



Sustainable Engineering Solutions for the Organic Food Trend

Hong Yi Li^a, Ai Chin Thoo^b, Hon Tat Huam^c and Ying Tuan Lo^d

Universiti Teknologi Malaysia^{ab}, City University of Macau^c, XJTLU Entrepreneur College, Xi'an Jiatong-Liverpool University^d

Corresponding Author's Email: lhy527666@gmail.com

ABSTRACT

BACKGROUND & CONTEXT

The development of organic food processing reflects a general shift in society towards sustainability, health, and ethical production. Despite advances in organic agriculture and increasing consumer awareness, notable gaps remain in food processing technology and education, particularly in how they align organic values.

PURPOSE OR GOAL

This article aims to address the disconnect between current engineering education and the specific needs of the organic food sector by proposing a framework to integrate organic food processing principles into engineering curricula.

APPROACH OR METHODOLOGY

Using content analysis, this study examines recent academic literature and curriculum trends to explore how engineering education can evolve to meet the demands of the organic food processing industry.

OUTCOMES

The analysis identifies key areas—such as energy efficiency, quality control, and curriculum innovation—where engineering students can meaningfully engage. It also highlights the value of experiential learning and interdisciplinary collaboration in enhancing educational relevance.

CONCLUSIONS

The article advocates for a more inclusive, sustainability-oriented engineering education system that better prepares students to contribute to the organic food system, addressing real-world challenges through applied knowledge and ethical responsibility.

KEYWORDS

Engineering Education, Sustainability Engineering, Organic, Food Trend, Interdisciplinary Collaboration.

Introduction

The global food system faces increasing sustainability challenges, including resource depletion, greenhouse gas emissions, and public health concerns (Araújo et al., 2023; Prasanna et al., 2024). At the same time, the organic food industry is booming as consumers and producers seek ways to reduce chemical inputs, maintain ecosystem integrity, and improve the nutritional quality of food (Meena et al., 2023; Nayar, 2025). Despite this, engineering education remains rooted in the traditional food processing model, which prioritizes efficiency, automation, and large-scale production (Awulachew, 2024). In contrast, organic processing emphasizes low-cost operations, sustainability, and life cycle thinking.

Sustainable engineering is an interdisciplinary field that aims to evaluate and reduce the environmental impact of engineering systems through a life cycle perspective (from raw material acquisition, production and processing to product disposal) (Bassey et al., 2024; Larsen et al., 2022). Its core methods include life cycle assessment (LCA), resource efficiency optimization, and clean production technology, with the goal of protecting natural ecology and energy resources while meeting social and economic needs (Jie et al., 2023; Voronina et al., 2024; Yang and Solangi, 2024).

This study focuses on the following core questions: What are the main differences in technology and teaching methods between traditional food processing and organic food processing? By combining the life cycle thinking of organic food processing with sustainable engineering principles, engineering education students can more effectively develop technical capabilities and sustainable awareness.

Literature Review

Organic Food Trend

Purchase intention refers to a consumer's goal or plan to purchase a specific product or service in the future (Jaravaza et al., 2025; Makudza et al., 2024; Zeqiri et al., 2024). In addition, purchase intention is defined as the degree to which consumers purchase products from stores and their willingness to purchase desired products or services. (Duong and Ta, 2025; Ebrahimabad et al., 2024; Makudza et al., 2024).

Therefore, the more a product meets the needs of consumers, the higher the consumer's purchase intention (Odoom, 2022; Rizomyliotis, 2024; Song et al., 2024). Nowadays, many people are interested in green products.

The main reason is that green products are more environmentally friendly than traditional or competing products in production, use and process. For example, when consumers are concerned about their health, some health-related products (such as organic food) can increase consumers' purchase intention (Kumar et al., 2025; Ma et al., 2022; Qi et al., 2024). When consumers buy organic food, they will regard it as a sustainable product that is beneficial to human health and nature (Musah and Yakubu, 2022; Raj et al., 2024).

For consumers who care about health, environmental sustainability, and the nutritional value of food, they will show positive purchasing intentions even if organic food is expensive (Nadricka et al., 2024; Roy et al., 2023). For consumers who care about health, environmental sustainability, and the nutritional value of food, they will show positive purchase intention even if organic food is expensive. Nowadays, both developed and developing countries are paying attention to the concept of healthy food, and the sales of organic food are also growing.

Sustainable Engineering

As an interdisciplinary field, sustainable engineering attempts to balance the triple bottom line of environment, society and economy through a life cycle perspective (El Haouat et al., 2024; Gutierrez-Bucheli et al., 2022). However, the existing framework relies too much on life cycle assessment (LCA) and resource efficiency indicators and often ignores the institutional and market barriers faced by clean production technology and circular economy in practice (Maklavany et al., 2023). LCA can quantify emissions and resource consumption, but due to the different data acquisition costs and model assumptions in different places, its results are difficult to directly provide actionable guidance for policymakers and engineers (Maklavany et al., 2023; Pinedo Lopez et al., 2024).

To truly promote green transformation, sustainable engineering must go beyond single technical assessment and combine incentive mechanisms, fair distribution and stakeholder collaboration to achieve practical benefits in different contexts (Aldama et al., 2023).

In terms of research methods and tools, quantitative models such as LCA, material flow analysis (MFA) and multi-criteria decision analysis (MCDA) have frequently appeared, but they are controversial due to their over-reliance on assumptions (CAVALLI). Although dynamic life cycle models attempt to introduce time and technological progress factors, their simulation of market fluctuations and path dependence is still one-sided (Rodino et al., 2023; Van Hoof et al., 2024); while digital monitoring methods such as Industry 4.0 and the Internet of Things are seen as solutions, they exacerbate technological inequality between large and small enterprises and developed and developing regions under high costs and data gaps (Atieh et al., 2023; Peter et al., 2023). Researchers need to analyze the applicability of these tools at different scales and in different regions from a critical perspective and reflect on whether they truly contribute to sustainable goals or provide advantages to a few pioneers.

The application of sustainable engineering in the fields of construction, transportation, and chemical industry is mostly "demonstration" cases, lacking a universal model that can be promoted (Huang et al., 2025). For example, Nordic passive buildings significantly reduce energy consumption with the advantages of climate and capital, but it is difficult to replicate in areas with limited climate conditions and financial support; although the clean production transformation of US petrochemical companies has reduced volatile organic compound emissions, it is heavily dependent on government subsidies, and small and micro enterprises are unable to follow suit (Caglar and Askin, 2023; Tariq et al., 2022).

Current research focuses on improving technical performance, but rarely pays attention to the policy environment, community participation, and value sharing process (Maklavany et al., 2023). Future research should expand cases to different socioeconomic backgrounds, and deeply examine the impact of policy incentives, public participation, and benefit distribution mechanisms on the effectiveness of sustainable engineering, so as to form a sustainable engineering paradigm with universal significance (Esiri et al., 2023; Hao et al., 2022).

Research Methodology

Content analysis is one of the most commonly used analytical methods, which can effectively analyze the current status of a field and thus understand the development trend of the field (Bhandari, 2023; Downe-Wamboldt, 1992). This study only included English papers published in academic journals in the Scopus database between 2015 and 2025. Data mining was conducted in 2023, using keywords such as "sustainable engineering", "organic food trend", "engineering education" and "food trend" to search for studies. Keywords appeared in the titles and abstracts of the searches and were sorted by relevance. Figure 1 shows all the steps of literature screening.

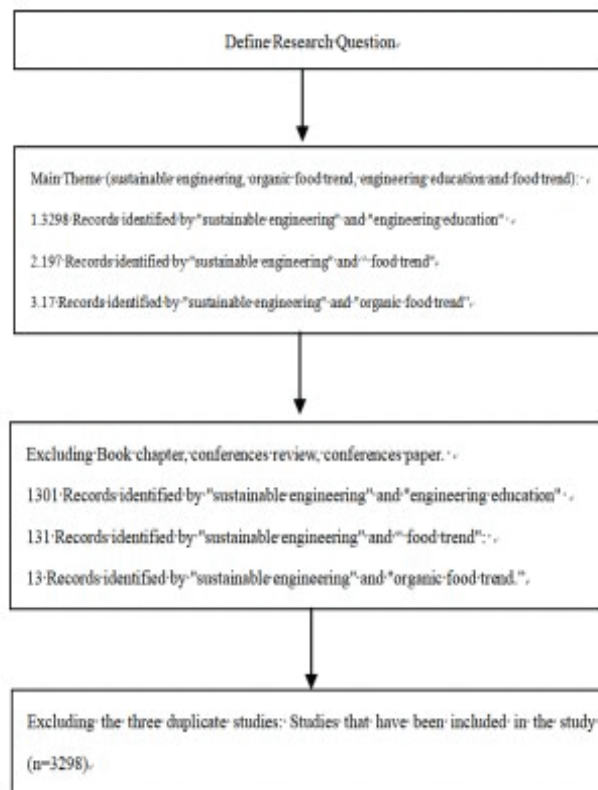


Figure 1: Flow Diagram for the Selection of Literature Reviewed

Discussion

Table 1 compares the representation of traditional and organic food processing models in engineering education. The comparison reveals significant differences in content, teaching methods, and values. The traditional model emphasizes production efficiency and shelf life, while the organic system emphasizes minimal processing, nutrient retention, and ecological integrity. Many engineering students have not yet been exposed to other evaluation criteria, such as life cycle impact, food integrity, or consumer trust. Projects that successfully integrate organic food processing often adopt a "farm-to-campus" collaborative model with local cases.

These practices not only enhance students' technical skills, but also cultivate students' ethical thinking and sustainable awareness. However, the promotion of such practices still faces the problem of insufficient course certification mechanisms and university support mechanisms.

Table1 : Comparison of educational perspectives on organic and conventional food processing in engineering education

Category	Organic Food Trend	Traditional Food Trend
Core Values	Minimal processing, authenticity, sustainability	Efficiency, stability, scalability
Engineering Focus	Low-impact techniques, renewable energy, small- batch design	High-speed automation, long-term preservation
Learning Methods	Experiential, community engagement, case-based	Lecture-based, laboratory exercises
Key Outcomes	Food quality, ethical responsibility, innovation	Mass production, technical optimization
Industry Partners	Agricultural cooperatives, local SMEs, NGOs	Large manufacturers, regulatory agencies

Future Research Directions

To further promote the integration of organic food processing and engineering education, future research should focus on the following aspects: first, conduct large-scale interdisciplinary educational course experiments to compare the long-term impact of different teaching modes (such as short-term workshops and semester-long projects) on students' technical capabilities and sustainable ethical awareness; second, establish a stable cooperation mechanism with organic certification agencies, farms and food companies, and explore the feasibility and best practices of the "farm-campus" integrated teaching base; finally, develop standardized evaluation tools and continuously optimize course content to meet the evolving industry needs and sustainable development goals.

Conclusion

As the organic food industry continues to grow, its demand for engineering technology and ethical concepts is also increasing. This article proposes the idea of incorporating organic food processing into engineering courses, aiming to cultivate compound talents with social responsibility and environmental awareness.

Through conscious curriculum design, project-driven learning and interdisciplinary cooperation, engineering education can cultivate professional forces that emphasize both technology and values for the sustainable transformation of the organic food system. Combining technological innovation with sustainable food practices will bring dual impetus to educational reform and industry development.

References

- Araújo, Rafael G, et al. (2023). Agro-food systems and environment: Sustaining the unsustainable. *Current Opinion in Environmental Science & Health*, 31, 100413. <https://doi.org/10.1016/j.coesh.2022.100413>
- Atieh, Anas Mahmoud, et al. (2023). The role of intelligent manufacturing systems in the implementation of Industry 4.0 by small and medium enterprises in developing countries. *Engineering Reports*, 5(3), e12578 <https://doi-org.ezproxy.utm.my/10.1002/eng2.12578>
- Awulachew, Melaku Tafese. (2024). Engineering principles and business model innovation in food systems to achieve sustainable development goals. *Asian Science Bulletin*, 2(3), 229-241. <https://doi.org/10.3923/asb.2024.229.241>..<https://doi.org/10.3923/asb.2024.229.241>
- Bassey, Kelvin Edem, et al. (2024). AI-Enhanced lifecycle assessment of renewable energy systems. *Engineering Science & Technology Journal*, 5(7), 2082-2099. 10.51594/estj/v5i7.1254
- Bhandari, Arabinda. (2023). Design thinking: from bibliometric analysis to content analysis, current research trends, and future research directions. *Journal of the Knowledge Economy*, 14(3), 3097-3152. 10.1007/s13132-022-00920-3
- Caglar, Abdullah Emre and Askin, Bekir Emre. (2023). A path towards green revolution: How do competitive industrial performance and renewable energy consumption influence environmental quality indicators? *Renewable Energy*, 205, 273-280. <https://doi.org/10.1016/j.renene.2023.01.080>
- CAVALLI, MATILDE. Development and application of an integrated Life Cycle Assessment and Multi-Criteria Decision Making Model to support sustainable solutions in the fashion industry: the case of Fashion Art. <https://hdl.handle.net/20.500.12608/64711>
- Downe-Wamboldt, Barbara. (1992). Content analysis: method, applications, and issues. *Health care for women international*, 13(3), 313-321. <https://doi.org/10.1080/07399339209516006>
- Duong, Nhung Thi Hoai and Ta, Minh Quang. (2025). Investigating online purchase intention of Gen Z on TikTok live stream shopping. *HO CHI MINH CITY OPEN UNIVERSITY JOURNAL OF SCIENCE-ECONOMICS AND BUSINESS ADMINISTRATION*, 15(4). <https://doi.org/10.46223/HCMCOUJS.econ.en.15.4.3416.2025>
- Ebrahimabad, Fatemeh Zare, et al. (2024). Augmented reality versus web-based shopping: how does AR improve user experience and online purchase intention. *Telematics and Informatics Reports*, 15, 100152. <https://doi.org/10.1016/j.teler.2024.100152>
- El Haouat, Zineb, et al. (2024). Environmental optimization and operational efficiency: Analysing the integration of life cycle assessment (LCA) into ERP systems in Moroccan companies. *Results in Engineering*, 22, 102131. <https://doi.org/10.1016/j.rineng.2024.102131>
- Esiri, Andrew Emuobosa, et al. (2023). Public perception and policy development in the transition to renewable energy. *Magna Scientia Advanced Research and Reviews*, 8(2), 228-237. <https://doi.org/10.30574/msarr.2023.8.2.0101>.
- Gutierrez-Bucheli, Laura, et al. (2022). Sustainability in engineering education: A review of learning outcomes. *Journal of Cleaner Production*, 330, 129734. <https://doi.org/10.1016/j.jclepro.2021.129734>
- Hao, Chen, et al. (2022). Enhancing public participation in governance for sustainable development: Evidence from Bungoma County, Kenya. *Sage Open*, 12(1), 21582440221088855. <https://doi.org/10.1177/21582440221088855>
- Jaravaza, Divaries Cosmas, et al. (2025). Online purchase intentions of affluent women: blending African beliefs, consumer vanity and luxury beauty products online purchase intentions. *Cogent Social Sciences*, 11(1), 2451119. <https://doi.org/10.1080/23311886.2025.2451119>
- Larsen, Vibeke Grupe, et al. (2022). What are the challenges in assessing circular economy for the built environment? A literature review on integrating LCA, LCC and S-LCA in life cycle sustainability assessment, LCSA. *Journal of Building Engineering*, 50, 104203. <https://doi.org/10.1016/j.jobe.2022.104203>
- Ma, Longbo, et al. (2022). Analysis of Chinese consumers willingness and behavioral change to purchase Green agri-food product online. *Plos one*, 17(4), e0265887. <https://doi.org/10.1371/journal.pone.0265887>.
- Maklavany, Davood Mohammady, et al. (2023). Eco-environmental analysis of different routes for the synthesis of MIL-53 (Fe): an integrated life cycle assessment and life cycle cost approaches. *ACS Sustainable Chemistry & Engineering*, 11(26), 9816-9832
- Makudza, Forbes, et al. (2024). Modelling mobile advertising, consumer response and mobile shopping behavior. A post COVID-19 pandemic perspective. *Cogent business & management*, 11(1), 2368102 <https://doi.org/10.1080/23311975.2024.2368102>

- Meena, Ram Narayan, et al. (2023). Organic farming a key to food security and agricultural sustainability. In *Organic Farming* (pp. 1-30). Elsevier. <https://doi.org/10.1016/B978-0-323-99145-2.00007-0>
- Musah, Alhassan and Yakubu, Ibrahim Nandom. (2022). Exploring industrialization and environmental sustainability dynamics in Ghana: a fully modified least squares approach. *Technological Sustainability*, 2(2), 142-155. <https://doi-org.ezproxy.utm.my/10.1108/TECHS-06-2022-0028>
- Nadricka, Kristina, et al. (2024). Are consumers more or less averse to wasting organic food? *Journal of Environmental Psychology*, 93, 102222. <https://doi.org/10.1016/j.jenvp.2023.102222>
- Nayar, Vijayanthi. (2025). *Organic Farming: Sustainable Practices for Healthy Food*. Educoback Press. <https://doi.org/10.1016/j.procs.2022.12.282>
- Peter, Onu, et al. (2023). Industrial internet of things (IIoT): opportunities, challenges, and requirements in manufacturing businesses in emerging economies. *Procedia Computer Science*, 217, 856- 865. <https://doi.org/10.1016/j.procs.2022.12.282>
- Pinedo Lopez, Jhon, et al. (2024). Sustainability strategies: A proposal for food sector SMEs, based on the integration of life cycle assessment and ESG strategies. *Journal of Infrastructure, Policy and Development*, 8(12), 1-30. <https://doi.org/10.24294/jipd.v8i12.8934>
- Prasanna, S, et al. (2024). The role of food industries in sustainability transition: A review. *Environment, Development and Sustainability*, 1-21. <https://doi.org/10.1007/s10668-024-04642-1>
- Qi, Xin, et al. (2024). Factors influencing young adults' organic food purchase intention on fresh food e-commerce platforms. *British Food Journal*, 126(12), 4277-4303. <https://doi-org.ezproxy.utm.my/10.1108/BFJ-04-2024-0417>
- Raj, Vijay Amrit, et al. (2024). A bibliometric review of organic menus at restaurants: Research streams and future research path. *Journal of Quality Assurance in Hospitality & Tourism*, 25(4), 1043- 1069. <https://doi.org/10.1080/1528008X.2022.2146028>
- Roy, Arijit, et al. (2023). The consumer perception and purchasing attitude towards organic food: A critical review. *Nutrition & Food Science*, 53(3), 578-599. <https://doi-org.ezproxy.utm.my/10.1108/NFS-04-2022-0130>
- Song, Yang, et al. (2024). AI or human: How endorser shapes online purchase intention? *Computers in Human Behavior*, 158, 108300. <https://doi.org/10.1016/j.chb.2024.108300>
- Tariq, Gulzara, et al. (2022). Influence of green technology, green energy consumption, energy efficiency, trade, economic development and FDI on climate change in South Asia. *Scientific reports*, 12(1), 16376. <https://doi.org/10.1038/s41598-022-20432-z>
- Van Hoof, Bart, et al. (2024). Decision-making for circular economy implementation in agri-food systems: A transdisciplinary case study of cacao in Colombia. *Journal of Cleaner Production*, 434, 140307. <https://doi.org/10.1016/j.jclepro.2023.140307>
- Voronina, Yuliia, et al. (2024). Economic and environmental component in the field of sustainable development management. *Calitatea*, 25(201), 7-14. 0.47750/QAS/25.201.02
- Yang, Zongzhi and Solangi, Yasir Ahmed. (2024). Analyzing the relationship between natural resource management, environmental protection, and agricultural economics for sustainable development in China. *Journal of Cleaner Production*, 450, 141862. <https://doi.org/10.1016/j.jclepro.2024.141862>
- Zequiri, Jusuf, et al. (2024). The impact of social media marketing on brand awareness, brand engagement and purchase intention in emerging economies. *Marketing Intelligence & Planning*, 43(1), 28-49. <https://doi-org.ezproxy.utm.my/10.1108/MIP-06-2023-0248>

Acknowledgement

The authors acknowledge the Fundamental Research Grants Scheme (FRGS), grant number FRGS/1/2024/SS01/UTM/02/4 - R.J130000.7829.5F725 funded by the Ministry of Higher Education (MOHE) Malaysia, and part of this research is supported by UTMFR, grant number 23H26, Universiti Teknologi Malaysia.

Copyright Statement

Copyright © 2025 Li Hong Yi: The authors assign to the Research in Engineering Education Network (REEN) and educational non-profit institutions a non-exclusive license to use this document for personal use and in courses of instruction provided that the article is used in full, and this copyright statement is reproduced. The authors also grant a non-exclusive license to REEN to publish this document in full on the World Wide Web (prime sites and mirrors), on portable media and in printed form within the REES and RCEE & RHED 2025 proceedings. Any other usage is prohibited without the express permission of the authors. Hong Yi Li, Ai Chin Thoo, Hon Tat Huam and Ying Tuan Lo