An Analysis of Food Waste at Lafayette College:
Opportunities for Waste Reduction

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Summary

In a society overwhelmed by environmental crises, economic hardships, and social injustices, it can be difficult to identify what actions to take. We are often mired in the confusion, unable to pinpoint what issues to tackle. However, certain challenges are within the scope of our control, as in the case of food waste. Food waste, or the "wholesome edible material intended for human consumption, arising at any point in the [food supply chain] that is instead discarded, lost, degraded or consumed by pests" (Papargyropoulou et. al, 2014), is a product of the food systems we have built and is therefore susceptible to manipulation. Understanding of the consequences of wasted food, which include environmental, economic, and social repercussions, is beginning to spread beyond the scientific community. With this spread of knowledge comes a directive for action.

Existing resources, such as the EPA's food waste hierarchy, offer means to inform food waste solutions. The food recovery hierarchy, as depicted in Figure 1, categorizes solutions into 6 tiers. These categories are then ranked, with the top of the pyramid identifying the most favorable solution and the bottom of the pyramid identifying the least favorable solution. Landfills, as an emitter of methane, represent a "last resort" for food disposal. Moving up the hierarchy, composting offers a more sustainable and environmentally beneficial outlet for waste, repurposing food to fertilize the production of more food. Industrial use offers the opportunity to transform waste into energy, replacing traditional

Figure 1: EPA Food Recovery Hierarchy

CO_2 emitters like oil. The next two tiers of the pyramid recommend redirecting food that would be wasted to other consumers such as animals and food insecure individuals. Finally, the most favorable option of the food waste hierarchy is source reduction, which eliminates the production and distribution of excess food. These alternatives to food disposal can inform decisions made within local, national, and international food systems.

Lafayette College, as a microcosm of the United States, can serve as a model for food waste reduction if the necessary actions are taken. In order to discover the most efficient paths forward, I have compiled a four-piece compilation of information, recommendations, and tools for future work. Firstly, the report following this introduction provides a literature review of existing knowledge and research on food waste with specific attention to the context of the food system at Lafayette College. The literature review also details reasons for food waste, consequences of waste, and broad recommendations for waste reduction. This information serves as a platform for the analysis of food waste at Lafayette that follows. The section of the report dedicated to Lafayette highlights why the Lafayette community should take action, both on an institutional level and a student level, existing infrastructure, and opportunities for waste reduction. This report also details the results of a qualitative student survey I conducted in April, 2017 which illuminates student interest in food waste and self-reported waste behaviors. The report concludes with recommendations for future action, prioritized in accordance with the EPA's food waste hierarchy.

The second and third pieces of this project provides tools to raise awareness about food waste through different forms of media. Using data collected from my survey, research gathered for the report, and my own conclusions, I created 4 infographics for educational purposes. The third component of the project consists of a short 2-and-a-half-minute video to raise awareness

about food waste on Lafayette's campus. The video consists of interviews with Marie Fechik-Kirk, Lafayette's Sustainability Director, Bonnie Winfield, Lafayette's Director of Community Partnerships, Haley Mauriello, a student leading a food recovery initiative on campus, and Sarah Edmonds, the manager of LaFarm. With accompanying footage of campus kitchens, dining facilities, LaFarm, interviews with students, and other visual aids, the video seeks to offer a brief and direct explanation of what food waste is, why it is an issue, and what Lafayette can do about it as a community. The fourth and final piece of the project is a website to compile the report, infographics, and video. The website provides an organized and visually appealing format for consuming these materials and allows for long-term access to these resources.

The goals of this project are to provide a synthesis for all projects, people, and infrastructure related to food waste at Lafayette, tools for raising awareness, and informed recommendations for future action and research. The products of this study should be consumed with the knowledge that making Lafayette College a zero-waste institution is not an abstract concept. I conclude that the recommended actions are feasible and that the College has a responsibility to its mission and to its community to take these steps towards food waste reduction.

Literature Review

I. Definitions:

In order to understand the complex implications of "food waste," one must first dissect the language surrounding the issue. Because language has the power to shape perspective, we must be critical of the words we choose to frame a problem. For example, the term "food waste" can have diverse meanings. The Food and Agriculture Organization defines food waste as

"wholesome edible material intended for human consumption, arising at any point in the [food supply chain] that is instead discarded, lost, degraded or consumed by pests" (Papargyropoulou et. al, 2014). This definition has been amended by other scholars who suggest that the term "food waste" be extended to include any food diverted from the human food chain (i.e. animal feed) (Papargyropoulou et. al, 2014) or even any food consumed beyond the necessary nutritional needs of the human body (Papargyropoulou et. al, 2014). In addition to the expanding scope of this term, scholars have also narrowly applied "food waste" to describe the behaviors that lead to its production (Parfitt, Barthel, & Macnaughton, 2010), primarily negligence or wasteful disposition (Lipinski et al., 2013).

To further complicate the issue, the terms "food losses" and "food surplus" are also applied to this issue, offering additional connotations and perspectives. "Food losses" are often associated with food waste prior to consumption (Parfitt, Barthel, & Macnaughton, 2010) due to "spills, spoils, […] abnormal reduction in quality such as bruising or wilting" (Lipinski et al., 2013), etc. "Food surplus" can be used to describe waste at a production stage where more food is produced than is nutritionally necessary to feed consumers who access this food source (Papargyropoulou et. al, 2014).

Understanding the different definitions of these terms, while valuable, is not in itself productive. However, understanding the motivations behind using these terms is key. For instance, the terms "food losses" and "food surplus" may suggest that the solution to reducing food waste lies primarily in the production end while the use of the term "food waste" may direct attention to the consumer end. Using these terms without comprehending their connotations can therefore limit the scope of a solution. Furthermore, the term "food waste" is surrounded by negative connotations which may obscure opportunities to take advantage of excess production

(Schmidt, 2016). The term "food surplus" may therefore be useful in encouraging recovery of these resources (Schmidt, 2016).

While these various terms should be taken into consideration whenever discussing the issue, for the purposes of this essay, "food waste" will be used in accordance with The Food and Agricultural Organization's definition which acknowledges waste throughout the food supply chain (Papargyropoulou et. Al, 2014). However, even within this definition, there is further room for interpretation as food waste separates into "unavoidable", "possibly avoidable", and "avoidable" (Parfitt, Barthel, & Macnaughton, 2010). According to Parfitt, Barthel, and Macnaughton, unavoidable food waste encompasses food that is not, and has never been, fit for consumption under "normal circumstances" (2010). This may include organic matter such as bones, shells, or banana skins (Betz, 2014). "Possibly avoidable" waste includes food that only some people consume or that can be edible only when prepared certain ways (Parfitt, Barthel, & Macnaughton, 2010). "Avoidable" waste can mean any food that was once consumable which has since been made unusable through improper storage or preparation or has been discarded due to negligent consumer behavior (Betz, 2014; Parfitt, Barthel, & Macnaughton, 2010; Heikkila, 2016; Papargyropoulou et. al, 2014). While these labels offer somewhat flexible categorical boundaries, interpretation of "avoidable" and "unavoidable" remains subjective. For the purpose of this essay, "food waste" will define all possibly avoidable and avoidable foods as described by the above definitions.

Other key definitions include "food supply chain", "food loop", "waste prevention", and "waste management". The food supply chain, sometimes known as the "food value chain" (Lipinski et al., 2013), outlines how food moves from agriculture to food processing and manufacturing to retail and then to consumption (Papargyropoulou et. al, 2014). Because food

may be wasted at any point along the food supply chain, this concept must be used to inform decisions about food waste solutions. "Food loop" is a less common term used to describe the production and progression of food in a sustainable food system. The food loop can be understood as a framework for creating a single material path in which food is grown and harvested locally, distributed for consumption, and composted for more production (Mylon et al., 2011). Solutions for addressing food waste throughout the food supply chain, or "loop" in an ideal system, include "waste prevention", which refers to the production end of the supply chain, and "waste management" which refers to the consumption and distribution end of the supply chain.

II. Context

The food supply chain and its various components vary based on the contexts of culture, industry, infrastructure, and consumption patterns. Therefore, when dissecting food waste on a college campus as I will do in this study, it is vital that we understand food within the framework of the food service sectors, higher education communities, and urban settings in the United States.

Firstly, colleges and universities frequently depend upon contracts with outside companies in the food service sector. The "food service sector" is defined as "one part of the food system […] responsible for any food or meal prepared and served outside the home" (Heikkila et al., 2016). This relationship must acknowledge the needs and goals of both the college and the company providing the food. Looking specifically at the consumer end of this food supply chains, it is evident that college student behaviors significantly contributes to the

problem of waste in the campus setting. On average, college students waste 142 pounds of food per person every year (The Campus Kitchens Project).

Once the food supply chain is understood within colleges, it is then important to understand the place of the college's food system within its local environment. Lafayette College resides in Easton, Pennsylvania, an urban area with roots in industry and a growing retail sector (Landauer, 2014). Urban areas like this can significantly affect the perspectives of inhabitants, as food systems remain largely invisible in these settings (Pothukuchi, 1999). This low visibility is due to a number of factors including citizens taking the ease of access and affordability for granted, the association of food systems with rural areas, the technologies that industrialized the natural food systems, and the dichotomy between rural and urban policy (Pothukuchi, 1999). For these reasons, urban inhabitants tend to subconsciously distance themselves from the food they eat. The growth of urban living and future projections (Grimm, et al., 2008) indicate that this disconnect may continue to grow.

Stepping back to view the food supply chain on a larger scale, one can see that the United States is far from solving the issue of food waste with 40% of the food produced going uneaten (Gunders, 2012), and 97% of this food waste going to landfills (Levis et al., 2010). In fact, the United States and other developed countries are the leaders in generating food waste (Papargyropoulou et. al, 2014). While developing countries also contribute to food waste,

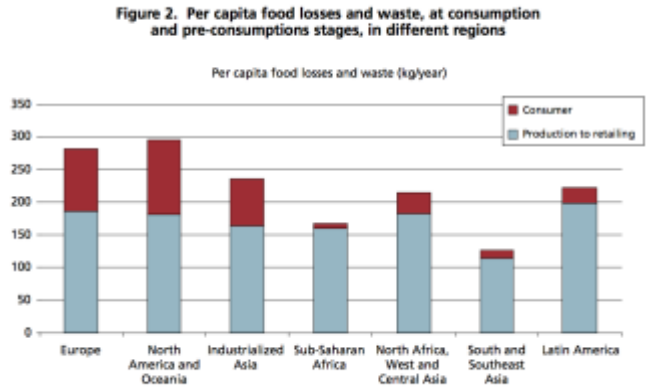

Figure 2: Per Capita Food Losses and Waste
Retrieved form Food and Agriculture Organization of the United Nations

albeit to a lesser degree, how and when food is wasted differs with the greatest losses for developing countries occurring during production and storage and the greatest losses for developed countries occurring at the consumer level (Parfitt, Barthel, & Macnaughton, 2010; Halloran et al., 2014). Overall trends are skewed towards the former waste behavior with 24% of global food waste occurring at production, 24% at handling and storage, and 35% at consumption (Lipinski et al., 2013).

III. Reasons for waste:

A review of these statistics has led to investigation surrounding the causes of food waste. Various studies have been conducted to qualitatively and quantitatively measure food waste, engage with producers, distributors, and consumers about their behaviors, and assess the effectiveness of waste prevention and waste management. Experiments pertaining specifically to food waste on college campuses have largely been observational, such as identifying waste locations on campus (Smyth & Fredeen, 2009), surveying consumers to identify reasons for waste (Parfitt, Barthel, & Macnaughton, 2010), weighing food waste at different points in the food supply chain (Betz, Buchli, Gobel, & Muller, 2014), and surveying responses to educational campaigns (Whitehair, Shanklin, & Brannon, 2012).

Results, which vary in scope and specificity, have pointed to a variety of food waste stressors and catalysts. Heikkila, Reinikainen, Katajajuuri, Silvennoinen, and Hartikainen's study, is useful in its ability to outline contributing factors throughout the food supply chain including business, society, communication, management, and diners (2016). From a business perspective, food waste is likely to be exacerbated by the style of service, particularly buffet-style catering and the prioritization of customer satisfaction (Heikkila et al., 2016). This

business perspective in conjunction with society's cultural acceptance of food waste (Halloran et al., 2014), can produce apathetic behaviors on both ends of the food supply chain. Management and communication are also key when discussing food waste in the food service sector as mistakes in ordering, the production of noisy environments (Heikkila et al., 2016), and lack of coordination (Halloran et al., 2014) lead to inefficiencies in resource use. The consumer role is also significant as diners bring high expectations of quality and appearance and a low appreciation for food (Heikkila et al., 2016).

In addition to these internal factors, external forces also shape the magnitude of food waste. Legislation is a key contributor to food waste as high standards of food safety and restrictions on distribution facilitate waste's path to the landfill (Heikkila et al., 2016). For instance, the National Restaurant Association requires specific cooling rates for food in order to decrease the chance for pathogen growth, complicating the serving process and providing opportunity for greater food waste (National Restaurant Association, 2013). On the other hand, the *lack* of regulation on food "sell by" dates has also led to increased waste as companies fail to communicate to consumers the label's indication of peak quality rather than spoilage (Lipinski et al., 2013).

IV. Consequences:

While the pervasiveness of the issue may daunt the average consumer, the consequences of continuing this behavior indicate the need for immediate and direct action. From an environmental perspective, food waste is synonymous with the waste of land, water, and energy resources (Papargyropoulou et. al, 2014). In the United States, the production of food accounts for 50% of U.S. land and 80% of the country's total freshwater consumption (Gunders, 2012).

Furthermore, the growth of food is also harmful to biogenic cycles (Papargyropoulou et. al, 2014) with approximately 28 million tons of fertilizer applied to food that is ultimately wasted (Lipinski et al., 2013). Pollution from food waste can also be measured in the amount of methane produced by its decomposition in landfills (EPA). With these massive amounts of wasted resources and pollution, it is unsurprising the food waste contributes approximately 8% of annual greenhouse gas emissions (Johnson, 2017). A report published by Champions 12.3, asserts that "if food waste were its own country, it would be the third largest emitter of such gases in the world, after China and the U.S (Johnson, 2017).

Economic resources are also wasted as food is wasted. On the production end of the food supply chain, food takes up 10% of the U.S. energy budget. For the average American consumer, annual food waste costs around $1,600 per year for a family of four (Lipinski et al., 2013). Considering all of the costs of input by actors along the food supply chain, the United States spends approximately $165 billion dollars each year on food that is wasted (Plumer, 2012). Companies in the food industry are beginning to realize the cost of their food waste and are financially benefiting from efforts to reduce this waste, earning more than a "14-fold return on investment in food waste reduction" (Johnson, 2017). In addition to costs in the production, distribution, and consumption sectors of the food supply chain, economic costs also exist at the disposal level with massive investment in landfills (Hirshfeld et. al, 1992). Landfills not only require funds to construct and maintain, but also decrease nearby property values (Hirshfeld et. al, 1992). Furthermore, using land for waste disposal has notable opportunity cost in that the land cannot be developed or preserved in its natural state (Hirshfeld et al., 1992).

In addition to environmental and economic consequences, food waste also instigates social injustice and a failure in the food supply chain. Roughly 1 in 9 people in the world suffer

from hunger (Hunger Notes, 2016b). In the United States, 12.7% of households are food insecure, meaning that they lack reliable access to food (Hunger Notes, 2016a). Yet 40% of food in the U.S. goes to waste (Gunders, 2012), highlighting the current food system's ability to make food accessible. While food redistribution remains a topic of interest for those seeking to reduce waste, the paradox of excess food production coexisting with undernourishment persists.

V. Solutions:

While no clear, singular solution has been found to address the complex issue of food waste, steps toward addressing food waste have been discussed frequently in the scientific community, particularly in the past decade. The United States Environmental Protection Agency outlines the different approaches in a food recovery hierarchy [Figure 1], (EPA). In this model, disposal of food is ranked as least favorable followed in ascending order by composting, industrial uses, feeding animals, feeding hungry people, and source reduction (EPA). Here we might apply the term "waste management" to the five lower tiers of the hierarchy, with "waste prevention" as the most desirable course of action.

Figure 1: EPA Food Recovery Hierarchy
Retrieved from EPA

The solutions repeatedly emphasized in academic journals and research fall within the scope of the tiers labeled: source reduction, feeding hungry people, and composting. Composting is generally associated with unavoidable food waste which can be used to fertilize

future food production. In the context of a college setting, this solution offers design challenges and the careful management of limited resources (S. Fried, personal communication, March 10, 2016). However, even small scale composting may offer significant impact as outlined in the Western Michigan University student paper on the recycling of coffee grounds which can serve as effective, nutrient-rich compost, with the implementation of inexpensive infrastructure (Lilac & Strating, 2016).

Suggestions that emphasize feeding hungry people are sometimes interpreted as "re-use", or "redistribution". This can be defined as the "voluntary[y] giving away [of] food that otherwise would be lost or wasted to recipients such as food banks, which then redistribute the food to those in need" (Lipinski et al., 2013). Given the social consequences of food waste outlined in Section IV, this alternative offers a way to alleviate social distress. Food donation may also be "useful for marketing purposes" from the business model perspective (Betz, 2014). The Campus Kitchens program, where students collect and prepare excess food to redistribute to community members, provides a tested model for food donation at institutions of higher education and highlights the opportunity for educational benefits in this process (Papargyropoulou et. al, 2014). Legislation pertaining to food donation must also be considered in food waste reduction. Initiatives such as the "Good Samaritan Law" offer the opportunity to overcome legal barriers to donation (Lipinski et al., 2013). Legislation may also be used to provide tax incentives for donation (Lipinski et al., 2013).

In terms of source reduction, the elimination of food waste at all levels of the food sector's food supply chain is proposed. In preparation, opportunities for food waste reduction include improved staff training (Heikkila et al., 2016), careful management of expiry dates, and menu adaptation (Betz et al., 2014). In serving, research suggests that reducing portion sizes

when possible (Lipinski et al., 2013), the use of smaller serving bowls in buffets (Betz et al., 2014), and the shift to half-full serving bowls towards the ends of mealtimes will reduce waste (Betz et al., 2014). Clearly communicating the meaning of food labels to consumers can improve shopping and consumption habits (Lipinski et al., 2013). Communication is also key in helping to educate consumers about the consequences of food waste which can lead to reduced plate waste and responsible shopping habits (Parfitt, Barthel, & Macnaughton, 2010; Lipinski et al., 2013).

Lafayette College: An Analysis of Food Waste Reduction Potential

The following analysis outlines how the previous research, contributions, and recommendations apply to Lafayette College's food system. I use information gathered from interviews, observations, and research I conducted in the Spring of 2017 to discuss the mission of the college as it relates to food waste, Lafayette's dining experience, LaFarm and composting, food donations, student attitudes and behaviors, and food system actors.

I. Mission of the college

Considering the efforts Lafayette College has made towards making the campus more sustainable (Morse, 2016; Tropp, 2017; Collins, 2016), one might question the need for further action. Complacency becomes the default of large institutions whose priorities lie elsewhere. However, within the fabric of Lafayette's mission—it's goals, plans, and history, lies the directive for a more sustainable food system.

Simply looking at Lafayette's mission statement yields insight into how food waste reduction furthers the college's goals. According to the college's website, Lafayette

> "encourages students to examine the traditions of their own culture and those of others; to develop systems of values that include an understanding of personal, social, and professional responsibility" (Lafayette CollegeB)

The beginning of the statement calls on students to reflect upon the way they live their lives in relation to other cultures. The culture of food waste in the United States is one of negligence, as discussed in Section II of the Literature Review. Developed countries, with North America in the forefront, are lead contributors in global food waste (Papargyropoulou et. al, 2014). Global trends show that much of this occurs at the consumer end (Lipinski et al., 2013), indicating that a shift in behavior and attitude can lead to food waste reduction. If students at Lafayette are to examine their own traditions and cultures within this microcosm of the United States, behavior surrounding food waste must be included.

The second line of the Mission Statement, which delves into the need for "personal, social and professional responsibility" (LafayetteB), not only has clear implications for food waste, but is also reinforced by the college's charter and history. As discussed in Section IV of the literature review, wasting food has significant social consequences. Understanding that each person is responsible for their own actions that lead to waste and the social repercussions of such behaviors clearly falls within the college's mission. Furthermore, Section 46.E of Lafayette's charter states that Lafayette should seek to "enhance the College's relationships with the external community, including the greater Lehigh Valley" (Lafayette College, 2015). Enhancing this relationship means expanding the scope of mindfulness when making decisions, including those related to dining services. Not only can lack of attention to the larger community affect the local food system economically, but it can also be detrimental to the local environment, as

contributions to landfills increase, and to social infrastructure, as people living a few blocks from the college's plentiful buffet lines struggle to find their next meal.

The College's social responsibility is even more evident in the history and future of the school. Lafayette was founded by the people of Easton in 1826 (Lafayette CollegeA), and therefore has more than a geographical tie to the city. As plans for major expansion of the College in the Easton community continue to unfold, as seen in the new Williams Arts Campus (Miller, 2015), the administrative move to the downtown Alpha Building (Kelly, 2017), and the proposed housing on College Hill (Tropp, 2016), this social responsibility will become even more paramount. If the college wishes to encroach upon more of the City's property, goodwill and reciprocity will be essential. However, these expansion plans will also make it more difficult to reduce and manage food waste on campus, as the student population rises at a rapid rate.

From an environmental standpoint, the college is committed to becoming a more sustainable campus. With the signing of the American College and University's Presidents' Climate Commitment (ACUPCC) in January, 2008, the college agreed to set goals and "pursue climate neutrality" (Facilities Planning, 2011). The President's Climate Action Plan, developed in November 2011, details the college's plans to make an inventory of all greenhouse gas emissions, provide measurable goals, and to ultimately reduce greenhouse gas emissions by 20% from 2007 to 2021 (Lafayette College, 2011). Despite these goals, the college has made little progress towards meeting a 20% reduction (Gordon, 2017). Moving forward, the college has substantial opportunity to decrease greenhouse gas emissions through the reduction and better management of food waste, which produces methane when left in landfills (EPA). By reducing

waste and improving waste management, significant progress can be made towards meeting the Climate Action Plan's goal.

II. Lafayette's Dining Experience

At Lafayette College, Bon Appetit serves as the food service provider on campus, managing two buffet-style dining halls, Marquis and Upper Farinon, and 4 cafes, Lower Farinon, Gilberts Café, Simon, and Skillman Café [Figure 3]. In addition to these venues, Bon Appetit services faculty dining and catering for on-campus events. Communication and coordination is key to running these facilities as food is prepared and transported to different locations. Faculty dining, Simon's, and Skillman Café all rely on Marquis Hall as a base for food delivery and various prep work while Upper and Lower Farinon operate as a separate unit. While Lafayette's campus is relatively small at 340 acres (Lafayette CollegeA), the food transportation still requires catering vehicles. The opening of the Spot as a lunch hub for students on the Williams' Arts Campus further emphasizes the need for efficiency and cross-utilization of resources.

Figure 3: Lafayette Dining Map
The map indicates the locations of facilities and operations in Lafayette's food loop

While Bon Appetit strives for the ideal of zero waste, this goal is difficult to realize given variability and variety of food demands on campus. To combat the challenges involved with

ordering the correct quantity of food, dining services has kept records of the student traffic at various dining locations. These records indicate trends during certain times of day or days of the week, such as the peak times of lunch service depending on class schedules, as well as annual trends, such as the average attendance of students during Valentine's Day (S. Fried, personal communication, March 10, 2017).

In addition to predicting quantities of food, Bon Appetit is also able to reduce waste through strategic preparation and menu planning. In the buffet-style facilities, each dish is prepared from scratch and cooked in batches to serve. By cooking in batches as needed, the chefs are able to limit the excessive production of cooked food and save any unused food for another meal. This is key to reducing food waste because any food in a self-service facility that is made accessible to diners must be thrown out at the end of the day due to safety concerns (National Restaurant Association, 2013). Bon Appetit also creates "outlets" for the excess food in the kitchens by planning menus to include the same ingredient in successive meals. For instance, the dining hall may serve grilled chicken one day, put extra chicken in the salad bar the next, and use any remaining chicken in a soup. This planning is also seen in catering, as last minute orders mirror the menu for other dining facilities that day (S. Fried, personal communication, March 10, 2017).

Despite this organization and well-measured system of ordering, the business model of food service operators paired with the expectations of the diners at these facilities, frustrate attempts to achieve zero food waste. Part of the issue lies in the hours of operation. Students rely on the convenience of an all-day dining facility. With the exception of 2 transition periods in the buffet style facilities where food options are limited to the deli and stone-fired sections (S. Fried, personal communication, March 10, 2017), the dining halls feature full buffet lines even

when traffic is expected to decrease. From a retail perspective, the *appearance* of having full dishes is a key strategy to attracting diners (S. Fried, personal communication, March 10, 2017). According to Marie Fechik-Kirk, the campus' recently hired Sustainability Director, this style of food service is perpetuated by larger cultural trends in the United States, as diners expect buffet lines to continue to flow (personal communication, February 16, 2017).

Another key component to dining infrastructure at the college is the Meal Plan system. In recent years, Lafayette College's Meal Plans have undergone significant change in order to address 4 primary challenges: community, social justice, health, and food quality. According to Paul McLoughlin, Dean of Student Life, at the time of his arrival in 2012, the campus had a significant takeout culture, where only first year students were required to enroll in the Meal Plan. As a result, first year students heavily relied upon dining facilities and upperclassman primarily relied on Pard Dollars and alternative dining options (P. McLoughlin, personal communication, February 13, 2017). Because meal equivalency was so high at Marquis and Upper Farinon, upperclassman gravitated towards Lower Farinon, Gilberts, and Simon's. McLoughlin recognized this dining system as a barrier to uniting students over class years and therefore implemented a Meal Plan requirement for all class years, with the exception of commuting students, in 2015.

This change was also instigated by McLoughlin's concerns with the social justice issue of food insecurity on campus. With students on the block plan, where meals could be used anytime at the discretion of the student, or plans with only Pard Dollars, McLoughlin saw students running out of food before the end of the semester. He therefore implemented mandatory and more regulated Meal Plan requirements in order to ensure that students would no longer be limited in their meal options due to economic status. For students receiving financial aid, the

cost of living at Lafayette is calculated using the 20 meals a week Meal Plan. However, for students struggling financially who do not receive full financial aid, this cost can be a burden compared to less expensive food alternatives.

The third challenge of health was primarily a reaction to the meal equivalency system in which students could use a meal swipe for its equivalent dollar value at cafes and takeout facilities on campus. McLoughlin became concerned over the non-nutritional meals he saw student purchasing, and believed that their performance suffered as a result. He therefore eliminated the opportunity to use meal swipes for their dollar equivalency in the new plan. The health challenge was also combatted with a change of dining service provider from Sodexo to Bon Appetit, a company that prides itself on local and nutritional food (P. McLoughlin, personal communication, February 13, 2017).

The final challenge of food quality related to the number of students on Meal Plans. With fewer students on the Meal Plan, the base investment in the dining system was low, leading to a poorer quality of food. Furthermore, students who were not enrolled in a Meal Plan who used dining facilities were benefiting from the investment of those on the Meal Plan. This was yet another factor in the decision to make the Meal Plan mandatory.

Despite these clearly defined intentions and justifications for the changes in the Meal Plan system, not all consequences were accounted for, particularly that of the increased food waste on campus. The Meal Plan, compared to visiting off campus restaurants or using cash equivalency, may encourage students to place less value on the food they are eating. With an upfront investment, often from the financial aid office or from family, students are disconnected from the monetary value of their food. In addition, the elimination of meal equivalency at dining facilities and the weighing of food items such as salads, allows students to take more without

financial consequence. With all class years on the Meal Plans, more students are also likely to attend the buffet-style dining halls, where lack of limitations can lead to negligent consumption. Fluctuation in dining hall attendance is yet another factor that leads to food waste, as the ordering of food is given more variables with the increased number of students.

While Dean McLoughlin acknowledges that the increase of students on the Meal Plan and more regulated dining options have likely led to increased food waste, he asserts that the reasons behind the changes and the priorities of the college take precedence. This position affects not only food waste on campus, but also relationships with the larger Easton community. McLoughlin notes that catering to student demands comes before the goals and desires of the Easton community, as evident in the competition between dining halls and local restaurants. For instance, the campus is looking into providing a smoothie bar for students. The institution of a smoothie bar would put financial stress on restaurants, such as Don Juan's and Mojo Hill, that are frequented for their smoothie options. The College's current understanding of dining at Lafayette, does not include the food system beyond campus boundaries (P. McLoughlin, personal communication, February 13, 2017). Bonnie Winfield, Director of Community Partnerships at the College, offers a different point of view, stating that "the borders are false" and that we share not only a zip code but a community (personal communication, March 9, 2017). While acknowledging that one campus cannot remain cognizant and responsive to the world's needs, it can and should expand awareness to the local community. It is important to understand that the relationship between Lafayette and Easton offers mutual benefits and that fostering that relationship can strengthen the sustainability of the college.

III. LaFarm and Composting

In the past decade, the food system at Lafayette has expanded to include LaFarm, located 3 miles off campus at Metzgar Fields. From its beginnings in 2009, LaFarm has expanded and enhanced the quality and quantity of food produced. Between 2013 and 2015 alone, LaFarm grew from 20,000 square feet to 37,000 square feet, nearly tripled its annual work hours from 340 hours to 980 hours, and increased production from 2,309 pounds per year to 3,945 pounds per year (Edmonds, 2015). With the addition of an irrigation system, wash shed, on-campus market days, and the establishment of the student farm program, Lafayette Food and Farm Cooperative (LaFFCo), LaFarm has become an increasingly significant presence in Lafayette's food loop. In addition to providing experiential opportunities that reconnect students to food and educational opportunities for research across multiple departments, LaFarm sells its produce to Bon Appetit to serve in campus dining facilities. This relationship has grown with the transition in dining services providers and through Sarah Edmonds' management of LaFarm, increasing the amount of food it sells to Bon Appetit to approximately 4,000 pounds in 2015 (Edmonds, 2015; S. Edmonds, personal communication, March 29, 2017).

The presence of LaFarm offers further opportunities for waste reduction by providing a destination for composted food. Between 2014 and 2015, LaFarm applied approximately 30,000 pounds of college-made compost to its soil (Edmonds, 2015). However, since the beginning of the composting initiative at Lafayette in 2007, sustaining a compost system on campus has proved difficult. The compost system began as a research opportunity and feasibility study instigated by student interest and supported by Civil and Environmental Engineering (CEE) professor Arthur Kney (Dorn et al., 2013). In 2009, with continued student research, a funds awarded by the Department of Environmental Protection and matched by Lafayette's

administration, and an outside donor, the College purchased two Earth tubs (Dorn et al., 2013). A sheltered area was built by the Hummel Lumber site, with rain barrels and scales available for testing and maintenance (A. Kney, personal communication, April 21, 2017).

At the beginning of composting operations, labor was divided between students and Sodexo, the dining services provider at the time (A. Kney, personal communication, April 21, 2017). While initial support from Dining Services, the administration, and student organizations allowed the program to begin, difficulties developed with plans for expansion and concerns over long-term maintenance. Stacy Dorn '12 with the support of Professor Kney, worked to develop a detailed document that provided instructions for Plant Operations, who would assume responsibility for the compost labor (Dorn et al., 2013). The administration sanctioned two Plant Operations employees to maintain compost operations for 45 minutes each day. However, the reliance on different actors in the system and failure to perform operations led to breakdowns in the system that halted composting for weeks at a time. Student volunteers were also difficult to maintain on a regular basis (A. Kney, personal communication, April 21, 2017).

Further difficulties stemmed from the operation's reliance on pulpers. Pulpers are used to compress food waste, reducing the volume of waste and the time to compost. The decision to use pulpers was based on research gathered from other schools and the limited space provided by the 2 Earth tubs. The choice of pulpers purchased, ultimately chosen by Sodexo for their inexpensive price, has led to continued failures due to the high volume of food waste being processed. A recent discovery that the pulpers leave plastics in the compost which rise to the surface of the soil has led to further discussion about their use (A. Kney, personal communication, April 21, 2017).

In its current state, the compost system is not operational. New challenges have emerged with recent construction at the Hummel lumber site necessitating a new location for compost, a change in landscape services to an outside provider, and a lack of financial resources. Professor Kney also acknowledges the low economic incentive for implementing and maintaining a compost system (personal communication, April 21, 2017). In order for operations at Lafayette to resume, there must therefore be significant demand at a student level with support from the Sustainability Office. The College must also find a new site for composting, with the recognition of the logistics involved in moving operations to LaFarm. If the operation is to continue using pulpers, investing in new, hardier models will be necessary to accommodate volume. The College must also negotiate its contracts with landscape services, in order to redistribute responsibility from students to staff, and with Bon Appetit, to establish accountability.

While an internal compost system would play a significant role in waste reduction, Professor Kney suggests looking towards initiatives within the broader Easton Community as another outlet for food waste. Hayes and Sawyer, an engineering firm working with the Easton Waste Water Treatment Plant, is conducting research to investigate how a high strength digester could be used with solid waste and food waste to power the treatment plant (A. Kney, personal communication, April 21, 2017). While compost offers limited economic opportunity, this project incentivizes the reduction of food waste through a reduction in energy costs. Kney sees this as an opportunity for Lafayette in the future. However, in terms of tightening the food loop at Lafayette and considering the environmental benefits of composting, this alternative should not be viewed as an isolated solution.

IV. Food Donations: Challenges and Ways Forward

For the past year and a half, an initiative to begin a food donation system at Lafayette has been pushed to the foreground of waste reduction efforts by Geology and Environmental Studies student Haley Mauriello. Mauriello has worked closely with dining services and the new Sustainability Office to successfully introduce a weekly donation system in the Spring of 2017. While this accomplishment represents progress towards food waste reduction, it is only the beginning of the possibilities embedded in food donation.

Through conversations with the Dean of Student Life, the Dining Services manager, and the Sustainability Director, it is clear that the program has faced, and will continue to face, challenges. As an institution reliant on receiving charitable gifts, Lafayette cannot make monetary contributions without raising questions about tax deductions. Furthermore, the economic implications of students donating unused meal swipes towards food recovery offer problems for the Meal Plan's business model, where students are only projected to use 75-85% of their meal swipes. According to Dean McLoughlin, if all students were to donate the remaining 15-25% of unused meal swipes, the price of the Meal Plan would increase. That being said, the college has begun offering students the opportunity to donate their guest swipes for monetary equivalency during designated weeks due to an initiative within the First Year Commons program. The concern over the liability of donating food has also been considered, resulting in the dependence on students as intermediaries to donation in order to excuse Bon Appetit of any liability assumed through direct donation of food. (P. McLoughlin, personal communication, February 13, 2017)

The newly established food donations program currently operates with several volunteers collecting food from Lower Farinon once a week and donating said food to Safe Harbor, a

homeless shelter adjacent to the school (H. Mauriello, personal communication, March 28, 2017). The food donated comes from Lower Farinon's grab-and-go station, which Dining Services Manager Sarah Fried identifies as the "biggest culprit of waste" on campus (S. Fried, personal communication, March 10, 2017). This food is collected by dining services staff and transferred to the vans owned by the Center for Community Engagement, which maintain regularly scheduled trips to Safe Harbor and other local shelters as part of the MOSAIC volunteer programs (H. Mauriello, personal communication, March 28, 2017). Safe Harbor was chosen as the first destination for donated food due to its close proximity and well-established relationship with Lafayette. Before executing the first donation, Bonnie Winfield, Director of Community Partnerships in the Center for Community Engagement, and Marie Fechick-Kirk, visited the shelter to discuss the needs of residents and logistics of donation (B. Winfield, personal communication, March 9, 2017).

Moving forward, Lafayette must consider how this program can be expanded to further reduce waste and build mutually beneficial relationships with the Easton community. The food recovery systems at Lehigh University and St. Joseph's University highlight opportunities for growth. Madison Smith, a student coordinator for St. Joseph's food recovery program, identifies the basic needs of any food recovery operation on a campus level:

> The basic infrastructure to get this program running is a willing dining hall service to provide the food, committed student volunteers with a car to transport the food with the proper supplies that FRN National helps to fund, and a local shelter in need of this type of food. (personal communication, April 3, 2017)

At the current stage of Lafayette's program, the relationship with dining services is newly established. While the initial cooperation can prove to be challenging, as Smith notes, expansion

will require further negotiation and substantial communication. This relationship may even develop on a financial basis, as in the case of St. Joseph's dining services hosting a benefit lunch to raise money for the food recovery program. The volunteers needed to sustain the program are also key, although as more students become invested in the program, Sharon Sangermano, a student food recovery coordinator at Lehigh, notes that organizing and finding the appropriate responsibilities for larger numbers of people can be challenging (personal communication, April 4, 2017).

The transportation system at St. Joseph's and Lehigh offer examples of ways to give the food recovery program at Lafayette more flexibility and independence. Both schools rely on university cars to transport food. Smith asserts that becoming an official organization on campus allowed the program to obtain funds and access to campus transportation (personal communication, April 3, 2017). Sangermano explains how Lehigh gave the program access to auxiliary vehicles, with dining services paying for gas (personal communication, April 4, 2017). Both of these alternatives represent the need for a strong relationship with both dining services and the administration.

The sources and destinations of donations can also grow as the program matures. While Lower Farinon offers pre-packaged and easily accessible food for donation, other grab-and-go stations and even buffet facilities may also provide substantial opportunity for recovery. Both St. Joseph's and Lehigh's programs work with buffet-style dining halls, delivering unused trays of food to local shelters (M. Smith, personal communication, April 3, 2017; S. Sangermano, personal communication, April 4, 2017). While the idea of donating trays of hot food may appear more daunting than cold sandwiches and salads, these food items would otherwise be unusable during future meal periods due to safety regulations. With an increase in donation

sources, donation destinations could also be expanded to include other shelters in the Easton area such as the Third Street Alliance and any of the various 7 meal centers located in the City (Easton Hunger Coalition).

Expansion is also possible in the frequency of donation. As the number of volunteers increases and transportation becomes more accessible, Lafayette's food recovery program could increase from 1 to several times a week, just as St. Joseph's increased to 3 times a week since its establishment in 2014 (M. Smith, personal communication, April 3, 2017).

The national Food Recovery Network program, which serves as a source for information, resources, and guidance for 219 colleges and universities across the country, will be an important resource for Lafayette's program as it moves forward (Food Recovery Network). Sangermano notes that FRN has helped to develop long term goals through monthly check-ins, provided students leaders and networking opportunities with other FRN chapters, food tracking forms, and donation tubs at discounted prices (personal communication, April 4, 2017).

However, logistical challenges such as these may eclipse community concerns if organizers do not prioritize the people receiving food. As seen through the Campus Kitchens model, establishing relationships with local shelters can be difficult and must be considered a priority (Papargyropoulou et. al, 2014). Marie Fechick-Kirk notes that the program must be cautious in its ambition as the shelters receiving donations will come to expect and rely on delivered resources, making it necessary to maintain stability and regularity (personal communication, February 16, 2017). Bonnie Winfield emphasizes that it will also be key to maintain the "trifecta" model held by the Center for Community Engagement, in which service is balanced by reflection and education (B. Winfield, personal communication, March 9, 2017). The materialistic nature of food donation must be supported by broader understandings of

community needs and consideration of the causes of these needs. The Center for Community Engagement, Sustainability Office, environmental organizations, and academic departments should consider opportunities for collaborative education efforts and that reach beyond their respective pools of students.

V. Student Attitudes and Behaviors

While Section I outlines the reasons the college should invest in this issue on an institutional level, further incentive to purse the aforementioned waste reduction measures are provided on a student level. The college takes great pride in responding to student needs, particularly within dining services. Students participate in dining surveys and on the Food Services Advisory Committee, while additional input is received through communications with Student Government and through individual complaints and requests (P. McLoughlin, personal communication, February 13, 2017). This level of responsiveness to student demands indicates that the college will respond to a call for waste reduction if it comes from the student body. Through a survey that I conducted for this report in April, 2017, it is clear that the issue of food waste is both salient and intense within the student population.

Lafayette currently has very little quantitative or qualitative data regarding food waste. I conducted a survey about food waste in order to gage awareness of the issue on campus, understand self-assessed behaviors, and to identify areas of concern for students that may be useful in develop future awareness campaigns for food waste reduction. While the results of this survey can be used to understand the issue from the student perspective, it is important to note that student responses are subjective and cannot be used to accurately measure the amount of food students waste. I developed a 10 question survey submitted to and approved by the

International Research Board (Appendix A). I distributed this survey to students outside of the two buffet-style dining halls, Marquis and Upper Farinon, during lunch periods. A total of 104 completed surveys were gathered and statistically interpreted (Appendix B).

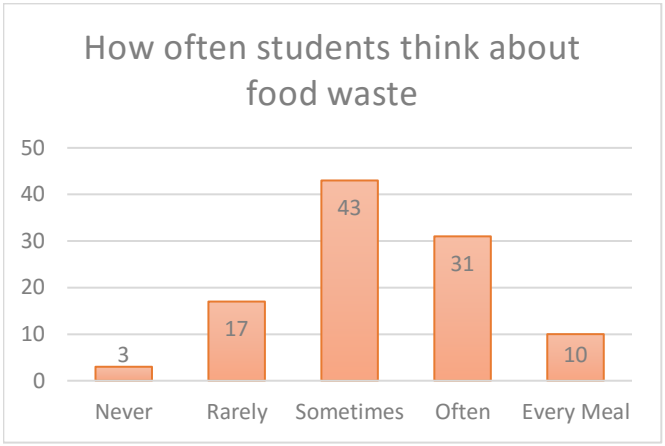

Figure 4: How Often Students Think About Food Waste
The data reflects student responses to question 2 of my survey

This interpretation yielded information about how aware students are about food waste and how they self-report their own waste behavior. Results for the survey question asking students how often they think about food waste indicate a positively skewed normal distribution, with students thinking about food waste "sometimes" to "often" on average [Figure 4]. However, students appear to be aware of the concept of "food waste" to a much higher degree than they are cognizant of their personal waste, with 96% of students reporting that they have heard of food waste. When comparing this awareness to behavior, it appears that students are slightly less likely to waste food than they are to think about wasting food. When asked "How often do you take more food than you eat?", student responses showed a

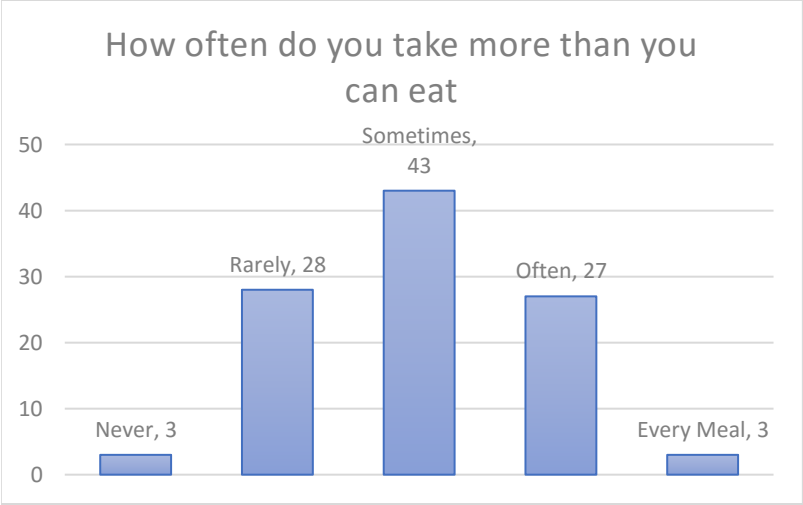

Figure 5: How Often Students Take More Than They Eat
The data reflects student responses to question 4 of my survey

normal distribution with the highest percentage of students reporting that they "sometimes" take more food than they eat [Figure 5].

While this assessment of waste behavior in self-serve facilities is useful in determining how often portion control causes waste, other factors play a role in waste behavior within grab-and-go facilities. When asked if they would eat a sandwich from a grab-and-go station labeled with a previous day, the greatest number of students (46%) responded that they would eat those sandwiches, indicating that students are less likely to waste food based on labeling than they are when putting food on their plate [Figure 6]. However, during the survey distributions, several students expressed their confusion on whether or not these labels indicated best buy dates, expiration dates, or date of preparation. This confusion may have led to multiple interpretations of the question. Furthermore, while nearly half of respondents reported that they would eat the sandwich, 34% reported that they would only eat the sandwich if there were no sandwiches marked for the current day and 20% indicated that they would not eat the sandwich. Projecting results onto the entire population of 2,450 students (Lafayette CollegeA), that would mean that 833 students would only eat the

Figure 6: Food Labeling
Data reflects student responses to question 5, in which students are asked about their consumption behaviors at grab-and-go facilities on campus

grab-and-go sandwiches under certain conditions, and 490 students would not eat these sandwiches.

Looking at waste behavior as it applies to fruit, a key staple in grab-and-go meals at Lafayette, results indicate that appearance is a substantial factor in fruit selection with 63% of students who would only eat bruised or browning fruit if no alternatives were available and 11% of students who would not eat bruised or browning fruit in any circumstance [Figure 7]. Given the fluctuations of students at dining facilities, the high consumer standard indicated by survey responses, and the retail perspective that demands that dining facilities maintain fully stocked appearances, it is likely that a significant portion of this fruit is sent to the landfill, even without quantitative evidence to track the waste.

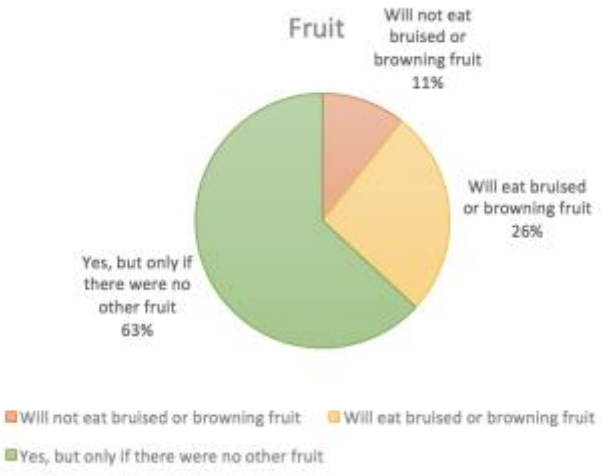

Figure 7: Fruit
Data reflects student responses to question 6 of my survey, in which students are asked to report their behaviors in grab-and-go facilities on campus

These self-assessed behaviors are key to understanding the student mindset surrounding food waste. Understanding where and for what reasons students waste food offers a platform for future education initiatives. Sharing information with students about food labeling would clear confusion surrounding "best buy" dates. If students are educated and reminded about these issues, it would become more acceptable for Bon Appetit to only stock grab-and-go meals and fruit that are nearing or past their sell by dates. Students who currently only eat sandwiches past their best buy dates or eat bruised or browning fruit if no alternatives are available, would then

be encouraged to purchase these foods. In self-serve facilities, hanging posters to encourage students to be mindful of plate waste or providing smaller plates could reduce plate waste. In the Spring of 2017, an awareness and data collection campaign entitled "Weigh the Waste" was conducted in campus dining halls. Volunteers stood in front of the disposal windows, directly collecting plate waste from students in clear, plastic containers which were then weighed at the end of the meal period. The data collected from the two separate weeks in which waste was weighed indicates that simply making the waste visible can impact behavior. Between the first weighing in March and the second weighing in April, a 2% reduction in student plate waste was recorded (M. Fechik-Kirk, personal communication, April 26, 2017).

These education and awareness campaigns would be most effective if they catered to broader interests. Students were asked to identify how much they care about certain issues listed in my survey that fell into the categories of "environmental", "social", and "economic." Responses indicated that students at Lafayette are most invested in social issues, followed by environmental, and then economic. Given this information and the knowledge that food waste is tied to issues within all three of these categories, a campaign that emphasizes social issues connected to food waste, such as hunger and poverty, may be the most effective means of encouraging students to change their consumption behaviors.

While encouraging students to alter their behaviors can be effective, it cannot be the only solution. The administration must also take action and the survey results indicate that it is in the students' interest to do so. On average, students feel that the issue of food waste on campus is "important" and the aforementioned education and awareness campaigns may serve to further increase the intensity of student investment in this issue. Moving forward, the

administration should consider food waste as an important issue on campus and prioritize infrastructure that will reduce its creation.

VI. Food System Actors

The previous sections highlight why and how dining services, the Office of Student Life, LaFarm, the administration, and students are involved in the issue of food waste. However, food waste is not limited to these parties, with numerous other actors contributing to the food system. Developing and renegotiating the relationships between actors will likely be the most important and most difficult step towards food waste reduction.

On an administrative level, the offices of Student Life, Residence Life, and Sustainability are key players. While dining services is not directly answerable to the Dean of Student Life, the Dean does frequently work with dining services in evaluating and making changes to the system. The Office of Student Life also serves as a liaison for students wishing to communicate with dining services, whose day to day operations and business mindset make it difficult for direct communication with students. While this channel of communication is important, it must be expanded if other players are to coordinate with dining services in future waste reduction projects. The Office of Residence Life has played a recent role in organizing students through the First Year Commons, a cooperative within first year student dorms. Within the Commons, a group of first year students in the class of 2021 have pushed for a Meal Swipe donation system (P. McLoughlin, personal communication, February 13, 2017). Instigating these connections between students at an early stage of their college educations will allow for momentum in the student body moving forward. The Sustainability Office, which now includes a Sustainability Director, a Campus Energy Manager, and the LaFarm Manager, offers an

environmental platform for waste reduction initiatives and has begun to open its channels of communication to other players.

Two key actors who remain relatively isolated in the social map [Figure 8] are Landscape Services and Bon Appetit. As parties under contract with the college, Lafayette must recognize that relationship-building and communication will be greater challenges. However, with Bon Appetit's direct relationship with food production and distribution, and Landscape Services' potential to assist with the compost program, the College must make an effort to connect these actors to others on campus. LaFarm and Landscape Services must form a partnership through administrative support in negotiating contracts. Tying additional student organizations to these players will also allow new and developing projects related to compost to move forward. Bon Appetit will need to develop a relationship with Landscape services in order to provide the food waste for composting. In terms of the food recovery efforts on campus, Bon Appetit's sustained support and communication with students recovering food must continue and grow with the projected expansion of the program.

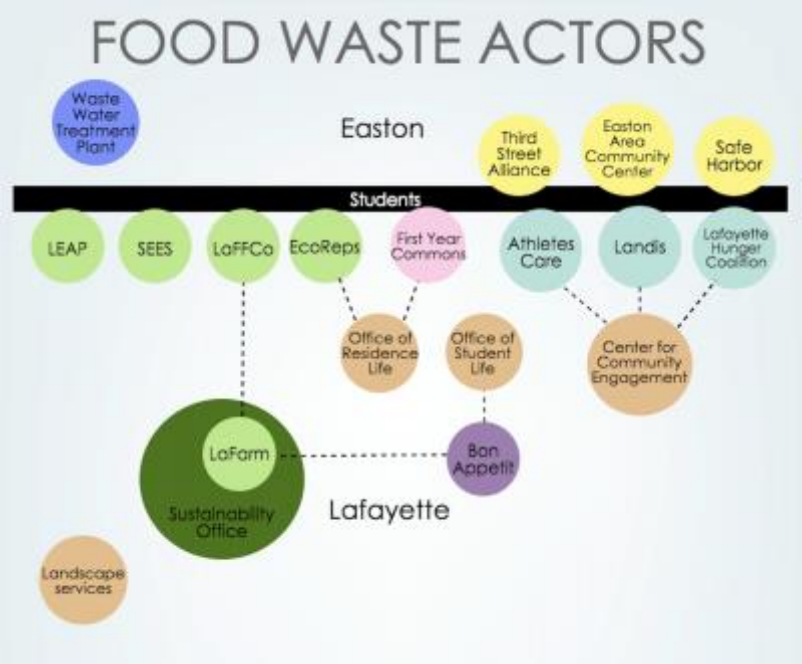

Figure 8: Social Map of Food Waste Actors
The map outlines the various groups involved in Lafayette College's food system. The dotted lines identify the current channels of communication.

While it is impossible to connect every student at Lafayette to these administrative offices and private contractors, it is feasible to connect student organizations. Enhancing access to administration and private contractors will facilitate student-led food waste initiatives by providing additional resources, information, and logistical cooperation. Environmental organizations such as LEAP, the Society for Environmental Engineers and Scientists, LaFFCo, and EcoReps all have the potential become involved in food waste reduction, yet often fail to move their ideas forward due to lack of outside support and difficulties in communicating with each other. LEAP has been involved in the recent "Weigh the Waste" initiative, which tracks plate waste in dining halls, as well as a number of other sustainability campaigns. SEES has close ties to the composting program and facilitates connection between the engineering departments and sustainability initiatives. LaFFCo provides student connections to food production and works to educate students about the food they eat through events like "Farm to Table". EcoReps is a key actor due to its potential to educate students living in residence halls about ways to live more sustainability. The newly established Sustainability Office offers an umbrella organization for these environmental clubs to not only communicate but to contribute to larger goals. The Easton Hunger Coalition serves as a model for this organization scheme, providing a resource for information and facilitating conversations between existing food recovery programs without usurping their agency.

Social justice and community services organizations compose another area of the food waste social map, which is often isolated from surrounding actors. Under the Center for Community Engagement (CCE), a number of well-established programs facilitate relationship-building between students and the broader Easton Community. The CCE's long-term presence and active efforts to breakdown artificial barriers between Lafayette and Easton provide

connections between potential food waste initiatives and local shelters such as the Third Street Alliance, Easton Area Community Center, and Safe Harbor. These relationships have already proven valuable in the food recovery efforts. As food waste initiatives and the recognition that food waste is more than a one-dimensional problem grow, connections between the CCE and Sustainability Office must also expand to share the responsibilities of programs and to efficiently collaborate.

The City of Easton is also a food waste actor at Lafayette. Caution must therefore be taken in ensuring that the food recovery efforts do not become one-sided, with Lafayette as the "giver" and the shelters as the "receivers". Guaranteeing that the inputs and lifestyles of shelter residence are considered and that shelter administration is consulted and respected should be a priority for those involved with the food recovery program. In the composting efforts, Easton's Waste Water Treatment Plant may also become a key player, making it necessary for the College's administration and those involved with composting to open new channels of communication. This communication can be structured as formal meetings between the Waste Water Treatment Plant and members of Lafayette's administration, the Sustainability Director, and faculty invested in food waste reduction. Regular email correspondence must also be maintained outside of these meetings. The Easton Hunger Coalition, Nurture Nature Center, and Lehigh Food Policy Council can also offer guidance, resources, and opportunities for further food waste reduction if regularly included in discussion.

Bridging the communication gap between these food waste actors is paramount if the campus is to make progress. With so many interests in the issue and the diversity of perspectives, lack of coordination can only lead to confusion and inefficiency. The failure of the above social map lies within the lines drawn. A system of communication between actors cannot

be built upon channels that connect only two players at a time. Creating transparent spaces for communication that offer connection between all parties is key. While the Sustainability Committee theoretically offers such a space for environmental initiatives on campus, its broad focus can sometimes be detrimental to action. Creating a space that is dedicated to food waste reduction and that involves representatives from all interested parties will allow for a breaking down of the communication barriers depicted in this social map. While the creation of such spaces can be instigated by students and faculty, members of Lafayette's administration with the powers to make policy changes must also take leadership roles. If the administration is not involved, the barriers to communication will only be reinforced.

Conclusion

Looking at the extensive and complex factors in Lafayette College's food loop, it is apparent that the solution is not a simple one. There will be no single course of action that leads to a zero-food-waste institution. However, using the EPA's food recovery hierarchy, future actions can be prioritized.

At the bottom of the hierarchy, as the least favorable destination for food waste, is the landfill. Moving forward, all actions should be to move waste upward on the hierarchy, ultimately reducing our greenhouse gas emissions, providing a healthier environment for future communities, and redistributing valuable resources. Compost, as the next tier on the hierarchy offers a more sustainable alternative with considerable opportunities for growth. In order to resume composting efforts, the College must invest in new infrastructure including but not limited to a new location and shelter for the Earth tubs, hardier pulpers, more funding for student research, and negotiations with Landscape Services and Bon Appetit to establish accountability.

Lafayette also has opportunities to redistribute waste for industrial use, the next tier of the hierarchy. With the research and development of the high strength digester at Easton's Waste Water Treatment Plant, Lafayette may have another outlet for waste if the administration is active in reaching out and building relationships early in the process.

While Lafayette does not currently have the infrastructure to make feeding hungry animals an outlet for food waste, the establishment of a food recovery group on campus has opened doors to recovering food for hungry people. The next steps in this organization must be to become an official organization on campus in order to access campus funds. This may be achieved either through Student Government or through the Center for Community Engagement's MOSAIC program. Additional resources could be gleaned through hosting benefit lunches through dining services, with St. Joseph's food recovery program and the Food Recovery Network as sources of guidance in planning such an event. With these additional resources, the program could open to more shelters and collect more food from different locations on campus. Maintaining relationships with these shelters beyond the weekly drop off period should also be considered by members of Lafayette's food recovery program in addition to education and reflection events for volunteers.

Highest on the food waste hierarchy is source reduction. The college has several alternatives for source reduction that should all be considered given their minimal resource use and potential for waste reduction. The Meal Plan system offers opportunity for waste reduction through several policy changes. Reducing the number of students on the Meal Plan could have considerable impact on waste reduction. While acknowledging that it is important to maintain investment in plate cost, eliminating the Meal Plan requirements for students living in off-campus housing or perhaps only for seniors should be considered as a small but important

measure. Furthermore, the College must consider reintroducing Meal Equivalency at grab-and-go stations as it reconnects students to the value of the food they purchase and reduces the waste of items such as fruit and chips. Reintroducing the weighing of food would also make students more conscious of their purchases. While health should remain a concern on campus, students should have the ability to make educated decisions about their food choices.

Other policy changes should be applied by Bon Appetit at the distribution end of the food supply chain. In the grab-and-go stations, stocking only items that are about to pass their "best buy" dates would prevent student from purchasing the more recent food items and would require less purchasing for Bon Appetit. In the buffet-style facilities, using smaller bowls or half-batches during non-peak hours would reduce the food thrown away due to Servsafe policies.

In coordination with these policy changes, the College must also prioritize education. Dining Services in tandem with the Office of Student Life should lead these efforts as the two parties responsible for providing food for students through the Meal Plan. If Dining Services is to reduce the number of items stocked at a given time or only stock items near their best buy dates, students should be made aware of the reasons behind the decisions. Dining Services should also make labeling information more transparent as many students remained confused on what the labels mean. More coordinated efforts to raise awareness and remind students of their waste behaviors should also be developed by Dining Services, the Office of Student Life, the Sustainability Office, and student organizations. Connecting food waste to social justice through Hunger and Homelessness week and integrating a "Food Waste Awareness Week" during Earth month would offer focused and direct engagement with students. While 96% of students have heard of food waste, the percentage of those who are aware of its consequences has not been measured.

Prioritizing food waste reduction may also require more investment in LaFarm, a food system actor that has the potential to reduce its food production waste. Funding the construction of a ServSafe kitchen facility at LaFarm could eliminate the waste of products on the verge of spoilage by offering the opportunities to can and pickle foods on site. Better storage facilities for LaFarm's produce would also reduce the spoilage of food that has yet to be used by Bon Appetit. While current storage facilities have not been identified as major sources of food waste on campus, LaFarm Manager Sarah Edmonds acknowledges that better storage, particularly spaces with moisture control, would contribute to waste reduction (S. Edmonds, personal communication, March 29, 2017).

The intangible aspects of waste reduction are perhaps the most necessary and most neglected measures. As discussed in Section VI, communication is both a major obstacles and opportunity for waste reduction. Providing a space for all food waste actors to exchange ideas must be a priority—perhaps even the first step—in any future action. Marie Fechik-Kirk hosted a meeting for all those interested in food recovery in the beginning of the Spring 2017 semester to discuss what additional organization was needed, identify obstacles, and inform attendees of recent developments. Representatives from Athletes Care, Lafayette Hunger Coalition, SEES, LEAP, Eco Reps, LaFFCo, First Year Commons, Meals at Third Street, Dining Services, LaFarm, the Nurture Nature Center, and the Sustainability Office attended. Future meetings about food waste should draw from this model but expand to include other topics surrounding food waste, such as composting and policy changes. The second frequently neglected measure is that of data collection. As an institution striving to reduce its greenhouse gas emissions, Lafayette should make regular efforts to weigh food and interpret trends. If the compost program resumes, the effort of separating food waste from trash will be a daily responsibility that

will facilitate measurements. Without these measurements of food waste, it will be impossible to track the effectiveness of future actions.

This discussion of food waste reduction alternatives highlights a number of actions Lafayette can pursue including policy change, education and awareness, resuming and improving composting, investing in LaFarm infrastructure, expanding food donations, and prioritizing communication. While this report clearly outlines these courses of action, it cannot be considered as useful unless others are willing to pursue future research. The food system is not linear as alluded to in the "food supply chain" model (Lipinski et al., 2013). Each actor impacts another member of the social map, and each member has the potential to correct or exacerbate wasteful behaviors on campus. While lack of coordination within the system would forestall progress, inaction would be the greatest failure. Prioritizing food waste reduction would allow Lafayette to pursue its mission of community, move towards a healthier environment, and empower students to live more sustainability once they leave Lafayette.

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Appendix A

IRB Submission:

Food Waste Independent Study

This study will be a part of an Engineering Studies Independent Study about food waste on Lafayette College's campus. The goals of this research are to gage awareness of the issue on campus, understand self-assessed behaviors, and to identify areas of concern for students that may be useful in identifying future marketing campaigns for food waste reduction. The final report aims to synthesize past and current research surrounding this issue in a literature review, identify existing infrastructure, behaviors, and obstacles surrounding food waste at Lafayette, and propose a path for future action based on research findings. With this study, I seek to understand the salience of the food waste as an issue for students at Lafayette and to communicate these findings in a way that will inform future decision-making.

Food waste is an emerging issue that has a growing presence in the scientific community. It is estimated that approximately one third of food produced is lost or wasted globally (Heikkila, Reinikainen, Katajajuuri, Silvennoinen, & Hartikainen, 2015). This waste primarily goes into landfills (Levis, Barlaz, Themelis, & Ulloa, 2010) where it leads to considerable pollution. Additionally, the economic and natural resources used to produce this unused food are ultimately squandered, while those struggling with food insecurity lose the opportunity to consume surplus. While no previous studies have been conducted on Lafayette's campus to assess food waste, either quantitatively or qualitatively, research has been conducted at other academic institutions. These experiments have largely been observational, such as identifying waste locations on campus (Smyth & Fredeen, 2009), surveying consumers to identify reasons for waste (Parfitt, Barthel, & Macnaughton, 2010), weighing food waste at different points in the food supply chain (Betz, Buchli, Gobel, & Muller, 2014), and surveying responses to educational campaigns (Whitehair, Shanklin, & Brannon, 2012).

Research for this project will primarily focus on the results collected through a student survey. This survey will target the scholarly goals stated previously through questions that measure the subjects' awareness of the issue, the individual salience of the issue, behaviors surrounding the issue, and potential motivating factors for behavioral adjustment. The survey will consist of the following questions:

1. Have you heard of food waste before? (Yes/No)
2. At the end of a meal, how often do you think about the food you waste? (Never, Rarely, Sometimes, Often, Every Meal)
3. How would you rate the importance of food waste as an issue on campus? (Very unimportant, Unimportant, Neutral, Important, Very Important)
4. How often do you take more food than you eat? (Never, Rarely, Sometimes, Often, Every Meal)
5. Say it's Wednesday and you're at a grab-and-go station in a campus dining facility. Would you buy a sandwich labeled "Tuesday"? (Yes, Yes but only if there were no sandwiches marked Wednesday, No)
6. Are you currently involved in any hunger organizations or initiatives?
7. Are you currently involved in any environmental organizations or initiatives?

8. How would you rate the following issues? (Very unimportant, Unimportant, Neutral, Important, Very Important)
    a. Fertilizer pollution
    b. Poverty
    c. Deforestation
    d. Unemployment rates
    e. Hunger
    f. Small business loss
    g. Use of fossil fuels
9. Do you have any suggestions on how to reduce food waste? (Write in)

Questions 1 and 2 specifically target awareness of the issue. Question 3 attempts to gage the salience of the issue. Questions 4 and 5 reflect student waste behavior. Questions 6 and 7 will be used to identify if involvement in related organizations is related to salience and awareness. Question 8 gages the salience of various environmental, social, and economic issues surrounding food waste. Data collected from this question will be used to identify which type of the three issues students most care about in order to better inform what consequences of food waste should be emphasized in future awareness campaigns. Question 9 provides an opportunity for students to contribute to future projects and food waste reduction initiatives.

The distribution of this survey will involve collecting information outside of dining facilities. I will stay at these locations for 1-2 hour periods and ask people if they are willing to participate. Willing participants will receive a paper copy of the survey to fill out at that time. Finished surveys will be placed in a closed box to be viewed at a later date. Participants will be given the debriefing statement after they have completed the survey.

The survey will be distributed during dining hours in order to obtain data while the participants mind is on the subject of food. This procedure will yield more accurate information regarding awareness and behavior. Survey data will be entered into an Excel spreadsheet and interpreted via statistical analysis and graphic representations. The data will be used to represent a randomized sample of students who use Lafayette's dining facilities and will inform future decisions about food waste on Lafayette College's campus. Understanding student awareness of the issue will indicate whether a future awareness campaign would be an effective step towards waste reduction. Salience of the issue may be used as a persuasive tool for administrative staff to take action or as an indicator that a deeper understanding of the issue amongst students is necessary. Indications of wasteful behavior regarding dates on food and overconsumption will inform future efforts to educate students about reducing their food waste.

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Final Survey:

Have you heard of food waste before?
□ Yes □ No

At the end of a meal, how often do you think about the food you waste?
□ Never □ Rarely □ Sometimes □ Often □ Every Meal

How would you rate the importance of food waste as an issue on campus?
□ Very Unimportant □ Un-important □ Neutral □ Important □ Very Important

How often do you take more food than you eat?
□ Never □ Rarely □ Sometimes □ Often □ Every Meal

Say it's Wednesday and you're at a grab-and-go station in a campus dining facility. Would you buy a sandwich labeled "Tuesday"?
□ Yes □ Yes, but only if there were no sandwiches marked Wednesday □ No

Do you eat fruit that is bruised or browning?
□ Yes □ Sometimes □ Never

Are you currently involved in any hunger organizations or initiatives?
□ Yes □ No

Are you currently involved in any environmental organizations or initiatives?
□ Yes □ No

How would you personally rate the importance of the following issues?

	Very Unimportant	Unimportant	Neutral	Important	Very Important
Hunger	□	□	□	□	□
Fertilizer Pollution	□	□	□	□	□
Poverty	□	□	□	□	□
Deforestation	□	□	□	□	□
High cost of living	□	□	□	□	□
Fossil fuel use	□	□	□	□	□
Business loss	□	□	□	□	□

Do you have any suggestions about how to reduce food waste on campus?