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Navigating the relationships among food waste practices, environmental intentions, and sustainability knowledge of students

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Navigating the relationships among food waste practices, environmental intentions, and sustainability knowledge of students

An Honors Thesis submitted in partial fulfillment of the requirements for Honors in *Civil Engineering.*

By
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ABSTRACT

Colleges and university campuses are among the greatest food wasters in the US due to combined over production and plate waste from consumers. While some schools have developed programs aimed at reducing and sustainably managing food waste, much of it ends up in landfills and produces greenhouse gas emissions. The overall goal of the research was to collect a comprehensive data set on university students' food waste practices and behavior, environmental and sustainability knowledge, and environmental intentions. For probing relationships among these drivers, a structural equation model and student survey was developed. The survey of 37 questions was collected on 121 students. The model revealed that awareness of greenhouse gas emissions, waste management, and awareness that sustainable food waste handling had a positive impact on environmental attitudes. The intention to practice sustainable food waste management positively impacted on the estimated food waste per meal, the effect of food waste practices, and the desire to more sustainably manage food waste. Our structural equation model will help us understand more about the food waste perceptions of the students who eat at the dining halls on campus. This work will ultimately garner significant insight about how to provoke meaningful participation in reducing greenhouse gas emissions from landfills and develop sustainable food waste practices through educational information and resources.

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1.0 Introduction

Americans waste approximately 300 kg of food per capita yearly or USD$ 165 billion worth of food (Figure 1).[1–3] College and university campuses account for a large portion of this food waste, with approximately 22 million pounds of food annually across the US disposed of in landfills.[2] The food waste on these campuses is mainly due to the buffet style way they serve their food along with plate waste. This preparation style is ideal for serving large numbers of people in a small amount of time, but often leads to over preparation along with students getting more food than they eat. Efforts have been developed over the past few years to sustainably manage generated food waste.[4] However, little work has been done to systematically investigate food waste practices through student surveys to gauge their perceptions, attitudes, and practices. Exploring relationships among food waste practices, environmental intentions, and sustainability knowledge of students can help to develop sustainable solutions and intervention practices.

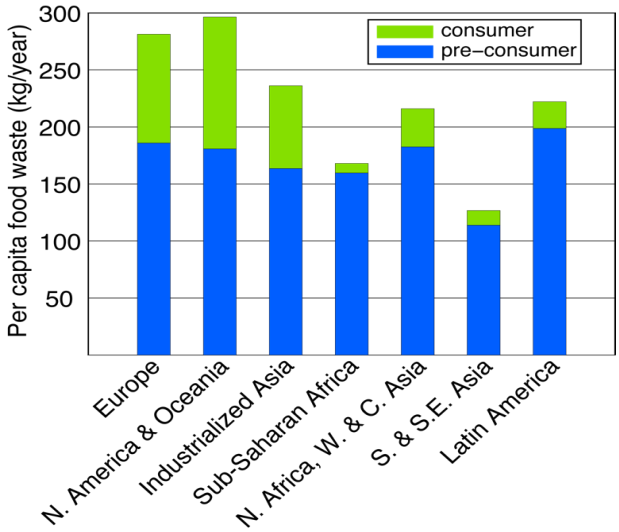

Figure 1. Per capita food waste by region based on consumer and pre-consumer. Pre-consumer waste encompasses all food that is discarded before it reaches the consumer, and post-consumer waste refers to any food that is thrown away after being served to customers.[1]

To probe diverse factors that influence food waste practices, various statistical techniques could be used. For observed data that can be directly measured, t-test and linear models are commonly used.[5] However, studying complex interconnect relationships among both observed and latent variables requires more advanced statistical or modeling tools. For example, structural equation modeling (SEM) is a statistical tool that uses a hypothesis-testing approach to the analysis of a structural theory bearing on some phenomenon.[6] Causal processes that are under study are represented by a series of structural equations. Structural relations can then be modeled pictorially to enable a clearer conceptualization of the theory being studied. A hypothesized model is tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. If goodness-of-fit is met, the model argues for plausibility of the postulated relations among variables. If not, the tenability of such relations is rejected. SEM takes a confirmatory approach to the data analysis that can incorporate unobserved (latent) and observed variables. Structural equation modeling only started to be used across disciplines in the 1990s and has been used by a handful of researchers to explore food waste practices; none of these studies focus on students as the study population.

The overall goal of this thesis is to gather and analyze data collected from the survey and explore opportunities for advancement of students in preventing food waste from going to landfills. First, a conceptual model based on the existing body of knowledge was compiled to create the conceptual SEM. The survey has been thoughtfully designed to probe several variables relating to knowledge on advanced resource recovery, food waste practices, intentions to practice sustainable food waste

management, sustainable food waste management behavior, environmental attitude, awareness of greenhouse gas emissions and waste management, desire to more sustainably manage food waste, and awareness of sustainable food waste handling. Each of the latent variables has been analyzed using observed variables collected by the survey. Several hypotheses were involved in this study relating factors that influence food waste. Specifically, knowledge on resource recovery will have a positive impact on the environment; awareness of greenhouse gas emissions, waste management, and awareness of sustainable food waste handling will have a positive impact on environmental attitude; the type of diet a person has determines their environmental attitude; and the intention to practice sustainable food waste management will positively impact on the estimated food waste per meal, the effect of food waste practices, and the desire to more sustainably manage food waste. This work leveraging SEM will allow significant insight about how to provoke meaningful participation of students in preventing food waste from going to landfill by providing educational information and resources.

2.0 Materials and Methods

2.1 Hypothesized structural equation model and survey design

The conceptual SEM, with hypothesized relationships between variables, was developed based on a review of existing literature on factors influencing food waste practices.[4,7–10] Figure 2 shows the hypothesized model. Variables and pathways that are novel include knowledge on resource recovery, diet, estimated food waste per meal, and food waste practices. For example, one hypothesized relationship is that knowledge on advanced resource recovery positively influences environmental attitude, while environmental attitude in turn correlates with the intention to practice sustainable food waste management. A survey questionnaire was developed specifically for this research, modeled after previously developed questionnaires on food waste perceptions and practices. The survey is included in Appendix A. The survey aimed to gather information on the key variables in the hypothesized model, with latent variables comprised of at least three indicator questions or measures.

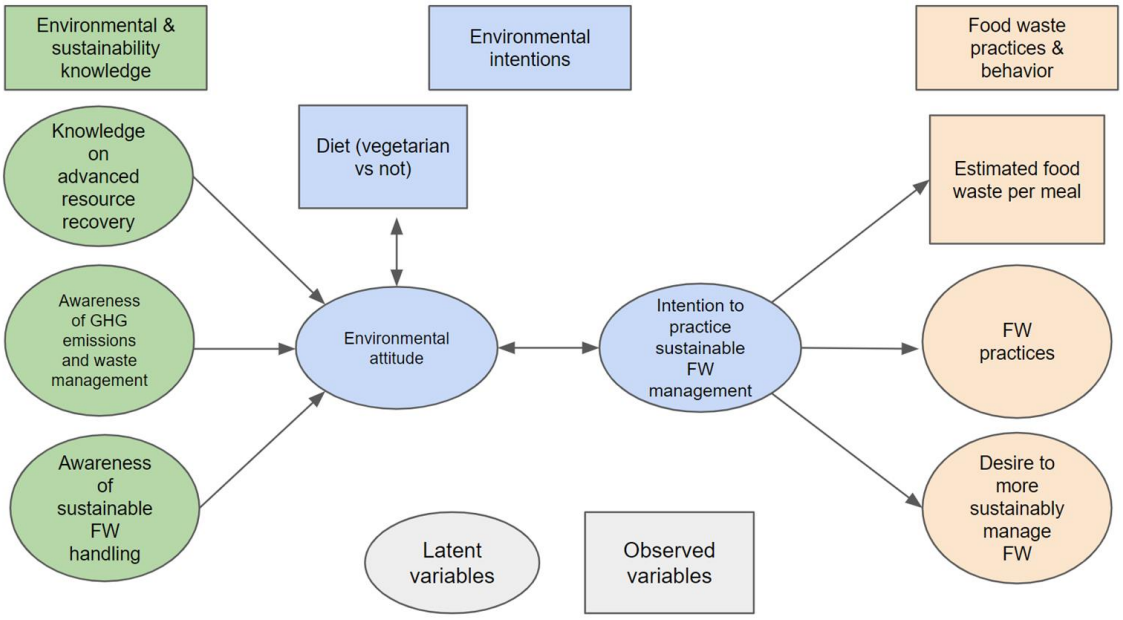

Figure 2. Hypothesized structural equation model where latent variables are included in bubbles and observed variables are boxes. Variables were developed around the centralized themes of environmental and sustainability knowledge, environmental intentions, and food waste practices and behavior.

2.2 Survey implementation

The survey was administered with the goal of collecting data from a representative sample of students who eat at the dining halls on the Georgia Southern University campus. The target sample size was approximately 150 participants to ensure sufficient statistical power for the structural equation modeling analysis. To recruit participants, the survey was advertised through multiple channels. Flyers were posted in the university dining halls, in classrooms, and on public bulletin boards across campus. The flyers provided a brief description of the study and a QR code or link to access the online survey. The survey was administered online using Qualtrics and was available for completion during a four-week period in Spring 2024. Participants could complete the survey using their smartphones, tablets, or computers at their convenience. The first page of the survey provided information about the study objectives, assured participants of the

confidentiality of their responses, and obtained informed consent. In addition to collecting data on students' food waste perceptions and practices, the survey also served as an educational tool by including information about the environmental impacts of food waste and tips for reducing and managing food waste on campus and at home. This information was provided at the end of the survey to avoid biased responses. To encourage participation and reduce the likelihood of missing data, several strategies were employed. First, the survey was designed to be brief and user-friendly, with an estimated completion time of 10-15 minutes. Second, participants had the option to save their progress and complete the survey in multiple sittings. A total of X students completed the survey. The collected data were screened for missing values and outliers before being analyzed using SEM.

2.3 Factor loadings

Before testing the SEM, confirmatory factor analysis (CFA) was conducted to assess the measurement model and determine the factor loadings of the observed variables onto their respective latent variables. Factor loadings represent the strength and direction of the relationship between an observed variable and its corresponding latent variable. CFA was performed using the lavaan package in R.[11] The code used for the CFA is provided in Appendix B. For each latent variable, a separate CFA model was specified, with the observed variables set to load onto their respective latent variable. The loading of the first observed variable for each latent variable was fixed to 1 to set the scale of the latent variable.

2.4 Structural equation modeling

SEM was conducted using the R programming language and the R Studio integrated development environment. The lavaan package in R was used for the SEM analysis.[11] Lavaan (latent variable analysis) is a widely used package for structural equation modeling, path analysis, and confirmatory factor analysis. It provides a flexible and powerful framework for specifying, estimating, and evaluating structural equation models.

The first step in the SEM analysis was to create a model specification syntax using the lavaan package. The model syntax defines the relationships between the latent and observed variables, as well as the paths between the latent variables. The hypothesized structural equation model (Figure 2) was translated into the lavaan model syntax, specifying the measurement model (relationship between observed and latent variables) and the structural model (relationships between latent variables). Next, the data from the survey were read into R and combined with the objectively measured variables (e.g., estimated food waste per meal, measured sustainability knowledge). The data were then screened for missing values and outliers, and descriptive statistics were computed to check for any anomalies.

The lavaan package was then used to estimate the parameters of the structural equation model using maximum likelihood estimation. The fit of the model to the data was assessed using several fit indices, including the comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). These indices provide information about how well the model reproduces the observed covariance matrix. Once the final model was established, the path coefficients (i.e., standardized regression weights) and their statistical significance were examined to

interpret the relationships between the latent variables. Indirect effects (i.e., the effect of one variable on another through a mediating variable) were also assessed using the lavaan package. The R code used for the SEM analysis, along with the model output and fit indices, is provided in Appendix C to ensure transparency and reproducibility of the results.

3.0 Results and Discussion

3.1 Latent variables and factor loadings

3.1.1 Knowledge on advanced resource recovery

For the latent variable of knowledge on advanced resource recovery, five questions were asked to probe students' understanding of various resource recovery opportunities (Table 1). Three of the questions loaded on the latent variable. Specifically, the questions that loaded (loading > 0.4 and p-value < 0.05) were related to familiarity with anaerobic digestion, biogas production, and circular economy. The questions that did not load were based on how familiar students are with recycling plastics, paper, and glass wastes and composting food waste.

3.1.2 Food waste practices

For the latent variable of food waste practices, four questions were asked to probe students' participation in various food waste practices (Table 1). Two of the questions loaded on the latent variable. Specifically, the questions that loaded were gauging if students think it's important to avoid wasting food in their household and if they would like to do more to avoid wasting food in their household. The questions that did not load were asking if students would waste less food if they had planned their purchases more carefully and if they waste food when they go out to eat with friends/family.

3.1.3 Intentions to practice sustainable food waste management

For the latent variable of intentions to practice sustainable food waste management, three questions were asked to probe intentions of the students to practice sustainable food

waste practices (Table 1). All three of the questions loaded on the latent variable. The questions that loaded were asking students whether they separate their food waste at home, dining halls, or restaurants regularly if there are food waste collection measures; if they plan to participate in food waste separation at home, dining halls, or restaurants; if they're satisfied with the food waste collection measures; if they try to separate their food waste at home, dining halls, or restaurants; and if they're convinced with the benefits of food waste separation at home.

3.1.4 Sustainable food waste management behavior

For the latent variable of sustainable food waste management behavior, four questions were asked to probe students' behavior regarding sustainable food waste management (Table 1). All of the questions loaded on the latent variable. The first two questions that loaded were asking if students regularly recycle certain parts of my waste by selling them to the recyclable waste collectors or putting them inside the recyclable item bins provided by the local authority. The other two questions asked if students attempted to reduce the amount of waste at my home or in the dining halls and if they regularly disposed of all their food waste separately from other wastes.

3.1.5 Environmental attitude

For the latent variable of environmental attitude, five questions were asked to probe students' environmental attitudes (Table 1). Four of the questions loaded on the latent variable. Specifically, the questions that loaded were asking if it's important to student's that the products they use don't harm the environment, if they consider the environmental

impacts of my activities, if they're concerned about the waste of resources, and if they consider themselves to be conscious of the environment. The question that didn't load was asking if students were willing to accept inconveniences for being more environmentally friendly.

3.1.6 Awareness of greenhouse gas emissions and waste management

For the latent variable of awareness of greenhouse gas emissions and waste management, five questions were asked to probe students' awareness of greenhouse gas emissions and waste management (Table 1). All five of the questions loaded on the latent variable. Students were asked whether or not they agree, strongly agree, disagree, or strongly disagree. The questions that loaded were related to awareness of the impact of greenhouse gas emissions on the environment and awareness of the implications of unplanned or illegal waste disposal on the environment. Students were also asked if they have heard about the contribution of greenhouse gas emissions in the waste management sector. Lastly, students were asked if they believe waste management disposal threatens environmental health and if they believe more sustainable waste management can reduce greenhouse gas emissions.

3.1.7 Desire to more sustainably manage food waste

For the latent variable of desire to more sustainably manage food waste, six questions were asked to probe students' desire to more sustainably manage food waste (Table 1). Five of the questions loaded on the latent variable. Specifically, the questions that loaded were asking if students actively take steps to reduce food waste in your household, if they

have a desire to more sustainably manage my food waste, if they do their best to empty their plate, if they try not to leave food on their plate, and if they intend to reduce their food waste. The question that did not load asked if students somewhat expected to have leftovers.

3.1.8 Awareness of sustainable food waste handling

For the latent variable of awareness of sustainable food waste handling, three questions were asked to probe students' awareness of sustainable food waste handling (Table 1). All of the questions loaded on the latent variable. Specifically, the questions that loaded were related to student's awareness about local recycling programs, local composting initiatives, and landfills in the Bulloch County area.

Table 1. Indicator variables are shown with their relative latent variables and calculated standardized loading and p-value.

indicator/question	latent variable	loading	p-value
How familiar are you with anaerobic digesters?	Knowledge on advanced resource recovery	0.856	<0.001
How familiar are you with biogas production?	Knowledge on advanced resource recovery	0.610	<0.001
How familiar are you with the term “circular economy”?	Knowledge on advanced resource recovery	0.477	<0.001
I think it’s important to avoid wasting food in my household.	Food waste practices	1.000	<0.001
I’d like to do more to avoid wasting food in my household.	Food waste practices	0.257	<0.001
I intend to separate my food waste at home, dining halls, or restaurants regularly if there are food waste collection measures.	Intentions to practice sustainable food waste management	0.727	<0.001
I plan to participate in food waste separation at home, dining halls, or restaurants if I am satisfied with the food waste collection measure.	Intentions to practice sustainable food waste management	0.791	<0.001
I will try my best to separate my food waste at home, dining halls, or restaurants if I am convinced of the benefits of food waste separation at home.	Intentions to practice sustainable food waste management	0.884	<0.001
I regularly recycle certain parts of my waste by selling them to the recyclable waste collectors.	Sustainable food waste management behavior	1.082	<0.001
I regularly recycle certain parts of my waste by putting them inside the recyclable item bins provided by the local authority.	Sustainable food waste management behavior	0.762	<0.001
I always attempt to reduce the amount of waste at my home or in the dining halls.	Sustainable food waste management behavior	0.552	<0.001
I regularly disposed of all my food waste separately from other wastes.	Sustainable food waste management behavior	1.035	<0.001
It is important for me that the products that I use do not harm the environment.	Environmental attitude	0.802	<0.001
I generally consider the environmental impacts of my activities.	Environmental attitude	0.845	<0.001
I am concerned about the waste of resources.	Environmental attitude	0.568	<0.001
I would consider myself to be conscious of the environment.	Environmental attitude	0.785	<0.001
Are you aware of the impact of greenhouse gas emissions on the environment?	Awareness of greenhouse gas emissions and waste management	0.599	<0.001
Have you heard about the contribution of greenhouse gas emissions in the waste management sector?	Awareness of greenhouse gas emissions and waste management	0.616	<0.001
Are you aware of the implications of unplanned or illegal waste disposal on the environment?	Awareness of greenhouse gas emissions and waste management	0.664	<0.001
Do you believe waste management disposal threatens environmental health?	Awareness of greenhouse gas emissions and waste management	0.781	<0.001
Do you believe more sustainable waste management can reduce greenhouse gas emissions?	Awareness of greenhouse gas emissions and waste management	0.796	<0.001
I actively take steps to reduce food waste in your household.	Desire to more sustainably manage food waste	0.504	<0.001
I have a desire to more sustainably manage my food waste.	Desire to more sustainably manage food waste	0.587	<0.001
I do my best to empty my plate.	Desire to more sustainably manage food waste	0.832	<0.001
I generally try not to leave food on my plate.	Desire to more sustainably manage food waste	0.911	<0.001
I intend to reduce my food waste.	Desire to more sustainably manage food waste	0.707	<0.001
I am aware of local recycling programs.	Awareness of sustainable food waste handling	1.344	<0.001
I am aware of local composting initiatives.	Awareness of sustainable food waste handling	1.098	<0.001
I am aware of landfills in my area.	Awareness of sustainable food waste handling	0.934	<0.001

3.2 Structural equation model

Confirmatory analysis approach was used to analyze the structural theory of the survey answers. Confirmatory analysis is a multivariate statistical procedure that is used to test how well the measured variables represent the number of constructs. An advantage of SEM is that models can be composed of both observed and latent variables. Observed variables consist of one simple quantitative question. Latent variables on the other hand, are a multitude of questions that will help probe the surveyor's thoughts about one variable. For example, our first variable had five questions asked to gather what knowledge the student filling out the survey had about advanced resource recovery. CFA and SEM allow for exploring pathways. The implied correlation matrix solved based on observed correlation matrix goodness-of-fit suggests for plausibility of hypothesized relationships. A clear conceptualization of the theory under study can be revealed once this is complete. The study showed five significant pathways and three non-significant pathways (Figure 3).

3.3 Significant pathways

All of the solid lines on the graph below represent significant positive relationships between variables being probed during the study. The significant pathways in the SEM are:

- Awareness of greenhouse gas emissions and waste management has a positive influence on environmental attitude. As awareness of greenhouse gas emissions and waste management increases, environmental attitude by 0.647, holding all other variables constant.

- Awareness of sustainable food waste handling has a positive influence on environmental attitudes. As awareness of sustainable food waste handling increases, environmental attitude increases by 0.163, holding all other variables constant.
- Diet (vegetarian or not) and environmental attitude have a mutual positive influence on each other. These two variables have a positive awareness of 3.428 on each other.
- Environmental attitude and intention to practice sustainable food waste management have a mutual positive influence on each other. These two variables have a positive awareness of 0.135 on each other.
- Intention to practice sustainable food waste management has a positive influence on someone's food waste practices. As intentions to practice sustainable food waste management increase, food waste practices increase by 0.389, holding all other variables constant.

The SEM revealed several significant relationships among key factors influencing food waste practices and attitudes. Notably, awareness of greenhouse gas emissions, waste management, and sustainable food waste handling all positively impacted environmental attitudes. This suggests that educating students about the environmental consequences of food waste and proper waste management techniques can help foster pro-environmental attitudes on campus. Interestingly, a vegetarian diet was found to mutually reinforce positive environmental attitudes, indicating that dietary choices and sustainability mindsets are closely linked. The intention to practice sustainable food waste management was directly influenced by environmental attitudes and in turn had a strong positive effect

on actual food waste reduction practices. Taken together, these results highlight the importance of raising awareness and shifting attitudes to promote sustainable food waste behaviors among students.

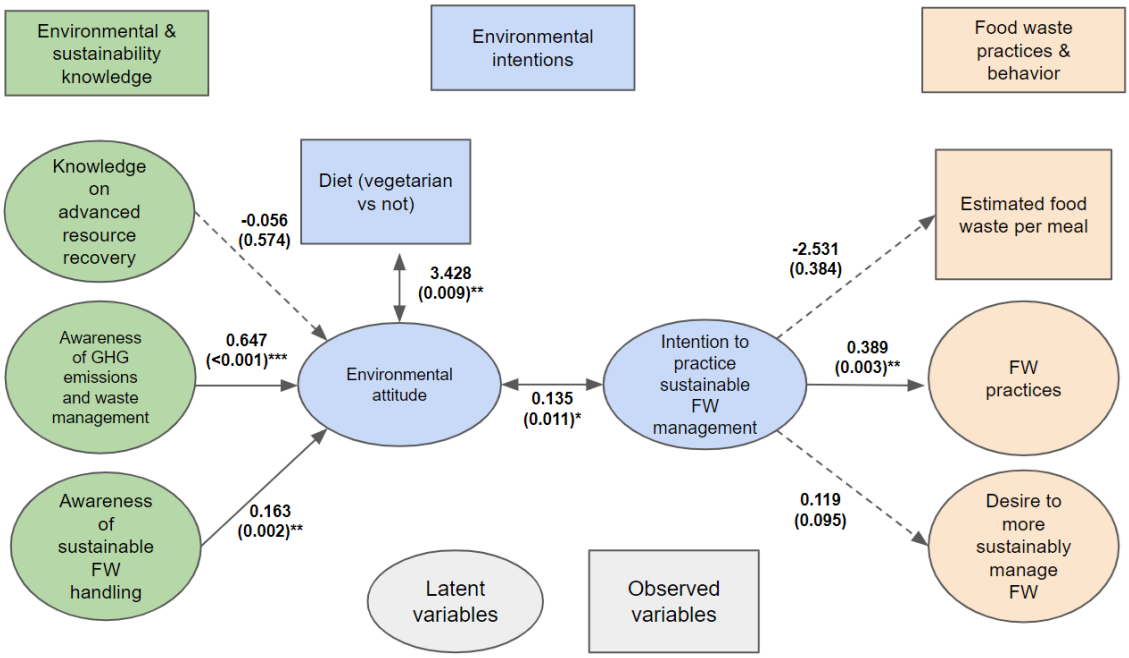

Figure 3. Structural equation model with path values. The top number on each path is the standardized path value, and the bottom number is the p-value. Paths with significant p-value of less than 0.05 are shown as solid. Dashed paths are non-significant.

3.4 Implications to sustainable food waste practices

The findings from this study have important implications for reducing food waste and associated greenhouse gas emissions on college campuses. Foremost, the results underscore the need for educational initiatives to increase student awareness about the environmental impacts of food waste and equip them with practical food waste reduction strategies. This could include information campaigns, workshops, cooking classes focused on using leftovers, and improved signage in dining halls promoting mindful consumption. Cafeterias should also explore offering more flexible portion sizes,

eliminating trays, and implementing effective composting programs to minimize waste. At an institutional level, colleges can partner with local farms and food banks to donate excess food. Lastly, schools should leverage the link between vegetarian diets and pro-environmental attitudes by providing more plant-based options and encouraging sustainable eating. By implementing multi-pronged approaches targeting awareness, attitudes, and infrastructure, universities can meaningfully engage students in food waste reduction.

3.5 Future work

To build upon this research, future studies should aim to collect food waste data from a larger and more diverse sample of college campuses to assess the generalizability of the findings. The structural equation model could be further refined by exploring additional factors, such as social norms, perceived behavioral control, and situational constraints that may influence food waste behaviors. Future work should also evaluate the effectiveness of specific food waste reduction interventions on college campuses through experimental or quasi-experimental designs. Conducting qualitative research, such as focus groups or interviews, could provide deeper insights into students' experiences and barriers related to food waste. Finally, researchers should investigate food waste reduction strategies that resonate with other key stakeholders, including dining hall staff, university administrators, and local food service providers. By expanding the scope of research and engaging diverse stakeholders, we can develop more holistic and impactful solutions to the pressing problem of food waste on college campuses.

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Appendix A

Survey Questions-

Q1 How familiar are you with anaerobic digesters?
Q2 How familiar are you with biogas production?
Q3 How familiar are you with composting food waste?
Q4 How familiar are you with recycling plastics, paper, and glass wastes?
Q5 How familiar are you with the term “circular economy”, i.e., a system where materials
Q6 On a scale from 0 to 100%, what percentage of your diet do you estimate to be plant-based or vegetarian (0 being “all meat or animal product diet” and 100% being “all plant-based vegetarian diet)?
Q7On a scale from 0 to 100%, what percentage of scraps or waste from one plate do you usually throw away after a meal on average? (25% of one plate gets thrown away)
Q8 I think it’s important to avoid wasting food in my household.
Q9 I’d like to do more to avoid wasting food in my household.
Q10 I’d waste less food if I planned my purchases more carefully.
Q11 I waste food when I go out with my friends/family.
Q12 I intend to separate my food waste at home, dining halls, or restaurants regularly if there are food waste collection measures.
Q13 I plan to participate in food waste separation at home, dining halls, or restaurants if I am satisfied with the food waste collection measure.
Q14 I will try my best to separate my food waste at home, dining halls, or restaurants if am convinced with the benefits of food waste separation at home
Q15 I regularly recycle certain parts of my waste by selling them to the recyclable waste collectors
Q16 I regularly recycle certain parts of my waste by putting them inside the recyclable item bins provided by the local authority
Q17 I always attempt to reduce the amount of waste at my home or in the dining halls
Q18 I regularly disposed all my food waste separately from other wastes
Q19 It is important for me that the products that I use do not harm the environment
Q20 I generally consider the environmental impacts of my activities
Q21 I am concerned about the waste of resources
Q22 I am willing to accept inconveniences for being more environmentally friendly
Q23 I would consider myself to be conscious of the environment
Q24 Are you aware of the impact of greenhouse gas emissions on the environment?
Q25 Have you heard about the contribution of greenhouse gas emissions in the waste management sector?
Q26 Are you aware of the implications of unplanned or illegal waste disposal on the environment?
Q27 Do you believe waste management disposal threatens environmental health?
Q28 Do you believe more sustainable waste management can reduce greenhouse gas emissions?
Q29 I actively take steps to reduce food waste in your household
Q30 I have a desire to more sustainably manage my food waste.
Q31 I do my best to empty my plate

Q32 I generally try not to leave food on my plate
Q33 I somewhat expect to have leftovers [reversed measurement]
Q34 I intend to reduce my food waste
Q35 I am aware about local recycling programs
Q36 I am aware of local composting initiatives
Q37 I am aware of landfills in my area

Appendix B

```
library(lavaan) # needed for CFA and latent variable analysis
library(psych) # needed for testing normality
library(dplyr)
library(tidyverse)
library(QuantPsyc)
library("readxl")

library(readxl)
data_food_waste <- read_excel("Dropbox/My Mac (Lewiss-
MBP.lan1)/Documents/GeorgiaSouthern/Research/Projects/EPA_AD_2022-
2024/SEM_Food_Waste/20240318foodwaste_data.xlsx", sheet = "cleaned")

# CFA Analysis

# Knowledge on resource recovery (krr)
krr_cfa <- ' krr=~ NA*Q1 + Q2 + Q5
            krr~~ 1*krr'
krr_cfa_fit <- cfa(krr_cfa, data = data_food_waste)
summary(krr_cfa_fit, fit.measures = TRUE)

# Food waste practices (fwp)
#Q11 removed
fwp_cfa <- ' fwp=~ Q8 + Q9
            fwp~~ 1*fwp'
fwp_cfa_fit <- cfa(fwp_cfa, data = data_food_waste)
summary(fwp_cfa_fit, fit.measures = TRUE)

# Intention to practice sustainable food waste management  (ipsfwm)
ipsfwm_cfa <- ' ipsfwm=~ NA*Q12 + Q13 + Q14
            ipsfwm~~1*ipsfwm'
ipsfwm_cfa_fit <- cfa(ipsfwm_cfa, data = data_food_waste)
summary(ipsfwm_cfa_fit, fit.measures = TRUE)

# Sustainable food waste management behavior (sfwm)
sfwm_cfa <- ' sfwm=~ NA*Q15 + Q16 + Q17 + Q18
            sfwm~~1*sfwm'
sfwm_cfa_fit <- cfa(sfwm_cfa, data = data_food_waste)
summary(sfwm_cfa_fit, fit.measures = TRUE)

# Environmental attitude (ea)
ea_cfa <- ' ea=~ NA*Q19 + Q20 + Q21 + Q23 + Q23
            ea~~1*ea'
ea_cfa_fit <- cfa(ea_cfa, data = data_food_waste)
summary(ea_cfa_fit, fit.measures = TRUE)
```

```
# Awareness of greenhouse gas emissions and waste management (aghg)
aghg_cfa <- ' aghg=~ NA*Q24 + Q25 + Q26 + Q27 + Q28
            aghg~~1*aghg'
aghg_cfa_fit <- cfa(aghg_cfa, data = data_food_waste)
summary(aghg_cfa_fit, fit.measures = TRUE)

# Desire to more sustainably manage food waste (dsmfw)
dsmfw_cfa <- ' dsmfw=~ NA*Q29 + Q30 + Q31 + Q32 + Q34
            dsmfw~~1*dsmfw'
dsmfw_cfa_fit <- cfa(dsmfw_cfa, data = data_food_waste)
summary(dsmfw_cfa_fit, fit.measures = TRUE)

# Awareness of sustainable food waste handling (asfwh)
asfwh_cfa <- ' asfwh=~ NA*Q35 + Q36 + Q37
            asfwh~~1*asfwh'
asfwh_cfa_fit <- cfa(asfwh_cfa, data = data_food_waste)
summary(asfwh_cfa_fit, fit.measures = TRUE)
```

Appendix C

```
library(lavaan) # needed for SEM and latent variable analysis
library(psych) # needed for testing normality
library(tidyverse)
library(QuantPsyc)
library("readxl")


# SEM Analysis
# Knowledge on resource recovery (krr)
# Food waste practices (fwp)
# Intention to practice sustainable food waste management  (ipsfwm)
# Sustainable food waste management behavior (sfwm)
# Environmental attitude (ea)
# Awareness of greenhouse gas emissions and waste management (aghg)
# Desire to more sustainably manage food waste (dsmfw)
# Awareness of sustainable food waste handling (asfwh)

data_food_waste <- read_excel("Dropbox/My Mac (Lewiss-
MBP.lan1)/Documents/GeorgiaSouthern/Research/Projects/EPA_AD_2022-
2024/SEM_Food_Waste/20240318foodwaste_data.xlsx", sheet = "cleaned")


# Create latent/observed variables
sem_model <- '

krr=~ Q1 + Q2 + Q5
fwp=~ Q8 + Q9
ipsfwm=~ Q12 + Q13 + Q14
sfwm=~ Q15 + Q16 + Q17 + Q18
ea=~ Q19 + Q20 + Q21 + Q23 + Q23
aghg=~ Q24 + Q25 + Q26 + Q27 + Q28
dsmfw=~ Q29 + Q30 + Q31 + Q32 + Q34
asfwh=~ Q35 + Q36 + Q37



# Pathways between latent/observed variables
ea ~ krr + aghg + asfwh
Q7_1 ~ ipsfwm
fwp ~ ipsfwm
dsmfw ~ ipsfwm

#correlation
ea ~~ Q6_1
```

```
ipsfwm ~~ ea
'

# Fit the SEM model and output a summary
fit_sem_model <- sem(sem_model, data = data_food_waste)
summary(fit_sem_model, standardized=TRUE, fit.measures=TRUE)

# RStudio Code for a display of the SEM
#semPaths(fit_sem_model, whatLabels = "std", layout = "tree", residuals = FALSE)

# covariance matrix
#fitted(fit_sem_model)
```