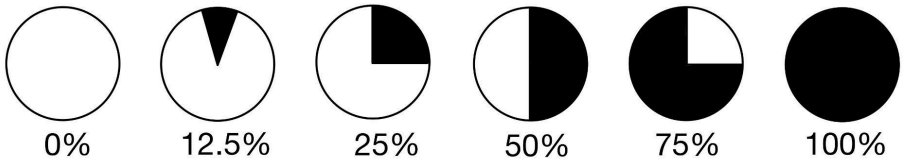
What factors do you think contribute most to your personal food waste habits? Please rank these factors based on their frequency of occurrence, where applicable:

I dispose of food scraps in the garbage instead of the compost	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer
I discard unfinished meals instead of saving or sharing them	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer
I overbuy groceries, resulting in excess and wasted food	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer
I forget about items in the fridge or pantry, leading to spoilage and waste	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer
I allow food to expire before I get a	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer

chance to eat it

Poor meal planning results in unused and wasted ingredients	☐ Always	☐ Usually	☐ Sometimes	☐ Rarely	☐ Never	☐ Prefer not to answer

5. Estimate the quantity of food discarded from your plate during a typical meal (excluding any portion saved for leftovers or shared with others, but including any food disposed of or composted):



- ☐ 0%
- ☐ 12.5%
- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%
- ☐ Prefer not to answer

Food Waste Perceptions

6. Please indicate the extent to which you agree or disagree with the following statements:

I am conscious of my own food waste, and make an effort to reduce it when possible	☐ Strongly agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly disagree	☐ Prefer not to answer
The idea of throwing out food bothers me	☐ Strongly agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly disagree	☐ Prefer not to answer
Food waste is an issue of environmental concern	☐ Strongly agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly disagree	☐ Prefer not to answer
It is my duty to minimize my	☐ Strongly agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly disagree	☐ Prefer not to answer

production of food waste						
I feel a sense of accomplishment when I successfully minimize food waste in my routines	☐ Strongly agree	☐ Agree	☐ Neutral	☐ Disagree	☐ Strongly disagree	☐ Prefer not to answer

Food Waste Intentions

7. We are interested in understanding the driving factors behind those who intentionally reduce their food waste. Please assess the degree of importance of each reason below, ensuring each reason is only chosen once (i.e. if you select "Saving money" as the most important reason, refrain from selecting it again as the second most important reason).

a) Which of the following is the most important reason behind your personal reduction of food waste?

- ☐ Saving money
- ☐ Environmental impact of food waste
- ☐ Regret about time spent shopping and preparing
- ☐ Concern about how others will perceive me if I waste
- ☐ I do not intentionally reduce my food waste
- ☐ Prefer not to answer

b) Which of the following is the second most important reason behind your personal reduction of food waste?

- ☐ Saving money
- ☐ Environmental impact of food waste
- ☐ Regret about time spent shopping and preparing
- ☐ Concern about how others will perceive me if I waste
- ☐ I do not intentionally reduce my food waste
- ☐ Prefer not to answer

c) Which of the following is the third most important reason behind your personal reduction of food waste?

- ☐ Saving money
- ☐ Environmental impact of food waste
- ☐ Regret about time spent shopping and preparing
- ☐ Concern about how others will perceive me if I waste
- ☐ I do not intentionally reduce my food waste
- ☐ Prefer not to answer

d) Which of the following is the least important reason behind your personal reduction of food waste?

- ☐ Saving money
- ☐ Environmental impact of food waste
- ☐ Regret about time spent shopping and preparing
- ☐ Concern about how others will perceive me if I waste

- ☐ I do not intentionally reduce my food waste
- ☐ Prefer not to answer

8. For students studying ENVS/SUST: Reflecting on your experiences in these courses, how have they influenced your attitudes, habits, and intentions regarding food waste? Please select all that apply:

- ☐ Increased awareness of the environmental consequences of food waste
- ☐ Adoption of strategies to minimize personal food waste, such as meal planning or composting
- ☐ Feeling of accountability to peers in reducing individual food waste
- ☐ Sense of duty to be a role model for peers/friends/housemates/family in reducing food waste
- ☐ My courses had no influence
- ☐ I am not studying ENVS/SUST
- ☐ Other: _____

9. For students enrolled in other programs that DO intentionally reduce their personal food waste: What are the influences behind your attitudes, habits, and intentions regarding the importance of minimizing food waste?

- ☐ Course content covering food waste impacts and reduction
- ☐ Influence of peers or housemates on food purchasing, consumption, and disposal habits
- ☐ Conversations with peers or housemates about the importance of reducing food waste
- ☐ Media coverage and public awareness campaigns highlighting the issue of food waste
- ☐ Peer-led initiatives aimed at promoting mindful consumption and waste reduction
- ☐ I am studying ENVS/SUST
- ☐ I do not intentionally reduce my personal food waste
- ☐ Other: _____

10. For students who do not intentionally reduce their food waste: What are some of the barriers to this? Please select all that apply:

- ☐ Lack of awareness or understanding about the environmental impact of food waste
- ☐ Time or economic constraints affecting meal planning and management
- ☐ Insufficient knowledge or skills regarding food storage and preservation techniques
- ☐ Social norms or peer influence that prioritize convenience over waste reduction
- ☐ Infrastructure limitations such as inadequate composting facilities
- ☐ Other: _____

APPENDIX B

Survey Introduction & Consent Form

You are invited to participate in a research study being conducted by an ENVS3502 research team, a group of undergraduate students at Dalhousie University. The members of the Here for B.E.E.R. research team are Molly Pert (ENVS), Stella Cimicata (ENVS), Evan Dick (MARI), Shelby Guo (ENVS), and Claire Demmings (SUST).

This survey is exclusively for Dalhousie students who are primarily situated on the Halifax campus and live off-campus (not in residence halls). Please participate only if you belong to this group.

The objective of this survey is to gain insight into the habits, perceptions and intentions of food waste within the community of Dalhousie students living off-campus. We will perform a comparative analysis of students enrolled in Environmental Science/Sustainability and students enrolled in other programs regarding these factors. Further, within the group of students studying Environmental Science/Sustainability, we will perform a comparative analysis of these factors between the different years of study.

If you choose to participate in this research, you will be asked to answer questions regarding your food waste habits, perceptions, and intentions in an anonymous online survey. The survey should take approximately 5 minutes to complete.

To thank you for your time you can choose to enter a draw for a chance to win a $25 gift card to The Trail Shop at the end of the survey. Your contact information for the draw will not be linked to your survey responses.

This study was reviewed and approved by the Department of Earth and Environmental Sciences at Dalhousie University.

You should discuss any questions you have about this study with Stella Cimicata (st457929@dal.ca) and Supervisor Caroline Franklin. Please ask as many questions as you like before or after participating.

Your responses to the survey will be anonymous. This means that there are no questions in the survey that ask for identifying details such as your name or email address. All responses will be saved on a secure Dalhousie server. Only the Here for B.E.E.R. team will have access to the survey results and these will be deleted on April 30th.

Your participation in this research is entirely your choice. You do not have to answer questions that you do not want to answer (by selecting prefer not to answer), and you are welcome to stop the survey at any time if you no longer want to participate. All you need to do is close your browser. We will not include any incomplete surveys in our analyses. If you do complete your survey and you change your mind later, we will not be able to remove the information you provided as we will not know which response is yours.

The risks associated with this study are no greater than those you encounter in your everyday life.

We will describe and share the general findings of this research in a presentation and a report.

- ☐ I consent to complete this survey
- ☐ I do not consent to complete this survey (survey is submitted if this is selected so non-consenting participants cannot continue with the questions)

APPENDIX C

Survey Promotion Materials


How much food do you waste?
If you are an undergraduate student at Dalhousie living off-campus, please fill out the survey for a chance to win a $25 Trail Shop gift card!
5 minutes!
This research was reviewed and approved by the department of Earth & Environmental Science at Dalhousie University.
If you have any questions, please contact ml290811@dal.ca
Scan the QR code to participate!
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