

Article

Food Systems in the Curriculum of American Undergraduate Sustainability and Environmental Science/Studies Programs

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Abstract

Food systems are crucial components of sustainable development challenges, from hunger to climate change to responsible patterns of production and consumption. Students in environmental degree programs would be better equipped to contribute to sustainability solutions, with insight into the production, processing, distribution, consumption, and disposal of food. In this paper, we aim to understand how sustainability and environmentally oriented programs (SEOPs) in American higher education institutions are preparing students to understand food systems, examining how frequently food systems classes are present in their curricula. Our study cataloged the curricular offerings and requirements of 449 undergraduate SEOPs in the United States for the 2024–2025 academic year. We find that 44% of SEOPs include food systems courses as electives in their programs of study, but only 9% make a food systems course a requirement. These findings suggest that food systems awareness may be deficient in college-trained sustainable development workers, potentially impeding efforts to achieve Sustainable Development Goals. This study offers a method for assessing the curricular integration of food systems content and provides a benchmark for those aiming to align academic programs with global sustainability targets. Integrating food systems courses into SEOP curricula can improve preparation for addressing interconnected sustainability challenges.

Keywords: food systems; Sustainable Development Goals; curriculum; AASHE; education; electives



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1. Introduction

Food is a foundational resource that plays a critical role in the well-being of individuals and communities worldwide. Food's significance goes far beyond mere sustenance; it is a vital component of global health, economic prosperity, and environmental integrity. In short, food has many and various connections to the three pillars of sustainability [1]. The necessity of transforming food systems has become highly evident as the world faces different challenges, like climate change, food insecurity, malnutrition, and environmental imbalance [2,3]. And, as food is deeply intertwined with numerous global and local issues, it is a critical focus for sustainable development and central to the successful pursuit of several of the United Nations's Sustainable Development Goals (SDGs).

Food is most readily linked to SDG 2 (Zero Hunger), which aims to improve nutrition and food security, as well as promote more sustainable forms of agriculture. Given that current food systems are responsible for producing both abundance and scarcity, there is

a growing recognition that sustainable agricultural practices must be scaled up to ensure that nutritious food is accessible to all while also protecting natural resources [4].

However, food is intricately linked to several other Goals, as well. Several markers of health and well-being that are part of SDG 3 are directly related to nutrition, including premature deaths from heart disease [5,6] and diabetes [7,8] and maternal mortality rates [9]. Adequate nutrition and clean, affordable energy (SDG 7) can sometimes be competitors for the same resources, particularly when it comes to land that might be cultivated for either food crops or bioenergy crops [10]. Reducing food waste is an explicit goal within SDG 12 (Sustainable Production and Consumption), as food systems are marked by inefficiencies and wastefulness. Currently, an estimated one-third of all food produced globally is either lost or wasted [11,12]. Further, agricultural production has particularly clear linkages to many resource management issues, including soil loss [13] and deforestation [14]. Comprehensive climate action (SDG 13) must include consideration of food systems. The agricultural sector accounts for roughly a tenth of global greenhouse gas emissions [15], while land use change associated with farming adds additional global and local climatic effects [16]. Food waste and the resultant decomposition of organic material is also a substantial source of greenhouse gases [17]. The refrigeration and transportation of food have their own climate impacts [18]. In addition, transforming food systems is critical for reducing the impact of climate change on agriculture and food security [3]. As with energy, agricultural production and life on land (SDG 15) are sometimes at odds. Biodiversity loss and land degradation are both directly connected to systems of food production and protecting terrestrial ecosystems is dependent on wiser agricultural practices [19,20].

Each of these Goals highlights the need for food systems to evolve in ways that promote sustainability, reduce resource inefficiencies, and address the growing environmental and social challenges associated with food production and consumption [4,21]. The interrelation between food systems and other aspects of the SDGs underscores the critical role that food system reformation plays in creating a sustainable future.

Food systems comprise the set of processes and elements by which populations are fed. Subsystems of the broader whole include crop cultivation and animal husbandry, processing, transportation, consumption, and waste management. Each of these subsystems presents its own complex challenges.

Our approach to this topic is informed by the theoretical framework of sustainability competencies [22], the skills that sustainability education should ideally cultivate. Within this framework, we particularly emphasize systems thinking, the skills needed for “identifying and understanding systems, predicting their behavior, and devising modifications to them” [23] (p. 675). A foundational command of systems thinking can be functionally valuable, both for sustainable development work generally and specifically for networks within food systems. That is, systems thinking gives sustainable development practitioners the knowledge and insight needed to navigate and contribute to the interdependent networks that underlie sustainable development challenges.

Given the central role of food systems in sustainable development, integrating food systems education into sustainability curricula is essential for preparing future leaders in environmental and development fields. To make meaningful progress towards achieving the SDGs (and whatever framework(s) may succeed them), the professionals who design and execute sustainable development strategies must be equipped with a comprehensive understanding of the interconnected domains that constitute food systems. These systems are inherently complex and interdependent, with changes in one area often producing ripple effects across others. A systems perspective, therefore, can reveal how shifts in agricultural practices influence environmental outcomes, social equity, and economic resilience [24,25], for example. Through food systems education, students learn to identify feedback loops,

trade-offs, and unintended consequences, skills that are critical for designing effective and equitable interventions. Moreover, food systems analysis provides valuable insights into key sustainability indicators, such as community health and economic stability, aligning with the three-pillar model of sustainability.

Education plays a pivotal role in raising awareness of the complexity and diversity within food systems, while also fostering a deeper understanding of how these systems function [26]. Institutions of higher education that offer programs in sustainability, environmental science, and related disciplines are uniquely positioned to advance food systems education. By embedding food systems into their curricula, these institutions can prepare their students with the interdisciplinary knowledge and critical thinking skills needed to address sustainable development challenges [27].

Moreover, food systems education encourages students to engage with both global and local sustainability challenges. While global issues such as climate change and biodiversity loss are critical, local instantiations of development barriers—for example, food deserts or agricultural runoff—require urgent attention, as well. Indeed, achieving the SDGs may be heavily dependent on the ability to localize issues [28,29]. This dual, global–local focus of food systems underscores the principle of “think globally, act locally,” a key idea in sustainability practice [30].

Importantly, studying food systems also invites ethical reflection, another key sustainability competency [22]. Issues such as food sovereignty [31], labor rights [32], and equitable access to healthy food [33] highlight the moral dimensions of sustainability. By grappling with these questions, students develop a deeper understanding of justice and inclusivity, preparing them to advocate for policies and practices that promote both environmental stewardship and social equity.

In sum, food systems education supports the core learning outcomes of sustainability programs: applying interdisciplinary knowledge, engaging in systems thinking, and developing practical, ethical solutions to complex challenges. It equips students not only with the technical and analytical tools needed for sustainability careers but also with the ethical awareness and (local) civic responsibility required to drive transformative change.

Given the importance of food systems education—both to nurture key competencies in sustainability and environmental science/studies students and to train the future leaders of the push to achieve the SDGs—it is critical to understand its prevalence within higher education. Particular attention is due to colleges and universities that house sustainability and environmentally oriented programs (SEOPs), as these programs will likely train the emerging generation of sustainable development professionals. The aim of the present study, therefore, is to determine the frequency with which food systems classes are present in SEOP curricula. Our objective is to assess to what degree food systems courses are currently a required or potential part of the programs of study of SEOP graduates.

To our knowledge, there has not been a comprehensive survey of SEOPs for the availability of food systems education-focused courses. The present study is designed to address this gap by answering two questions:

1. How many sustainability and environmentally oriented degree programs have food systems as a graduation requirement?
2. How many sustainability and environmentally oriented degree programs have food systems as an available elective?

Answers to these questions will provide insight into how SEOPs are preparing their graduates to effectively engage with the food systems at the heart of so many of the SDGs.

2. Methods

The focus of our research is on SEOPs, which we define as follows:

Baccalaureate degree programs that primarily focus on the scientific and interdisciplinary study of the environment and sustainability. These programs encompass fields such as Environmental Sciences, Environmental Studies, Sustainability Sciences, Earth Sciences, and related combinations like Geology and Environmental Studies or Marine and Environmental Science.

We exclude from the definition of SEOPs programs or fields that use the environment as the context for what is otherwise a disciplinary study, like Environmental Engineering.

Compiling data about food systems education in SEOPs across the United States requires a comprehensive list of relevant programs. For this purpose, we utilized the list created by the Association for the Advancement of Sustainability in Higher Education (AASHE). AASHE is an organization founded to promote justice and sustainability through initiatives in post-secondary education. Among the resources on the AASHE website is a list of the universities and colleges that have registered with them as having some sort of environmental science/studies, sustainability, or other related program. While the AASHE list may not cover the entire population of SEOPs, it provides an extensive sampling frame that should allow for significant inference about SEOPs in general.

We filtered the AASHE list to limit entries to baccalaureate degrees at U.S. institutions, yielding 1019 programs. Further filtering by academic discipline to include only “Environmental Studies and Sciences” and “Sustainability Studies and Sciences” programs narrowed the list to 629 programs. After this website-enabled filtering, we manually reviewed the names of degree programs to assess their alignment with our definition of SEOPs. After both layers of filtering were complete, we were left with a list that comprised 449 total programs. These programs were housed across 361 unique institutions, covering 41 states and the District of Columbia.

To assess whether these SEOPs had a food systems course as a requirement or elective, we examined the content of the departmental websites associated with each program. The critical information sought in this search was a list of courses that were either a requirement for graduation (“core courses”) or were options for satisfying degree requirements (“elective courses”). In some instances, the departmental websites did not provide this information. In these cases, we examined the institution’s academic catalog.

While food systems comprise the interlocking subsystems of production, processing, transportation, consumption, and disposal, a course needed only to cover at least one of these subsystems to be counted as a “food systems course.” As syllabi were not available for all courses across all campuses, for consistency’s sake we assessed the content of core and elective courses through the course title. Courses labeled with “food” or other terms that were directly related to food systems were categorized as “food systems courses.”

This approach of analyzing and coding course titles to assess food systems content is consistent with previous scholarship on sustainability education. O’Byrne et al. (2015), for example, used course catalogs to determine the disciplinary breadth and proportion of required and elective courses in sustainability programs [34]. A recent survey of methods to assess the integration of sustainability into engineering curricula found that course catalog content analysis was one of the most commonly employed processes [35].

Data collection was conducted between October 2024 and March 2025, with all coding shared between two researchers. Discrepancies in classification were resolved through discussion between the two coders and a third author to ensure consistency.

3. Results

Out of the 449 SEOPs assessed, we found that 198 (44.1%) had listed at least one food systems course elective that could be used to satisfy a degree requirement. Forty-one programs (9.1%) had a food systems course as a core course that was com-

pulsory for graduation. These findings suggest that a significant proportion of SEOPs may not be systematically supporting the development of key sustainability competencies through dedicated coursework in food systems. Of these 41 programs with a food systems core course, 32 had at least one additional elective course in food systems. A complete list of the 239 SEOPs with either a requirement or an elective can be found at the following address: <https://osf.io/mbzwj> (accessed on 15 May 2025).

Figure 1 shows the geographical distribution of SEOPs with food systems courses. In total, 40 different states plus the District of Columbia had at least one SEOP at an institution within their borders. In addition, two institutions offered online degrees that feature food systems electives, expanding access outside of traditional geographic boundaries.

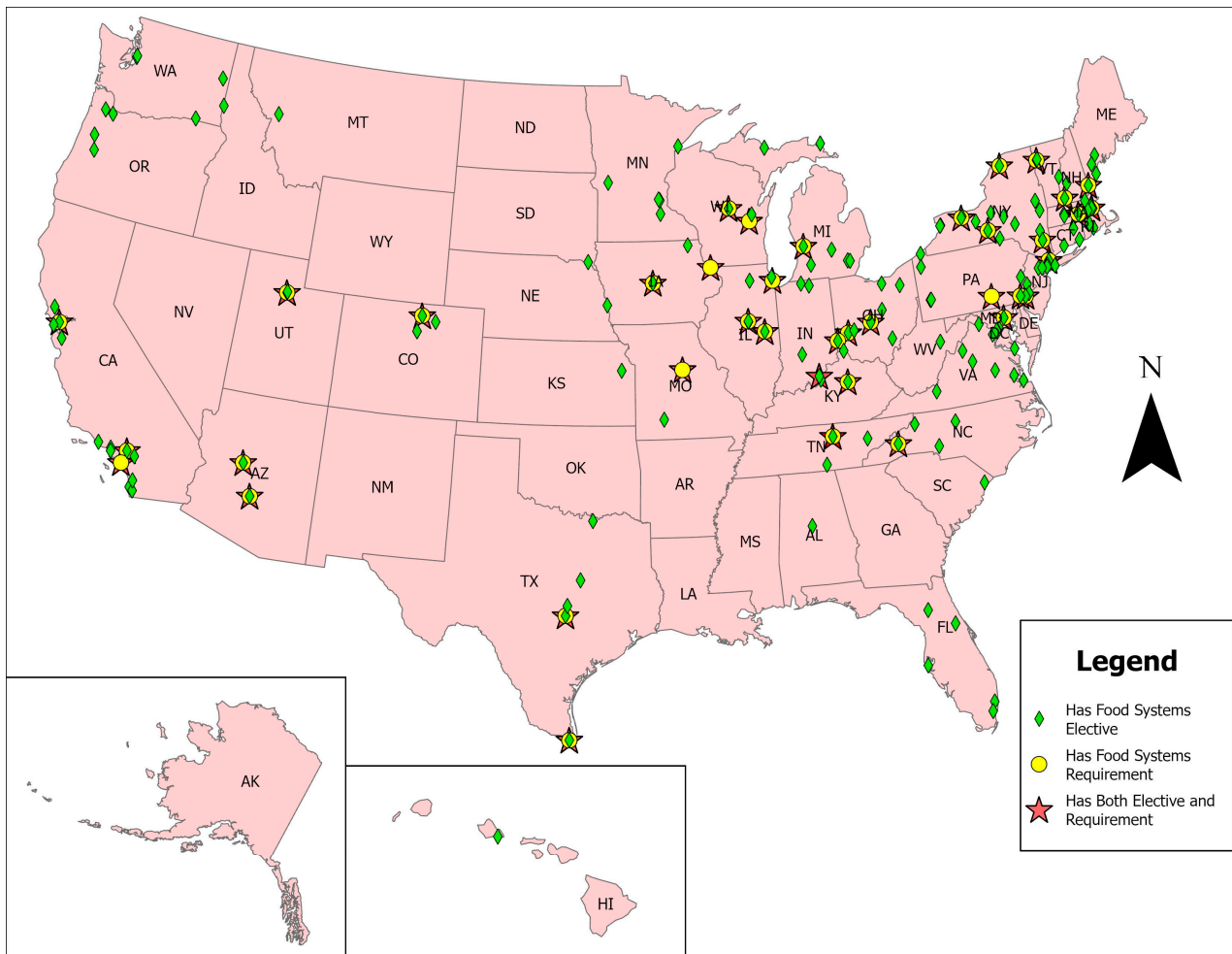


Figure 1. Geographical distribution of Sustainability and Environmentally Oriented Programs in the United States during the 2024–2025 academic year.

To better understand the institutional commitment to food systems education within SEOPs, we refined our search to focus specifically on programs that have food systems requirements rather than those offer food systems elective courses. Required courses serve as a strong indicator of curricular prioritization, as they reflect the knowledge and competencies that programs deem essential for all graduates. By analyzing required courses, we can gain a clearer picture of how food systems are being integrated into the foundational training of future sustainable development professionals.

Table 1 provides a summary of information about the 41 SEOPs that have food systems classes as graduation requirements. We found that most course titles suggest that courses will have a broad coverage of the topic (e.g., “Introduction to Food Systems”). However,

several titles suggest a specific focus on parts of food systems, including production (e.g., “Global Agricultural Sustainability”), justice and ethics (“Ethics of Eating”), and culture and society (“Food, Society, and Power”). Typically, these programs required a single course be completed to meet the requirement, although several programs had two or more.

Table 1. Details of SEOPs’ required food systems courses.

Institution Name	Program Name	Course Title(s)	Division	Cross-Listing
Arizona State University	Earth and Environmental Sciences	Sustainable Food and Farms	Upper	No
Champlain College	Applied Sustainability	Food Systems and Policy	Lower	No
Clark University	Environmental Science	Multiple, including, Food Security and Climate Change	Lower	No
Colorado State University	Environmental and Natural Resources Economics	Multiple, including Economics of Food Systems	Lower	Yes
Cornell University	Environment and Sustainability Studies	Ethics of Eating	Lower	No
Grand Valley State University	Environmental and Sustainability Studies	Multiple, including Global Agricultural Sustainability	Both	No
Illinois State University	Environmental Systems Science and Sustainability	Foodways	Lower	No
Indiana University (Online)	Sustainability Studies	Global Change, Food, and Farming Systems	Upper	No
Iowa State University	Climate Science	World Food Issues	Upper	Yes
Johns Hopkins University	Environmental Science & Studies	Water, Energy, and Food Nexus	Lower	No
Keene State College	Sustainability Studies	Food, Health, & Environment Farming with Nature in Mind	Lower	No
Messiah University	Sustainability Studies	Food, Society, and Power	Upper	No
Miami University (OH)	Environmental Science	Introduction to Food Systems	Lower	No
Northeastern University	Environmental Studies	Multiple, including Food Justice and Community Development	Both	No
Northeastern University	Environmental and Sustainability Sciences	Food Security and Sustainability	Upper	No
Pitzer College	Environmental Analysis	Multiple, including Food, Culture, Power	Lower	Yes
Prescott College	Environmental Humanities	Transforming Community Food Systems	Upper	Yes
Rochester Institute of Technology (NY)	Environmental Sustainability	Sustainable Food Systems	Upper	No
Roosevelt University	Sustainability Studies	Food	Lower	No
Sarah Lawrence College	Environmental Studies	Food, Agriculture, Environment, and Development	Upper	No
St. Lawrence University	Environmental Studies	Agriculture and the Environment	Upper	Yes
Swarthmore College	Environmental Studies	Our Food	Lower	Yes

Table 1. *Cont.*

Institution Name	Program Name	Course Title(s)	Division	Cross-Listing
Tennessee Technological University	School of Environmental Studies	World Food and Society Global Food Systems Sustainability and Insecurity	Both	No
Tennessee Technological University	Environmental & Sustainability Studies	World Food and Society Global Food Systems Sustainability and Insecurity	Both	No
Tennessee Technological University	Environmental and Sustainability Studies	World Food and Society Global Food Systems Sustainability and Insecurity	Both	No
The Ohio State University	Environment, Economy, Development, and Sustainability	Food Security and Globalization Food System Planning and the Economy	Upper	No
University of California, Berkley	Environmental Sciences	Multiple, including Food Systems in a Changing World	Both	No
University of California, Irvine	Environmental Science and Policy	Sustainable Food and Water Systems	Lower	No
University of Dayton	Sustainability	Food, Energy and Water Nexus	Upper	No
University of Dubuque	Environmental Science	Food and the Environment Agroecology	Lower	No
University of Illinois, Urbana-Champaign	Earth, Society, and Environmental Sustainability	The World Food Economy Humanity in the Food Web	Lower	No
University of Kentucky	Environmental & Sustainability Studies	Multiple, including Food Ethics	Lower	No
University of New Hampshire	Agriculture and Food Systems	Multiple, including Sustainable Agriculture and Food Systems	Upper	No
University of North Carolina, Asheville	Environmental Science	Economics of Food Agriculture	Both	No
University of Texas at Austin	Sustainability	Global Food, Farming and Hunger	Upper	No
University of Texas Rio Grande Valley	Sustainable Agriculture and Food Systems	Multiple, including Food and Culture	Upper	Yes
University of Wisconsin-Stevens Point	Sustainable Food and Nutrition	Ecology of Foods	Upper	No
University of Wisconsin-Oshkosh	Environmental Studies	Science of Sustainable Food	Upper	No
Vassar College	Environmental Studies	Geographies of Food and Farming Food Fights	Upper	Yes
West Chester University of Pennsylvania	Sustainable Food Systems Management	Sustainable Food Systems	Lower	Yes
Westminster University—Utah	Environmental Studies	Ecology of Food Systems	Lower	No

About an equal number of programs (16 versus 15) have food systems requirements listed as lower-division classes—those that are pitched to first- or second-year students—and upper-division classes. Seven programs have food systems requirements that could be satisfied by either a lower- or upper-division class.

In terms of the departmental location of the courses, only nine SEOPs with food systems requirements had the requirements cross-listed between multiple academic departments (e.g., jointly offered through the Anthropology, History, and Philosophy departments). The majority (32) of programs did not have cross-listed food systems courses.

4. Discussion

This article explores the prevalence of food systems courses in the curriculum of American SEOPs. Food systems are directly and indirectly connected to numerous Sustainable Development Goals, suggesting that a robust understanding of the intricacies of food systems is critical to making meaningful progress towards achieving those SDGs. If the upcoming generation of sustainable development professionals—many of whom may graduate from SEOPs—is to be well-prepared for their roles, it is critical that their education include structured coursework dedicated to food systems.

Examining the degree requirements of 449 U.S. SEOPs revealed that, in the 2024–2025 academic year, fewer than one in ten programs made a food systems course compulsory for graduation. Further, less than half of programs featured a dedicated food systems course as an elective that could be used to satisfy graduation requirements. These values suggest that there is currently a gap in the curricular integration of food systems information—at least in the form of standalone courses—despite the centrality of food to numerous ecological, social, economic, and health aspects of sustainability at local and global scales. A majority of SEOPs students may graduate without formal exposure to the complexities of food systems, potentially missing a vital avenue to practicing systems thinking skills, ethical reasoning, and interdisciplinarity, as well as acquiring content knowledge and general sustainability literacy.

The limited presence of required food systems courses links to the question of the extent to which and how SEOPs are equipping students with essential sustainability competencies. Systems thinking, identified as a core sustainability competency [22], is particularly relevant given the complexity and interdependence of food systems. Structured exposure to food systems gives students opportunities to practice systems-based analysis, identify feedback loops, and understand cross-sectoral impacts. Addressing climate change (SDG 13), for example, is dependent on understanding agricultural practices, the role of land use changes, and patterns in the demand for carbon-intensive products like meat. SEOPs graduates who are familiar with the linkages within food systems and the linkages between food systems and other systems may be more capable of recognizing and formulating holistic solutions. The absence of such coursework may therefore represent a gap in competency-based education within SEOPs.

The existing scholarship provides guidance on how food systems courses for SEOPs might be structured. Jordan et al. [36], for example, propose a three-stage model for food systems programs. The first stage entails offering introductory courses to explain food production processes, as well as the impacts of production on people and the society at large. The second stage is where students learn that food is grown according to social structures and systems, and that factors like culture, geography, history, and the economics of a place strongly influence food processes and systems. At this stage, students also learn how to monitor food systems, create sustainable food system frameworks, and understand how specific societies are affected by these systems. The third stage involves capstone courses, where students put into practice what they have been learning.

While it is not fully appropriate to rescale a program-level model to individual courses, Jordan et al.'s [36] framework does provide a basis for assessing the food systems classes offered by SEOPs. Although our study did not assess course content in detail, the titles of the required food systems courses suggest that many required courses engage the first and/or

second stages of the model. Embedding food systems education across multiple levels of the curriculum could help students develop improved systems thinking and applied problem-solving skills, for food systems specifically and for sustainable development more generally. Offering dedicated, integrative experiences such as capstone projects may be another route by which SEOPs could foster deeper learning.

Across a range of possible approaches and structures, elevating food systems within SEOP curricula presents opportunities for pedagogical innovation and improvement of student outcomes. Food readily links to experiential and community-based learning; for example, through conducting food/food waste audits or through collaborations with food banks. These methods have a strong record of increasing student engagement and deepening understanding [37,38]. Campus gardens might be a particularly impactful project type, as time spent in nature can strengthen the connection to nature and improve well-being [39,40]. Such experiences not only deliver academic content but also cultivate practical skills and civic responsibility. As food systems touch on diverse fields, including biology, public health, sociology, economics, and agronomy, food systems courses are natural venues for the sort of interdisciplinary dialog and syncretism that is a key competency of sustainability education [22]. Designing attractive, impactful, and memorable courses may help spread sustainability awareness beyond the proportion of students who are naturally inclined to enroll in SEOPs.

Although there are clear benefits to incorporating food systems courses in the SEOP curricula, programs and institutions still can face several barriers to the widespread integration of food systems as requirements or electives. The faculty within SEOPs—many of which have a relatively small number of faculty lines—may lack food systems expertise. And while interdisciplinarity in the academy is increasingly appreciated, traditional departmental and disciplinary siloing remain, which inhibits cross-campus course development [41] and may make it difficult to cross-list or co-teach courses. Addressing these challenges may require institutional support, faculty development, and new curricular designs. This study did not directly investigate these factors and they are important avenues for future research and institutional action.

This study makes a novel contribution to the SDG literature by providing the first comprehensive, quantitative snapshot of food systems education across U.S. SEOPs. Through systematically analyzing 449 programs, this work provides replicable methodology and a benchmark for future curricular assessments. The findings have practical implications for curriculum designers and sustainability educators seeking to align academic programs with the SDGs through, for example, hiring strategies and course development. Moreover, the approach used here could be adapted to assess the integration of other cross-cutting sustainability topics, such as energy, climate, or justice.

The analysis in this paper is limited in several ways. First, in using the list of programs registered with AASHE, we may have incidentally excluded some schools and programs from assessment. If there were some kind of systematic reason that these programs were not registered on AASHE, this omission could potentially skew the results. Second, in restricting our assessment to course titles, we may have missed some courses that focus on food. For example, food might be made the thematic core of a research methods or composition course. (At our home institution, the introductory communication course, which is used by a large number of students to satisfy a general education requirement, adopted SDGs as the topic through which the content matter is taught). While this method of catalog content analysis is consistent with prior sustainability curricular studies [34,35,42], it may overlook courses that address food systems without explicitly referencing them in the title. Third, we must recognize that requirements and electives are not the only way to impart learning. Students, particularly those that are most likely to

engage in food-related sustainable development work, might have their education enriched by co-curricular activities like internships, research, or social organizations related to food systems. Though these experiences may meaningfully build an understanding of food systems, they do not typically constitute the dedicated structure of an SEOP.

Future research could address these limitations and build on the current research in various ways. The research attempt to characterize the content of the food systems courses this study identified. The collection and analysis of syllabi from these courses might reveal trends in what material is emphasized (or omitted) in the food systems courses taken by SEOP students, including an explicit focus on the key sustainability education components of systems thinking and interdisciplinarity. Interviews with SEOP faculty could serve to add contextual richness to the presence (or absence) of food systems course(s) in the curriculum, exploring the role of these courses or the barriers to their introduction. Further, a follow-up study could investigate the impact that having (or not) a food systems course in a curriculum has on student understandings of and opinions about sustainable food systems. Such research could explore the relationships between food systems courses and behavior (e.g., vegetarianism), opinions (for example, about what a sustainable food system looks like), and knowledge of SDGs. A longitudinal study of SEOP graduates might assess the impact of food systems courses on career choice and sustainability literacy. Finally, future research might run an analysis similar to the current one to assess the prevalence of other topics with rich and multiple ties across the many SDGs (e.g., energy). Such an analysis would provide some context for the 9% and 44% values in this research, providing an indication of whether these values are particularly low or high.

5. Conclusions

In the global push to achieve the U.N. Sustainable Development Goals, higher education plays a key part in preparing future sustainability leaders. This study highlights a notable gap in the integration of food systems education within SEOP curricula, and therefore in the preparation provided by these programs. This gap suggests that many students may complete sustainability and environmental degrees without formal exposure to food systems, despite their centrality to multiple SDGs.

To address this gap, we recommend that SEOPs conduct curriculum audits to assess the integration of food systems content and identify opportunities for enhancement. Programs should consider embedding food systems courses as core requirements to ensure all graduates practice systems thinking, ethical reasoning, and interdisciplinary competencies. Interdepartmental collaboration and faculty development initiatives can support the creation and delivery of such courses, particularly in programs with limited food systems expertise. These efforts align with broader calls for sustainability education reform and can help prepare students to address complex, interconnected challenges.

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