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To the office of Contracts and Grants:

Food Waste – a Problem or a Solution?

A New Approach to Reducing Food Waste and Food Insecurity on University Campuses

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Executive Summary

Table of Contents

Table of Figures

Problem Statement

Our society faces a moral paradox. In 2020, 690 million people were undernourished [10], yet every year roughly one-third of all edible food produced is lost or wasted [11]. This inefficiency is due to the interaction of many elements and activities in the food supply chain [12], and these losses are detrimental to human, financial, and environmental wellbeing. Therefore, it is in the best interest of our society to find a solution to optimize this supply chain.

In only six weeks, a college campus can dispose of more than 1.5 tons of edible food waste [2]. At the same time, a recent study of college students showed that over 31 percent of college students are classified as food insecure [1]. One solution to reducing this waste is by redistributing it to individuals facing food insecurity, but the question of how to implement this arises. Another possibility would be the consideration of biofuel. Biofuel is an alternative energy source that reduces foreign oil dependency, reduces greenhouse gas emissions, and provides energy security [4]. Compost traditionally used for fertilizer sometimes contains compounds that lead to soil contamination [3]. Utilizing compost unfit for fertilizer to produce biofuel offers a sustainable waste-to-energy alternative for dealing with food waste [3]. However, traditional biofuel feedstock sources compete with the food sector, which has been highlighted as a major concern for production.

To combat food waste on the University of Florida's campus and beyond, we will be researching feasible ways to develop an app to distribute edible food waste to students facing food insecurity or cost-effective ways to convert composted food waste generated from dining halls into biofuel. By developing a notification system that will notify students whenever there is leftover food at events or dining halls, food waste on campus can be minimized while simultaneously providing healthy food to those in need. Furthermore, the possibility of utilizing compost for biofuel production eliminates food security concerns while still providing environmental and economic benefits. These options would positively impact the lives of staff and students not only at the University of Florida, but on campuses around the world, significantly decreasing the amount of waste generated.

Background Research

Introduction

Food is a global necessity, being both an integral factor of good health and a driving aspect of the economy. It is unsurprising that food is also an important aspect of the college experience, yet the contradicting problems of food waste and food insecurity plague universities around the world. In only six weeks, a college campus can dispose of more than 1.5 tons of edible food waste [2]. At the same time, a study done in 2020 showed that over 31 percent of college students are classified as food insecure, or lacking consistent access to food for an active and healthy life [1,5].

There have been many proposed solutions to such a paradox, including food redistribution as well as biofuel production. Food redistribution by technological means, through food sharing or the use of mobile applications, has been already been implemented at several universities with mixed results [6, 12]. Biofuel is a sustainable waste -to energy alternative that reduces foreign oil dependency, reduces greenhouse gas emissions, and provides energy security [3,4]. However, factors such as method of distribution and storage make food redistribution difficult. Furthermore, cost inhibits progress on implementing biofuel as a solution.

The purpose of our study is to investigate student thoughts and perceptions regarding food availability in order to gauge whether a messaging system or biorefinery is the proper solution to our problem.

Developing an app that will notify students whenever there is leftover food at events or dining halls, would help minimize food waste on campus while simultaneously providing healthy food to those in need. Furthermore, the possibility of utilizing compost for cost-effective biofuel production eliminates food security concerns while still providing environmental and economic benefits. By inquiring about student experiences with food on campus, our aim is to develop an approach to minimizing food waste/insecurity at the University of Florida and beyond.

Methods

Participants

Our team decided to conduct research using a voluntary online survey. In total, there were 76 responses. These participants were all students attending the University of Florida (UF). Demographic information was not asked of the survey participants, as it was not important to the topic of study. While food insecurity may be a plight that effects a more specific demographic, our group aimed to target student opinions on campus food waste reduction, which did not require us to analyze the general demographic of our responses.

Materials

The survey was made using the University of Florida Qualtrics survey generator, which is a survey engine available to every UF student. It gathers all of the responses in one place, providing graphs and other statistical tools to efficiently analyze the results. Containing seven questions, the survey asked for participants guess the quantity of campus food waste, as well as their own. It also assessed their knowledge and experience with food insecurity and campus food waste initiatives. Finally, the last couple of questions asked for an opinion on which solution would best benefit the campus, given two options:

- A text notification that that will notify students whenever there is leftover food at events or dining halls, redistributing the extra food to those in need and reducing waste generated.
- Research towards ways to convert composted food waste generated from dining halls into biofuel, and the possible construction of a biofuel plant on campus.

In the Appendix, I have provided the list of questions asked to each participant, along with given answer choices.

Procedure

As a group, we collaborated on a list of seven questions pertinent to our research. Using Qualtrics, we then created the digital survey using these questions. After publishing it, each group member distributed survey links, requesting responses through networking applications, such as Slack. It is worth noting that the survey was sent exclusively to workspaces/servers used by UF student organizations. The survey was left open for about six days, spanning from July 20th to July 26th. During this time, the survey accumulated 76 responses. Once the data collection process ended, we met as a group to review and analyze the results.

Results

The survey was distributed on applications used frequently by students at the University of Florida. As such the results shown in the first question confirmed that all survey participants were UF students.

Perceptions on Food Waste

Our study found that 97.37% of students believe that a moderate to large amount of food is wasted on college campuses each year (Figure 1). However, of the 76 respondents, 56.58% shared that they believe that they themselves waste only a small amount of food (Figure 1).
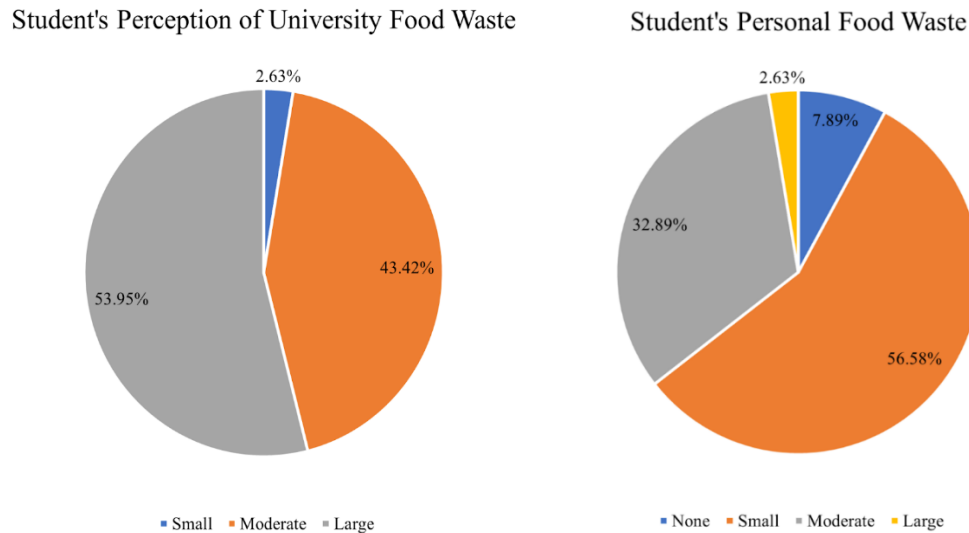

Figure 1: Student Perceptions of Food Waste

Experiences

When asked if aware of food waste initiatives on campus, only 9.21% of respondents were both aware and participated/utilized these resources, whereas 40.79% were completely unaware. Of the participants, a majority of 50% of students were aware but had not ever utilized these resources. Student responses on their experiences with food insecurity also provided some insight. Out of the 76 respondents, only 16.66% had experienced, or knew someone who experienced, food insecurity (Figure 2).

Opinions on Solutions

Given the choice between a food waste biorefinery and a messaging system to encourage food redistribution, a majority of 68.42% of participants were in support of the latter. Furthermore, 60.53% of students responded that they were highly likely to subscribe to text updates for free surplus meals from campus dining halls.

Figure 2: UF food insecurity among students

Patterns of Target Audience

Our research was mainly aimed towards finding information on those who have or know someone who has experienced food insecurity. Of the students who have experienced food insecurity, 75% were unaware of initiatives to combat the issue. The majority of this group (75%) also responded that they would consider subscribing to a surplus meal messaging system. Similarly, 71% of those who knew someone who had experienced food insecurity were also in support of this application (Figure 3).
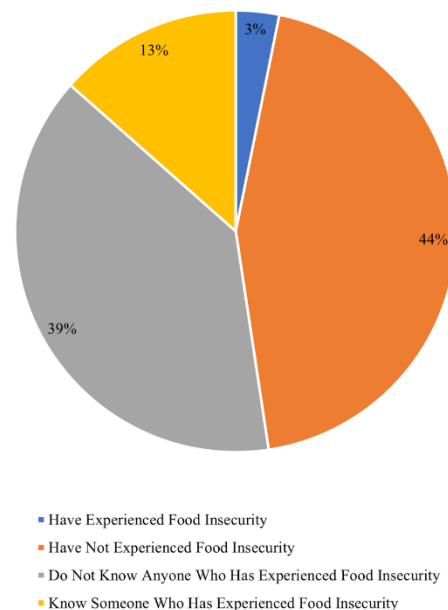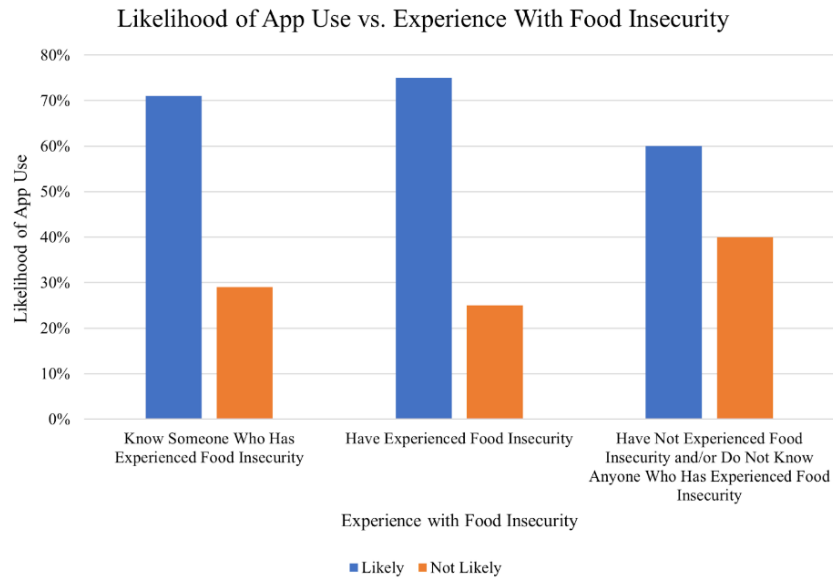
Figure 3: Pattern of experiences with food insecurity

Discussion and Conclusion

Based on the results of our survey, it is clear that the majority of students are aware of the issue of campus food waste and show a positive inclination towards the idea of setting up a message alert system to minimize such a concern (Figure 1).

Overall, student responses agreed that food waste was common on college campuses, even if they did not find it to be an issue concerning their own behavior (Figure 1). Similar results appeared in another study that had taken place in the United Kingdom. Lazell (2020) reported that students who participated in the study felt that as consumers they did not waste much food, citing personal reasons such as being 'too poor' to do so or the innate need to save money [6].

In section 3.3, results indicated that 68.42% of participants favored setting up a message alert system compared to research towards a biofuel refinery. This clarified research we gathered regarding the time and cost of implementing these ideas on a college campus. Just the construction of a biorefinery can cost up to about $224.2 million, and most research efforts are only in preliminary stages [7,8]. Although the price depends heavily on the type of biofuel, it is likely that efforts to separate the material may be even more difficult as it is not guaranteed to be homogenous. Implementing a text messaging system or app proves to be more cost-effective, often involving the development of an app or using existing resources for mass messaging, such as the learning management system provided by the university (ex. the "Free Food on Campus!" initiative) [9]. It is useful to know that while the cost strains of biofuel are evident, student opinion also supports that it would not be the best choice to implement.

Out of our results, only 16.66% had experienced or knew someone who had experienced food insecurity. This proved to be a conflicting statistic, as it was higher than the national average of 12.3% [1]. If our sample is an accurate representation of the student population, our findings support the fact that measures to combat food insecurity would be beneficial to the campus. There was also a correlation among those who had or knew of someone who experienced food insecurity, and the likelihood of them using an app/messaging system to receive surplus meals. In fact, among those

groups, the percentage of those who said they were likely to subscribe to surplus food messages was higher (Figure 3).

It is worth noting the limitations of the study performed, such as the sample size. The University of Florida has a population that is well above 30,000, thus may be unlikely that 76 individuals are an accurate representation of the student body. Furthermore, engineering students dominated the responses, as our distribution efforts extended mostly to engineering student organizations each member was involved with, which may have influenced the results in an unknown way. Other aspects such as socio-economic information, which we elected to not ask about, may also have an impact on the responses of our group. In future studies, it would be helpful to approach the topic from a socio-economic perspective, as well as extending the survey to allow for more responses.

While a cost-effective biofuel refinery may be not be feasible now, it is definitely something that may become more viable as research progresses. As for an immediate response to the issue of food waste, an app or messaging system proves to be something accessible and affordable to college students while also maintaining the original goal to reduce the amount of surplus food discarded.

Technical Plan
Research-Based Decisions

Through the research for this proposal, the team was able to narrow down our scope. First off, we had to determine if food waste was an issue on campus. Our assumption that it was an issue that needed a solution was supported by the findings of a study at the University of Florida which found that the Broward Dining Hall which is managed by Gator Dining Services reported that 576 pounds of food are wasted daily [19]. That means at least 43,200 pounds of food is wasted per semester at only one of the dining halls. Overall, the perceived amount of food being thrown away trends with a large amount of wasted food reported. This confirmed our purpose of the proposal.

We started off with two ideas to reduce food waste: a biofuel generator and a food redistribution system. The main issue with biofuel generation is the costs. The costs to operate the facility and to maintain it are higher than the budget allocates. In order to build a facility that produces biofuel at a profit, it would cost an average of 117 million dollars [18]. This is based on a biofuel generator that uses forest mass instead of food waste. Since using food waste to generate biofuel is an emerging technology and the research into developing biofuels from food waste is ongoing, the cost will inevitably increase. We have reached out to the campus Solid Waste Coordinator for comment on our findings thus far. Furthermore, the results from our survey revealed that students would rather have a text messaging service to reduce food waste rather than a biofuel generator. For these reasons, it was decided to focus on the text message notification proposal.

Then we moved on to our next solution which was the food redistribution to minimize waste. This system was intended to be an app but after considering the usability and effectiveness, it was decided to use a text messaging notification system instead. This system would address food insecurity on campus. With 17 percent of surveyed students indicating that they are food insecure or know someone who is, it is apparent that even in our small population of participants, that there is a need for a solution. This number aligns with a study stating that 15 percent of students were food insecure [20]. In order to alleviate food insecurity pressures, the development of a text messaging system will enable edible food waste to be eaten instead of discarded. Redistributing edible food waste to students has been done at

other universities. At Colorado State University, 500 students subscribed on the first day alone. The results in the survey we conducted indicate that students at the University of Florida are interested in enrolling in the text messaging system as well. More than half preferred this solution when compared to the biofuel generator and 61 percent stated that they would be either likely or very likely to enroll. For these reasons, it was decided that this is the proposal idea to expand upon.

In order to implement the text messaging service successfully, there are several more steps that need to be taken. We would have to determine which company to utilize for the text messaging service and ensure that it is user friendly and that people can be trained easily on how to send out the text messages. We have reached out to the Sustainability Manager for Gator Dining to determine the viability of our plan.

Location
Food Redistribution Location Consideration
The text messaging system is intended to reduce the amount of food waste thrown away while simultaneously addressing food insecurity on campus. Our intention for food distribution locations was for them to be established locations where the food originates from. This would aid in the convenience of picking up food and would streamline logistics of transportation should we have chosen to build a specific location. Another factor was food safety and maintaining the temperature of the food. The last factor determining if a location was viable is if the location was on campus.

Food Redistribution Location
After evaluating the outlined parameters for location availability, we evaluated potential locations. The one caveat that we have to consider is that events and vendors on campus selling or giving away food have variations in their location. For the top locations that remain at the same physical place, the dining halls are a viable location. The Gator Corner Dining and Broward Dining are buffet style dining halls that end up wasting food that could be redistributed. We have reached out to the Sustainability Manager for the Gator Dining Center and are awaiting her response to the viability of incorporating the dining halls in the food waste redistribution plan. The Reitz Union is the other permanent location on campus that would be an ideal location for food redistribution since there are multiple locations that have food waste as a byproduct. As for the locations that change depending on the vendor and event location, we suggest hiring a full-time employee within Event Services at the Reitz Union to coordinate and keep record of those locations.

Design
In order to design a system that works to the extent needed in order to effectively reduce food waste and address food insecurity, there are several factors that need to be considered. First and foremost, the users that will be picking up the food must easily be able to get the information they need quickly and effectively. A text messaging system notifies users immediately if there is food available for pick up. While we investigated using an app, it has several drawbacks. The app is required to be usable for both androids and apple products, and if the notifications are turned off, users will not be alerted when food

is available. These design flaws are the reason we preferred the text messaging system instead. In addition, the text messaging system allows the message being sent out to be modified. Specific instructions on where to pick up food can be conveyed easily. For example, the link to the address of a dining hall or even location can be sent out with the alert that there is food to be picked up. This will help ensure that users will be able to find the pick-up location easily. The message can also remind users to bring their own containers so that they will be able to transport the food from the pick-up location to their home, dormitory or apartment. The text messaging system will also have the functionality to unsubscribe from the service. This will be particularly useful for users that are moving out of the Gainesville area for reasons such as graduating or transferring schools. This would automatically take them off of the notification list and ensure that the target audience of students on campus will benefit from the service.

Marketing
<u>Opt-in messaging</u>
In order to mass-market the text messaging system to as many people at once, we decided the most efficient and effective option would be to use the text messaging system that many students are already subscribed to in order to raise awareness about this initiative. The current system is specifically designed as the UF Alert Notification system and we would consult the University of Florida's Department of Emergency Management, which runs the system in order to send the message.

<u>Posters for dining hall/Field & Fork/Compost stations</u>
The next method to spread awareness and market the text messaging system would be to strategically place posters with subscription information in locations where potential users of the text messaging service frequently visit. The specific locations would be the dining halls, the Food and Fork Pantry and the Student Compost Cooperative. Posters on the doors of the dining halls would ensure that students on campus that go to the dining halls would see the posters, become familiar with the cause, and subscribe to the service. Posters would also be located at the Food and Fork Pantry and the Student Compost Cooperative site as many of the people who are aware and use these initiatives would be interested in the purpose of the text messaging system.

<u>Flyers for dining halls and campus distribution</u>
Another method for marketing is to hand out flyers. Flyers can be distributed by volunteers at the beginning of the Spring 2022 semester. This will ensure that students will have a tangible form of the information necessary to determine whether or not they would like to enroll in the text messaging service. This can also be an opportunity for them to ask questions on how the process works if they have any concerns.

Budget and Schedule

Budget

The budget for the food surplus text notification system, as shown in Table 1, includes the cost of personnel, marketing materials, and the text messaging system. Personnel will be required to oversee notification operations and report food surpluses from dining halls and events to ensure timely notifications to students. To market and increase students' awareness of the notification system, posters, flyers, and opt-in messages will be utilized. Finally, Textedly™, a text message marketing service, will be used to send text notifications to students when there is surplus food available.

A technical coordinator will be hired to manage, schedule, and execute operations of the text notification system and will be paid an annual salary of $49,410 [13]. Additionally, employees at the dining halls will be trained on utilizing the notification system for twenty hours at minimum wage, $8.65 per hour [14]. To train ten employees will cost $1,730. The standard pay of dining hall employees has been excluded from the budget as it will be covered by the University. The total cost to employ a technical coordinator and train dining hall employees is $51,140 per year.

Posters will be displayed in University of Florida dining halls, at the Food & Fork Pantry, and at the #GatorsBEATWaste Station. The flyers will be distributed by volunteers around campus and placed on tables in the dining halls. To purchase four posters for the dining halls, two for the Food & Fork Pantry, and one for the #GatorsBEATWaste Station from Office Depot, at $12.99 per poster [15], will cost $90.93. As a starting point, 10,000 flyers will be purchased at 0.83¢ per copy [16], for a total of $8,300. The cost of opt-in messages will be incorporated into the text message marketing service and has been excluded from the marketing portion of the budget. The total cost of print marketing materials is $8,390.93.

A Textedly™ subscription, which includes 240,000 text messages for $2,800 per month [17], will be used to send opt-in and food surplus texts to students. The annual text limit is 2.88 million texts for $33,600. As the University of Florida currently utilizes a campus-wide text-alert system, this portion of the budget may need to be revised.

As shown in Figure 1, the total cost for the first year, including capital and operations costs, for the text notification system is $93,130.93. The cost of personnel may fluctuate annually depending upon employee turnover rates and the cost of the messaging system may vary depending upon the University of Florida's current messaging platform.

Food Surplus Notification System Budget

Personnel	Technical Coordinator		Training Dining Hall Staff		
	Salary	$49,410/yr	Hours		20
	-	-	PayRate		$8.65/hr
			Employees		10
	Total	$ 49,410.00	Total	$	1,730.00
			Total	**$**	**51,140.00**
Marketing	Posters @ $12.99/copy		Flyers @ 0.83¢/copy		
	Food & Fork (2)	$ 25.98	Number of Copies		10,000
	Dining Halls (4)	$ 51.96	-		-
	Compost Stations (1)	$ 12.99	-		-
	Total	$ 90.93	Total	$	8,300.00
			Total	**$**	**8,390.93**
Messaging System	Number of Messages		Cost		
	Per Month	240,000	Per Month	$	2,800.00
	Per Year	2,880,000	Per Year	$	33,600.00
			Total	**$**	**33,600.00**
Overall Cost			**Total**		**$93,130.93**

Table 1: Budget for Food Surplus Notification System

Schedule

Food surplus text notifications will begin at the start of the Spring 2022 semester. To meet this deadline, there will be coordination with the University, purchase of marketing materials, data collection of the University of Florida's Fall 2021 food waste, staff training, and opt-in messaging to students. Table 2 shows a comprehensive view of the schedule.

The first task will be coordinating with communications staff, dining hall employees, and catering coordinators at the end of the Summer 2021 semester. Correspondence will begin with the University of Florida Communications Team to gather information about the current campus-wide text messaging platform and budget. Also, the logistics of the notification system will be discussed with Dining Hall and Classic Fare Catering supervisors and coordinators for optimization. Next, to ensure ample time for the hiring process, the search for a Technical Coordinator will begin one week before the start of the Fall 2021 semester. It is imperative to fill the position early to allow adequate time for training and consulting on the logistics of the text notification system.

At the start of the Fall 2021 semester, data collection on the amount of food waste generated by the University will begin. This task is imperative to measuring the success of the text notification system in reducing food waste at the University. Mid-fall semester, marketing materials will be purchased to allow time for any printing errors or delivery complications. To avoid scheduling conflicts associated with holidays at the end of the Fall semester, employee training at the dining halls will take place on November 29 to December 3, 2021.

Posters will be displayed the week following Fall 2021 finals and flyers will be distributed during the first week of the Spring 2022 semester. Food surplus notification opt-in text messages will be sent to students one week before the start of the Spring 2022 semester. Students enrolled in the system will begin receiving food surplus notifications the first day of the Spring 2022 semester.

Task	8/9/21	8/16/21	8/23/21	10/17/21	11/29/21	12/2/21	12/20/21	12/27/21	1/5/22
Coordinate with UF communications team, dining halls, and Classic Fare Catering	■	■	■	■	■	■	■	■	■
Begin search for Technical Coordinator		■							
Begin gathering food waste data for Fall 2021			■						
Order posters and flyers				■					
Employee training for notification system					■				
Distribute and post marketing materials							■	■	■
Send opt-in text messages to students								■	
Begin notification messages for Spring 2022 to enrolled students									■

Table 2: Food Surplus Notification System Task Schedule

Evaluation Plan

Food Waste – a Problem or a Solution? is an initiative that will further contribute to overall campus sustainability, as well as student quality-of-life. Through the development of a text messaging and food redistribution system on campus, food waste from dining halls and campus events should decrease. Larger dining centers, such as Gator Corner and Broward Dining at the University of Florida, often maintain a buffet style selection of food. As such, there is uncertainty in the amount of food to prepare each day. Those who opt in for messaging will be notified when free surplus food is available at certain locations, targeting student food insecurity while also reducing food waste from each dining center. The reduction of costs to transport food waste to secondary locations is another benefit. However, there are some points to consider, such as effectively making sure students directly in need are aware of such an opportunity. Through advertising, we hope to ensure that news of our free subscription service reaches those who would benefit from it most. To ensure that the funds required of this project are being well-used, we have constructed the following evaluation plan to assess whether it is producing expected results. This plan consists of three main parts:

- Estimations of food waste data during the Fall semester versus the Spring semester
- Tallying of students who stop by to retrieve food
- Surveys to assess student satisfaction

Our plan is expected to be fully functional for the the Spring of 2022. This allows our group to use the 2021 Fall semester for gathering general data on the amount of food waste generated during a semester at the University of Florida. To help quantify this estimate by weight per month, we will be seeking aid from the campus Solid Waste Coordinator. We will then repeat this same process during the Spring semester, when our proposal is expected to be put in place. By comparing the food waste data, we will

be able to analyze whether or not there is a significant reduction in the amount of waste generated at campus dining halls before and after the implementation of the messaging system.

In addition, once the Spring semester begins, personnel running the areas where students pick up the surplus food will tally each time a student stops by to pick up food each day. Tallying will be performed at each dining location that is providing surplus food. Our group will compile all of the days at the end of the month and estimate average amount of students who actively use the system each day. While we may be able to count the number of students on the subscription list, there is no guarantee that every single person uses the system. Tallying will provide a realistic idea of how many people are actually retrieving food. This method of comparison can be used each month, to showcase how the system is positively benefitting the campus.

Each month a Qualtrics survey will also be sent out via the messaging system to assess student satisfaction. In these surveys, we want to inquire about the student's year of schooling, as well as opinions on functionality and food quality. Furthermore, we want to ask how students currently subscribed to the system heard/learned about the project. These surveys will also allow students to optionally suggest improvements or explain their complaints with the system. Reminders to complete the survey will be sent periodically. It is necessary in the effort to reduce food insecurity to make sure these students are receiving quality food. Through this survey we will gain information on those using the system, the effectiveness of our marketing methods, as well as customer satisfaction ratings.

Starting in the Spring, a progress report will be sent to the University of Florida once a month after compiling the above information. This report will include the above estimations on food waste generated each month from the campus dining halls, showing the comparison of the corresponding month during the Fall (ex. August vs. January; September vs. February). There will also be sections on the average amount students that come by each day at the dining halls to pick up surplus food, and relevant information from each monthly survey regarding the results of the marketing methods, and proof of satisfaction from students. Through this evaluation, the impact of our proposal should be accurately assessed, proving its benefit to the campus community.

Appendix

Survey Questions: Food Waste – a Problem or a Solution?

Are you currently a college student at the University of Florida?

- Yes
- No

How much food do you think is wasted on college campuses each year?

- None
- A small amount
- A moderate amount
- A large amount

How much food do you waste each year?

- None
- A small amount
- A moderate amount
- A large amount

Are you aware of food waste initiatives currently on campus, such as the Student Compost Cooperative (SCC) or UF's Field & Fork Pantry?

- Yes, I am aware and have participated in these initiatives or utilized these resources.
- Yes, I am aware of such initiatives and resources but have NOT utilized them.
- No, I am not aware of, nor participated in these initiatives.

According to the U.S. Department of Agriculture, food insecurity is defined as a lack of consistent access to food for an active and healthy life. During your time at UF, have you felt that you or anyone else you know has possibly experienced food insecurity? (Select all that apply)

- I have experienced food insecurity.
- I have not experienced food insecurity.
- No one I know has experienced food insecurity.
- Someone I know has experienced food insecurity.

In your opinion, which method of action towards food waste would benefit UF's students and campus more?

- A text notification that that will notify students whenever there is leftover food at events or dining halls, redistributing the extra food to those in need and reducing waste generated.
- Research towards ways to convert composted food waste generated from dining halls into biofuel, and the possible construction of a biofuel plant on campus.

How likely are you to enroll in text updates for free surplus meals from dining halls?

- Not very likely
- Likely
- Very likely

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