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Campus-Based Agriculture: The Future of Food at Gettysburg College

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Abstract

This research investigates various methods for producing food on the campus of Gettysburg College in order to improve food sustainability. The transportation of food contributes to the increased use of fossil fuels, which in turn leads to global warming and climate change. By producing a larger portion of its food on-campus, Gettysburg College could reduce the amount of food transported to the school, thereby lessening the College's environmental impact. Urban farming techniques, hydroponics, aquaponics, and greenhouse-based agriculture are explored as viable methods for achieving this goal. Examples of the use of these techniques on college campuses are drawn from Allegheny College, Acadia University, and Cornell University, among others. Possible strategies for Gettysburg College's implementation of the farming techniques proposed in this research are also included throughout.

Keywords

Agriculture, Food, Sustainability, Hydroponics, Gettysburg College

Disciplines

Environmental Studies | Food Studies | Higher Education | Natural Resources and Conservation

Comments

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Commercialized American agriculture is a widespread industry that provides a secure food supply for much of the country, including the thousands of colleges and universities in the United States. Many of these institutions, however, are located in urbanized areas unsuitable for conventional agriculture. Much of the food on urban campuses must be transported to the schools, often traveling far distances. Other campuses, regardless of location, may depend on third parties for their dining services. These larger dining service conglomerates often depend on widespread food networks that source food from distant locations. When the distance that food products travel is increased, the amount of energy needed to distribute the food also increases. These increases in energy use lead to elevated levels of fossil fuel combustion and carbon dioxide emissions, which contribute to climate change and global warming. If colleges and universities were to limit their need for food transportation, they could in turn reduce their negative environmental impacts. The purchasing of locally sourced foods is a valuable strategy for improving sustainability because it significantly reduces the distances that foods travel. However, there is another strategy that could be employed to effectively eliminate the need to transport a portion of a college's food supply at all: campus-based agriculture.

Campus-based agriculture allows students to be actively involved in their campus community while reducing the total amount of energy used to transport food to their college. The innovative techniques being utilized in campus-based agriculture are well suited to small

colleges, and these techniques also provide opportunities for student research and engagement in the life sciences. Given Gettysburg College's position as a small, rural liberal arts college with a flourishing research environment, campus-based agriculture stands as a viable method of improving campus sustainability. Particularly, the emerging methods of urban farming, hydroponics, aquaponics, and greenhouse-based agriculture would effectively utilize Gettysburg College's existing assets while reducing the negative environmental impacts associated with food distribution.

Though not located within an urban environment itself, Gettysburg College is equipped to adopt some innovative techniques from urban agriculture, the production of food within a city using local resources (Melcarek 433). Urban areas are typically ill suited to farming because of their limited amounts of growing space and natural resources; however, urban agriculture was developed to circumvent those obstacles (Collin and Collin 160). Thus, urban agricultural methods focus on utilizing available space and resources efficiently, a goal that is also central to sustainability. Because urban farming methods were specifically developed for areas with limited space, this type of agriculture is easy to implement within a small, pre-existing college campus without acquiring more land or building new structures. Furthermore, urban agriculture is highly fruitful; one-third of the world's vegetables, eggs, meat, and fish as well as thirty percent of the United States' agricultural production comes from urban farms (Melcarek 433). Urban farms do not require as much land as conventional farms, so the substantial contribution of urban farms to the global food supply indicates a certain degree of productivity that could prove effective in feeding the Gettysburg College campus community.

There are many methods of urban agriculture, including "community gardens, urban farms, edible schoolyards, roof gardens, and skyscraper [or vertical] farms" (Kaak 390). Of these

methods, roof gardens (also called rooftop gardens) would be particularly beneficial additions to the Gettysburg College campus. Rooftop gardens are a type of green roof, a roof that is covered by plants and soil (McKendry 241). Green roofs provide many benefits. Green roofs serve as insulation, increasing energy efficiency and reducing heating and cooling expenses (McKendry 241). Green roofs also reduce air pollution by filtering out carbon dioxide, and they can extend the lifespan of a roof by protecting it from the sun (McKendry 241). Many individuals also find green roofs to be aesthetically pleasing patches of color as opposed to the brown, gray, and black roofs commonly found on buildings (McKendry 242). When colleges utilize green roofs as rooftop gardens, the roofs have the additional benefit of producing food for the school on-site, thereby reducing the amount of food that must be transported to campus.

Carnegie Mellon University, Portland State University, Macalester College, and the City College of New York (CCNY) all have at least one building with a green roof (Egan; Wescott and Sundell; Mwamba). While all of these colleges are taking advantage of the cooling, insulating, and aesthetic benefits of green roofs, only CCNY reports using a green roof for the purpose of farming. This rooftop garden is reported to produce tomatoes, zucchini, cucumbers, broccoli, cauliflower, eggplants, and a variety of other vegetables for the campus community (Mwamba). The rooftop garden at CCNY evidences that urban agriculture techniques can be utilized to produce a wide variety of crops within the setting of a college campus. While some precautions are necessary, rooftop gardens are also suitable for retrofits (Shafique et al. 359). Provided that the appropriate structural information is taken into account (e.g. roof type, size, slope, and load-bearing capacity), existing roofs can be safely retrofitted with green roofs (Wilkinson et al.). Load-bearing capacity is the primary concern when adding a green roof to an existing structure, but the addition of green roofs to existing buildings is possible (Castleton et al.

1587). For example, Ohio State University added a green roof to an existing academic building in only fourteen days ("Green Roof on Howlett Hall"). Thus, if the proper precautions are taken, rooftop gardens could be added at Gettysburg College. Due to the need for students to be able to safely walk on the gardens to sow seeds and harvest crops, buildings with flat roofs, such as Masters Hall, the Dining Center, and Schmucker Hall, would be ideal candidates. Thus, rooftop gardens could prove useful additions to Gettysburg College that would supply the Dining Center and other campus eateries with fresh produce.

Another innovative agricultural method suitable for use on college campuses is hydroponic farming, or hydroponics. The term hydroponics refers to the cultivation of plant crops without soil (Crontn 91). Hydroponic systems can be described as situating plants with their roots in a nutrient-rich liquid medium that circulates through the growing apparatus, nourishing the plants (see fig. 1 for an example of a vertical or stacked hydroponic system).

Fig. 1. Oregon State University, and Barry Burnsides. *Hydroponics. Wikimedia Commons*, 22 Dec. 2014, commons.wikimedia.org/wiki/File:Hydroponics_(33185459271).jpg.

Hydroponic systems similar to the one shown in the preceding image are often kept in greenhouses, and multiple universities have employed hydroponic systems on their campuses.

For example, Acadia University in Nova Scotia, Canada has established the Growcer Project, a "hydroponic, vertical growing system housed inside a repurposed shipping container" (Turner). The Growcer Project is used to produce one hundred kilograms of greens and microgreens for campus dining facilities every month, and the hydroponic technologies use ninety-five percent less water than traditional agriculture (Turner). Similarly, Missouri State University also employs a vertical hydroponic growing system to produce food for consumption on campus (Young). The hydroponic system at Missouri State University operates out of a previously unutilized basement and produces herbs and specialty lettuces (Young). From 2016 to 2018, the project enabled the school to recover sixty thousand dollars that it would have otherwise spent on produce, and the project produced six thousand pounds of food within the same timeframe (Young). These universities show that empty spaces can be repurposed to produce significant amounts of food, saving money and utilizing all available resources.

Other ways to integrate hydroponics on a college campus include curriculum-based endeavors. For example, the University of Arizona engages students in hydroponics by providing a class on this agricultural technique ("PLS 217"). The course replaces lab time with greenhouse time while teaching students about plant science ("PLS 217"). At Gettysburg College, a similar approach could allow non-science majors to meet their laboratory requirement in an alternative learning environment. Thus, there are many ways to incorporate hydroponic farming on college campuses.

Just as hydroponics can be integrated with a college campus, this innovative farming technique can also be combined with other types of agriculture. The combination of hydroponics and aquaculture is called aquaponics (Crontn 91). Aquaponic systems grow fish and plants at the same time by cultivating a symbiotic relationship between the two species. The circulation of water between the plants and fish allows the animal waste from the fish to be used as a natural plant fertilizer (Crontn 91). The plants then filter the water before it is returned to the fish, allowing both food products to be grown simultaneously (Crontn 91). Aquaponic systems look very similar to hydroponic systems, but aquaponic systems add fish tanks, which are often kept beneath the plants (see fig. 2).

Fig. 2. Somma, Ryan. *Aquaponics with Catfish*. *Wikimedia Commons*, 4 June 2008, commons.wikimedia.org/wiki/File:Aquaponics_with_catfish.jpg.

Like hydroponic systems, aquaponic systems are commonly installed in greenhouses and can also be used on college campuses.

The University of New Hampshire and Allegheny College employ aquaponic systems on-site (Wright; Eatmon et al.). At the University of New Hampshire, the aquaponic system is

utilized for research as well as the production of food (Wright). Scientists at the University of New Hampshire are researching how to improve the efficiency of aquaponic farming, and their facility can grow heads of lettuce from seed to harvest weight in just thirty-five days (Wright). For reference, lettuces grown from seed in fields typically reach harvest weight in sixty-five to eighty days with some variability between cultivars (Hernandez 9). Thus, the work being done at the University of New Hampshire indicates that aquaponics can produce crops more efficiently than conventional agriculture, saving time and resources. At Allegheny College, the Food for Sustainability project grows aquaponic lettuces and tilapia throughout the year, selling the harvests to Parkhurst dining services on the college's campus (Eatmon et al. 329). The project produces twenty-five to fifty heads of romaine lettuce every week as well as one hundred pounds of tilapia each year (Eatmon et al. 331). The project also operates as an avenue for student research. Students have conducted research on ways to improve the mechanisms of the aquaponic system itself, studying how to improve plant and fish growth as well as the technology's operations (Eatmon et al. 331-332). Ultimately, the programs at the University of New Hampshire and Allegheny College provide promising examples of alternative ways to integrate campus-based agriculture with research.

While hydroponic and aquaponic systems are commonly installed in greenhouses, other methods of greenhouse-based agriculture are also crucial to the future of campus-based agriculture. Gettysburg College already has a greenhouse on-site, but its sore underutilization is a disservice to the students and college community. Revitalizing the greenhouse as a hub of experiential learning would greatly benefit the students and campus. Students interested in biology and environmental science could conduct groundbreaking research on emerging agricultural methods while providing Dining Services with locally grown produce.

Some examples of campus greenhouse use can be found in the programs at the University of Nebraska-Lincoln, Cornell University, and the University of Arizona ("Research"; Chang; "Controlled Environment Agricultural Center"). The University of Nebraska-Lincoln houses a 45,000 square foot Greenhouse Innovation Center for research in agronomy and horticulture ("Research"). A similar, though smaller, institution at Gettysburg College would allow students to expand into new areas of research, such as plant science and soil science, broadening and benefitting the campus' science programs. At Cornell, greenhouses are used to study many aspects of plant growth. Recent research topics have included the effects of LED lighting on plant growth as well as future developments in urban agriculture, such as vertical farming (Chang). Vertical farming refers to growing crops in vertical rows rather than horizontal rows; one acre of vertically stacked rows of plants can be equivalent to four to thirty acres of traditional outdoor farming (Collin and Collin 163). Installing a vertical farming system in the Gettysburg College greenhouse would enable students to research farming and produce food for the campus while using all of the available greenhouse space effectively. Lastly, the University of Arizona's Controlled Environment Agricultural Center (CEAC) is a research institution focused on the production of plants in greenhouses, also called "controlled environment agriculture" ("Controlled Environment…"). The CEAC serves as a hub for research, workshops, seminars, and outreach, allowing students and the community to be involved in the future of sustainable foods ("Controlled Environment…"). Through the CEAC, the University of Arizona uses greenhouse-based agriculture in order to "produce high value crops at maximum productivity in an efficient and environmentally friendly way" ("Controlled Environment…"). Expanding the use of Gettysburg College's greenhouse could thus equip the college to foster community engagement in food production through workshops and other outreach activities. The

programs at the University of Nebraska-Lincoln, Cornell University, and the University of Arizona serve as examples of the opportunities to integrate research with greenhouse-based agriculture on a college campus.

Ultimately, rooftop gardens, hydroponics, aquaponics, and greenhouse-based agriculture are all viable ways to increase on-campus food production at Gettysburg College. Rooftop gardens can be easily added to existing buildings, and hydroponic systems, aquaponic systems, or other alternative farming methods (e.g. vertical farming) could be used to revitalize unused spaces, namely the greenhouse. If established, these programs would increase the available opportunities for student research, providing possible areas of study for summer research involvement or senior research experiences. Overall, expanding student involvement in agricultural research could produce findings that would positively impact the surrounding farming community in Adams County and South Central Pennsylvania. In addition to the benefit of increasing research opportunities, these programs would reduce the need to order food from external sources, thereby lowering the greenhouse gas emissions associated with transporting food to Gettysburg College. Exploring methods of campus-based agriculture would utilize the school's existing assets while contributing to its overall goal of sustainability, making for a brighter future of food at Gettysburg College.

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