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A critical systems thinking methodology to explore circularity of food waste in a university campus

José-Rodrigo Córdoba-Pachón[a], Alberto Paucar-Caceres[b], Toni Burrowes-Cromwell[c], Angela Bywater[d], Ronak Shah[e], Mark Walker[f] and Kourosh Behzadian[g]

[a]Royal Holloway, University of London, London, UK; [b]Manchester Metropolitan University (MMU), Manchester, UK; [c]Independent Systems Thinking and Management Consultant, UK; [d]University of Southampton, Southampton, UK; [e]Royal Holloway, University of London and Santander Consumer Finance, London, UK; [f]University of Hull, Hull, UK; [g]University of West London, London, UK

ABSTRACT

This article reports on the learning process and main insights of applying a critical system thinking (CST) methodology to food waste prevention, at a UK university campus project. Many universities are considering or adopting circular economy (CE) principles to meet the 17 United Nations Sustainable Development Goals (UNSDGs). Yet, there is still lack of understanding about systemic issues and consequences of preventing food waste, towards improved management of campus food resources. Our case study approach combined Soft Operational Research (Soft OR) and other methods to identify possibilities and challenges regarding adopting CE ideas and technologies. These processes featured: initial food waste scrap separation and sorting, conversations with students and managers, student self-assessment of waste disposal, collating diverse perspectives and investigating on-site food composting or anaerobic digestion (AD) options. There were valuable project lessons from this tactile, practical approach. However, campus stakeholders following through with their own action agendas (while we maintained a critical, supporting role) came across as paramount. Among other insights from using Soft OR, our study presents this finding about the importance of flexibility and "slowing down" in seeking to progress the 12th UN Sustainable Development Goal (UNSDG) towards responsible consumption and production, by reducing food waste.

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1. Introduction

This article contributes to current discussions and experiences about systems thinking and Soft Operational Research (Soft OR) methods, regarding the circular economy (CE) paradigm and its underlying concept of circularity of resources. We propose a critical system thinking (CST) methodology of inquiry that follows key commitments (Jackson, 2019; Midgley, 2000). These are namely: critical awareness, pluralism and strategies for improvement.

The methodology informed a participative project entitled "Somebody's Food" at a UK university. Our aim was to study different stakeholder behaviours and goals surrounding campus food waste management. This was towards a generic process of adopting circular economy (CE) ideas and technologies. The latter included food composting or anaerobic digestion (AD). These are both examples of food waste regeneration, which allow capturing organic waste matter for nutrient and energy recovery (Kyriakopoulos et al., 2019; Fuqing et al., 2017; Srisowmeya et al., 2020).

There was important learning about food waste habits, the student perspectives and views of other campus stakeholders. These lessons related directly to how they treated food, as a valuable resource and what was being done about scraps and leftovers (that could be collected and redistributed). This information was teased out by combining Soft Operational Research (Soft OR) with other methods. The importance of supporting stakeholders in defining and pursuing their own agendas (often framed in sustainability terms) was among our key findings. Additionally, understanding the critical helping role of the Project Team, was insightful since it could progress future CST and Soft OR-based intervention designs. This is especially in scenarios when researchers may need to accommodate their analyses with the (often short-term, isolated) decision making and managerial action of others (Smith & Midgley, 2025).

After this introduction (Section 1), which contextualises the setting of the "practical" situation of food waste management in university campuses, this article is further organised as follows. Section 2 is a broad literature review illustrating the challenges and opportunities associated with food valorisation, in the global context. It also outlines how the CE

CONTACT José-Rodrigo Córdoba-Pachón j.r.cordoba-pachon@rhul.ac.uk Royal Holloway, University of London, London, UK.

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paradigm could be referenced to address the issue of food waste within university campuses. Three main strands of literature are reviewed here. These relate to: the management of food resources in university campuses and, examining the concepts of CE and circularity (as classic systems constructs useful for tackling complex, real-world situations, such as the United Nations Sustainable Development Goals-UNSDGs).

In Section 3, we outline the theoretical foundations of the intervention. Some early and later developments surrounding Critical Systems Thinking (CST) are reviewed and a methodology based on several CST commitments (critical awareness, pluralism, improvement) is proposed. It defines three stages, which are: *Appreciating; Accommodating; and Designing*.

Section 4 presents how the methodology is applied and tested through the "Somebody's Food" Project and in Section 5, we discuss several reflections from the intervention. These include challenging assumptions embedded in the managerial agendas of some stakeholders- even while providing crucial support.

Finally in Section 6, we propose a set of conclusions from this case study. We also acknowledge its limitations. Additionally, this section identifies some avenues for further research and some crucial messages from the article.

2. Literature review

This segment of the article reviews three distinct but overlapping areas: (1) the situation of food resource management in universities around the world; (2) related strategies to bring circular economy (CE) principles to fruition and; (3) circularity as Systems Thinking to operationalise such schemes.

2.1. Food resource management in university campuses

There is an increasing concern about our global food system crossing a threshold of available natural resources or planetary boundaries (Steffen et al., 2015). This viewpoint is mainly driven by a resource efficiency agenda. It responds to target 12.3 of the 12th United Nations Sustainable Development Goal (UNSDG) towards reducing consumer and retail waste and material losses in the food supply chain. The argument is that natural resource limitations are causing the marginalisation of entire populations. It follows that in the case of food resources, while some cannot afford quality food, other people simply throw good food away. A World Resources Institute (WRI) analysis of FAO data has shown that in regions like North America, Europe and industrialised Asia, the percentage share of the consumption side to food waste far outstripped the production side (Flanagan et al., 2019, 5). Moreover, about 40% of food goes to waste in countries like the US (Monbiot, 2022; ReFED, 2016), with similar statistics in countries like the UK (Waste and Resources Action Programme (WRAP), 2014, National Audit Office (NAO), 2023).

In this global food scenario, universities are deemed to be important actors in education, management and public outreach (Leal Filho et al., 2023). Universities bring together diverse groups of stakeholders who daily manage, consume or dispose of important food volumes. In 2023, Leal Filho and collaborators conducted a global comparison of food waste per meal/per university student. It shows a range of: 30 gr (China), 42 gr (Africa), 43 gr (Portugal), 60 to 70 gr in the UK and 400 gr (US). In the case of one Chinese university, this amounts to hundreds of daily tons of food being wasted, with 24% of it being considered edible (Ling et al., 2024). One report from the UK's Waste Resources Action Programme (Waste and Resources Action Programme (WRAP), 2014, 32–42) states that younger people (between 18 and 34 years) tend to waste more food than those between the 35–64 age group. Cost wise, a UK NUS (National Union of Students) study has revealed that in the last decade, avoidable food waste has amounted to an average of £5.25 per student per week, or £273 per year (NUS, 2013).

Given that important volumes of food are delivered daily, prepared, consumed and discarded on university campuses, these institutions may also be considered as bona fide *living labs for sustainable development (*SD) actions. This is especially where innovative practices can also be reflected in education and building awareness among surrounding communities (Barlett, 2011; Leal Filho et al., 2023; Ling et al., 2024). Therefore, any initiative or managerial action aimed at reducing food waste or preventing it in the first place, would require redesign of existing practices. Unfortunately, these are often based on compartmentalised, isolated target setting and monitoring.

When it comes to campus food management, universities could work on several fronts to help prevent and reduce food waste including (Leal Filho et al., 2023): a) planning ahead and creating awareness about food waste prevention; b) adequate food preparation and storage; c) developing or accessing complementary services to indirectly facilitate waste management; and d) implementing direct waste reuse schemes. To date, the lack of measurement or comparable data makes evaluation difficult, although there are business indications that investing and completing food waste initiatives could yield economic and other benefits in the medium term (i.e., 5 years) (Clowes et al., 2017; Huiru et al, 2019; Davison et al., 2022). In their study about two university canteens, (different countries), Davison et al. (2022) show that student-focused messaging

encouraging mindfulness about food waste, contributed to food waste reduction of about 10%. This study also confirmed the importance of improving education and awareness, something that other authors (Barlett, 2011; Lazell, 2016) and more specifically, Babbitt et al. (2022) call "human infrastructure" (i.e., behavioural and cultural aspects). When examining cross-sector collaboration to address the food waste problem, Burrowes-Cromwell (2022) also stresses this human factor. In broad systems thinking terms, she deems lack of awareness and relevant connections as an inherent "waste flow." Ultimately, the human information and behavioural factors are central to bringing improved flows of food to operational infrastructures, processes or activities.

2.1. The circular economy (CE)

An alternative way of thinking and helping universities to tackle their campus food waste is therefore needed. Despite the diversity of interpretations and lack of consensus about the concept of circularity of resources in CE (Kirchherr et al., 2023), generally, the CE paradigm is based on three (3) principles: 1) the elimination of waste and pollution; 2) a commitment to preserving and circulating materials at their highest value and 3); the regeneration of nature (Monbiot, 2022). In real terms, these principles also suggest that new or improved flows of resources could be designed and implemented.

The UK's Ellen MacArthur Foundation (MacArthur, 2023) also considers CE as a societal and economic paradigm to enable food waste reduction and, to keep organic food waste from the landfill. For example, the systemic features of CE reveal procedural linkages and may also help to develop connections across supply, service chains or productive processes. This would mean that materials that would normally be discarded could be maximized or otherwise reused (Kirchherr et al., 2023). Food waste generated from supply or catering processes could still be considered as a *resource* that is fit to re-enter the food value chain. As such, various materials could be then rescued and repurposed at different parts of operational or service chain processes.

When applied to campus food resource management, the above CE principles could therefore help administrators and other stakeholders to distinguish edible food (that can be timely repurposed or redistributed for human consumption) from food losses (e.g., skins, shells and other material incurred when producing edible food). In this respect, material waste which could be "upcycled," might then be separated and used to re-enter agricultural or animal feed processes, in various ways (Babbitt et al., 2022; MacArthur, 2023; Harvard Public Health, 2022; Piadeh et al., 2024). Moreover, both repurposing or upcycling (recycling) of food waste resources could help universities to address United Nations other sustainable development goals (UNSDGs)- *apart from* the Responsible Consumption and Production of Food. These goals include: *Zero Hunger* and (indirectly) *Quality Education* (Clowes et al., 2017; Piadeh et al., 2024; Teigiserova et al., 2020).

To date, several approaches based on the circular economy (CE) paradigm have been proposed in the literature (Leal Filho et al., 2023; Teigiserova et al., 2020; Waste and Resources Action Programme (WRAP), 2021; Zero Waste Europe, 2019). Figure 1 adopts a hierarchy of such tactics for managing food waste in universities. It should be noted that this hierarchy is based on the perceived degree of preferability, in terms of harm to the natural environment (Piadeh et al., 2024; Teigiserova et al., 2020).

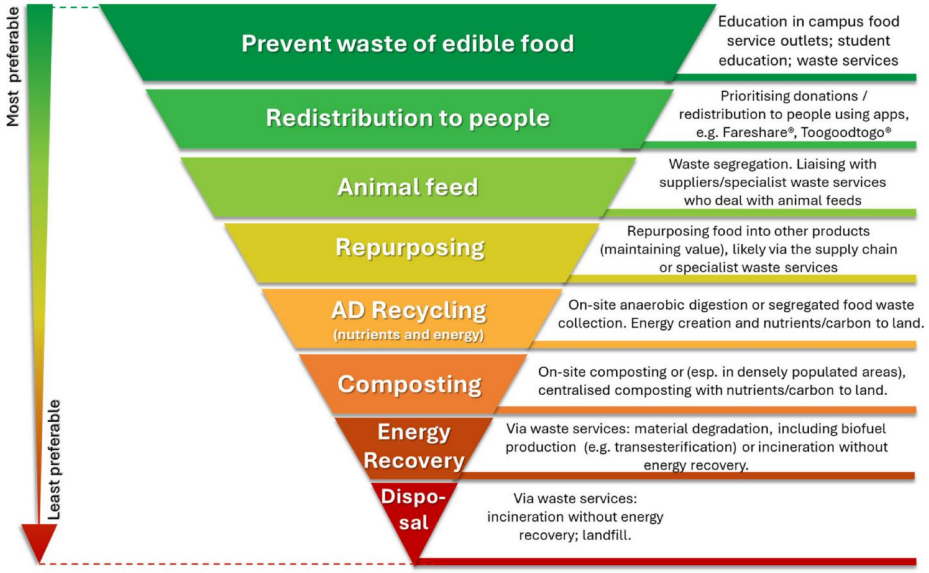

Figure 1. The food waste action hierarchy of CE strategies.

In the first instance, the most preferable strategy would be preventing waste of edible food. This is something that could be supported by activities involving: public education, disclosure of information (i.e., waste generated), labelling or packaging or waste management services (Babbitt et al., 2022; Reisch et al., 2021). Secondly, redistribution would mean universities repurposing or redistributing any edible food. Mobile applications like *FareShare*® or *Toogoodtogo*® might help food preservation and redistribution to persons in need. When food is no longer suitable for human consumption, universities could then work with specialist service providers to use it for animal feed. One alternative to animal feed would be to redirect such waste to produce biopolymers (Yan & Chen, 2015), insulated packaging (e.g., from chicken feathers) (Pluumo, 2023) or even beer – from bread waste (Toast Brewing, 2023). It is worth noting here that these initiatives may also enhance the evidence-based research aspirations of both staff and students (and by extension, the "green" commitments of the particular campus).

Against the backdrop of the above waste action hierarchy, on site Anaerobic Digestion (AD), recycling (upcycling) and composting are inexpensive technologies for consideration. These may help to regenerate or to transform organic matter from food waste, into several outputs, such as compost fertiliser or biogas (Piadeh et al., 2024). Likewise, in their technological review about CE and waste management, Kyriakopoulos et al. (2019, 13) refer to such material regeneration as a "waste to energy" capability. They argue for both financial and economic viability.

In the United Kingdom, WRAP (Waste and Resources Action Programme) even puts AD in a higher "recycling" sub-category to composting (Waste and Resources Action Programme (WRAP), 2021). This is due to its environmental benefits from helping to replace fossil energy and, its overall contribution to energy recovery (Teigiserova et al., 2020). Since carbon emission is also being associated with food waste collection and transport, decentralised/on-site composting or digestion would be (in principle) a preferable option for rural (or not densely populated) areas. More centralised AD systems could be reserved for densely populated or urban regions (Huiru et al., 2019; Zero Waste Europe, 2019). Since universities usually feature both limited and seasonal residential occupancy, the average campus might fall somewhere between these two classifications.

Finally, energy recovery or food waste disposal could be seen as the least preferable in the above hierarchy of CE strategies. This is given the number of additional resources, expertise and partnerships required for implementation. Additional concerns about potential harmful effects on the natural environment remain (Huiru et al., 2019).

Institutional status and organisational culture are major obstacles to achieving many of the above strategies at universities. According to Grolleau et al. (2024), well intended managerial campus strategies *could get in the way* of other, perhaps alternative actions. This is because many universities currently invest considerable resources adopting international standards, to be able to showcase their university social responsibility (USR) and reputation. These authors argue that by excessively focusing on such requirements, universities could become ethically blind to supporting other ideas, initiatives or mindsets and, with undesirable consequences. For example, certain individuals or faculty/departmental units might have "moral licence" to pursue questionable actions (such as increasing their waste), whilst some of their internal peers are yet striving for responsible goals (i.e., "sustainability"). Other activities that promote circularity (in general) could become "morally contaminated" if universities are perceived as investing in fossil fuels while at the same time, mistreating their employees, students, or just simply "playing the game" of local or global rankings.

2.2. Circularity as a systems thinking concept

The above review calls for comprehensive effort. The challenge is to consider how different initiatives about resource management and tackling campus food waste, would need to be better identified, debated, coordinated or monitored. This is where we see the value of adopting a systems thinking perspective in relation to food waste management. In general terms, Systems-Thinking (ST) is the ability to understand how the parts of a system may interact to impact the behaviour of the larger whole (in this case, a university, neighbourhood, wider community etc.). Meadows (2008, 2) describes it as a " … way of thinking that gives us the freedom to identify root causes of problems and see new opportunities".

At the very least, ST would allow exploring connections across a plethora of mindsets, issues and actions, towards some kind of collective action (Jackson, 2019; Midgley, 2000). As Babbitt et al. (2022, 1) posit: "While wasted food reflects inefficient food production and consumption practices, it also represents an opportunity for environmental, economic and social gains." If we apply reductionist (i.e., linear cause and effect) assessment to complex problems, this is the opposite end of systems thinking. It would mean reaching decisions or "solutions" with unintended consequences. In the long run, this may entail outcomes that are potentially detrimental

to the stakeholders involved or there could be even wider negative impact.

Robinson (2022) and Pokorna et al. (2024), consider the finite nature of resources (i.e., water, soil, air) as a basis for adopting a systems thinking perspective, together with relevant methodologies and methods. Using the circular economy (CE) paradigm, these researchers propose a systems thinking view could help people to visualise and to work on closing, reducing or regenerating appropriate resource loops, in relevant situations. Combining Soft OR methods would exemplify this (e.g., Rich Pictures, viable system model, causal loop diagrams). This is bearing in mind that there are similar classic elements of the paradigm like: computer simulations, closed loop diagrams, life cycle or impact assessments.

We agree with Pokorna et al. (2024) in their specific claim about opportunity to enhance the value and impact of the CE paradigm, by embracing diverse OR and systems thinking ideas, methodologies or methods to explore circularity, in complex situations. A similar opening was identified by Mingers and White (2010) in their review of the contributions of systems thinking to OR addressing sustainability issues. It was something that Paucar-Caceres and Espinosa (2011) also noticed in the distinct absence of more applications of OR methods to deal with such real-world issues.

Still in the Circularity context and regarding appropriate methodology towards change, Kyriakopoulos et al. (2019) identify Multi-Criteria Decision Making (MCDM) and Life Cycle Assessment (essentially for industrial production) as potential "frameworks." In recent times, authors Petropoulos et al. (2024) renew the call by stating that "[…] More complex PSMs [problem structuring methods in operational research] seem to be under-utilised, suggesting that their benefits cannot sufficiently inform real-world challenges, including environmental decision-making" [brackets added].

We must be wary though, that in practice, there could be a particular dominant view about circularity as an operational concept. It is often seen as a logistical, linearly oriented problem or set of problems, amenable to machine-like thinking and action. In all probability, this could narrow the scope of researcher inquiry (Chapman, 2004; Jackson, 2019).

Therefore (and whenever possible), any systems thinking or Soft OR based inquiry would need to be more open to manage and respond to different perspectives about food. These are pertinent cultural and behavioural elements for attention. They are especially important where food is not seen as a valuable resource, in the first place. Critical awareness, openness and flexibility would need to be built into research inquiry to inform the use of Soft OR methodologies or methods. This is so that when pursuing sustainability and its associated development goals, mechanistic and oriented thinking can be appropriately acknowledged but also challenged.

3. Critical systems thinking to explore circularity in food waste management

Critical Systems Thinking (CST) is a body of knowledge often associated with the fields of Soft Operational Research (Soft OR) or the use of problem structuring methods (PSM). It shares with these several of the methodologies or techniques used to explore or address complex situations like: Soft Systems Methodology (SSM), Interactive Planning (IP) or Critical Systems Heuristics (CSH) (Chowdhury, 2022; Córdoba & Midgley, 2006; Flood & Jackson, 1991; Flood & Romm, 1996; Jackson, 1991; Jackson, 2022; Jackson, 2019; Midgley, 2000; Mingers & Brocklesby, 1997; Smith & Midgley, 2025).

Like systems thinking, in CST, a situation is considered as a complex "mess" or system of interconnected problems (Ackoff, 1981). Deliberate effort is needed to first understand situations from the perspective of different stakeholders through interpretive lenses. Secondly, there is avenue for critical reflection and dialogue about what could constitute an improvement for present and future generations. This is achieved by using a combination of systems methodologies, their constituent methods or techniques.

CST brings several commitments to practice including (Chowdhury, 2022; Jackson, 2019; Midgley, 2000):

- *Critical awareness*– identifying, examining and challenging the conditions that give rise to a perceived, relevant situation. This incorporates being aware of strengths and limitations of the systems methodologies, methods or techniques available for use.
- *Pluralism*– facilitating creative appreciation of different perspectives or concerns about the situation, with informed combination and use of methodologies, methods or techniques (some of them systems-based) to help such appreciation.
- *Improvement*– working to securing sustainable changes for present and future generations.

3.1. Early CST developments

Jackson was one of the first systems thinkers to bring CST to (soft) OR practice. This was mainly through his work on Critical Systems Thinking, total systems intervention, and his systems of systems methodologies. Jackson identified the requirements for what he calls a "coherent pluralism" for management science and operational research practice as: (1) Flexibility in the use of

tools like methodologies and their constituent methods, models or techniques (2) Pluralistic thinking, which encourages the application of systems thinking methodologies serving different paradigms, in the same intervention and at all stages and; (3) Living with degrees of paradigm incompatibility. Jackson assumes that pluralism must learn to manage degrees of paradigm incompatibility.

A second strand of CST applied to tackle complex systems was proposed by advocates of Critical Systems Heuristics or CSH (Ulrich, 1984) and Boundary Critique (Midgley, 2000). CSH-very much of the emancipatory strand of CST, is a methodology that aims to equip planners and citizens concerned with an approach. The main goal is to help them reveal the "normative content" of any proposed plan. This methodology makes planners' intentions transparent to the people involved in a situation, giving the latter defensible arguments to test the planners "systems boundary judgements." Adopting a Kantian stance in practice, it will allow capture of the totality of relevant conditions of a problematical situation. This is in terms of knowledge and people deemed to be relevant, in a desired situation.

Boundary Critique (Midgley, 2000) focuses on using the systems idea to identify processes (rituals) of marginalisation that often leads planners or decision makers of a situation to privilege assumptions. This privilege may also extend to the people or knowledge that they favour, at the expense of others. A variety of methods and categorical questions could help to identify and to address marginalisation issues, which also affect the design of interventions (Ulrich, 1984; Córdoba & Midgley, 2006).

A third strand of CST comes from Mingers and Brocklesby's Critical Pluralism (Mingers & Brocklesby, 1997). They acknowledge the desirability and feasibility of applying multi-methodology in practice and openly warn about difficulty in trying to achieve this. These two researchers propose two possible ways to overcome the challenge: a) deploying a framework for mapping methodologies before a situation and b) providing some guidelines about linking parts of them. In this case, using a "blend of methodologies" would certainly benefit the agent(s)-i.e., the person (s) intervening in the situation or those who are affected by it. Thus, it would help them to identify and to address relevant and changing material, social and personal aspects that pertain to a complex situation.

3.2. Recent CST developments

Recent developments in CST are being informed by the philosophy of pragmatism (Chowdhury, 2022; Jackson, 2019, 2020). Pragmatic reasoning could favour multi-paradigm, multi-methodological practice in MS/OR (Mingers & Brocklesby, 1997). This essentially, " … in its every day meaning, confers the right to use whatever approach seems best for the circumstances" (Jackson, 2020, 844).

As a philosophy, pragmatism has already taken roots in the field of OR (Ormerod, 2006). It was taken on to challenge multi-methodology developments in CST/OR (Zhu, 2011) and is currently helping to firm up the foundations of sub-fields like OR consulting practice (Ormerod, 2020). Following pragmatism, critical systems thinkers like Jackson (2019, 2020) provide an updated CST methodology of: explore, plan, intervene and, check on situations (*EPIC*). This methodology aims to enhance openness, systemic observation and flexibility. Similarly, Chowdhury (2022) draws insights from the Hinduist form of *Nataraja* to also buttress CST appreciation of phenomena, whilst helping and reassuring facilitators or managers to use their crafting or intuition to adapt intervention strategies in changing conditions. Meanwhile, authors Rajagopalan and Midgley (2015) and Romm (2024) advocate for the inclusion of indigenous approaches to elicit valuable knowledge. This is something that Córdoba-Pachón (2023) also conceives of ritualising and reflecting upon the "seriousness" with which the standard use of methods in interventions are or can be conducted.

The current buttressing of methodological flexibility and adaptability in CST – as seen by Smith and Midgley (2025) would also demand a redefinition of the *meaning* of critique and *accommodation* in practice (these terms or ideals being narrowly defined within specific critical theories, used in early CST developments). Yet, there could be circumstances that are out of our control as practitioners (i.e., COVID 19). These could affect the pursuit of critical awareness, *as well as* debate about or definition *of* improvements. In this article, this insight will be referenced when reflecting on the use of the proposed CST methodology to further inform Soft OR research and activity.

3.3. A critical systems thinking methodology applied to food waste prevention on a university campus

Drawing from the above literature reviews and definitions, a methodology is therefore offered to explore food management situations on a university campus (Figure 2). It is worth noting that this methodology is seen as a system of inquiry (Midgley, 2000). It aims to allow flexibility in using different methods to help stakeholders and all participants to understand a situation, and to respond to emerging circumstances.

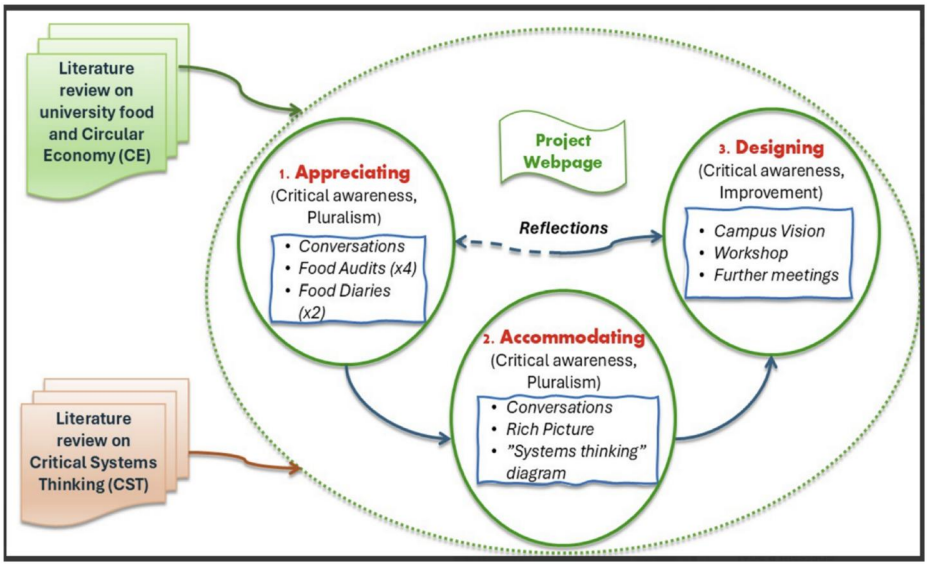

Figure 2. Proposed CST methodology to tackle complexities of food waste at a university campus (Source: Authors).

There are three inter-dependent and connected stages: a) *Appreciating*; b) *Accommodating* and; c) *Designing*. These stages are briefly explained as follows. Figure 2 also shows the CST commitments that we utilized at each stage.

The first stage (Appreciating) helped the project research team to learn about how food waste is managed on the campus in question. Crucially, this information was as perceived by different stakeholders. Put succinctly, it resulted from gathering data in different formats. Having being alerted by the literature, we then engaged stakeholders about the possible circularity of managing food resources and related waste. This was by applying CE principles or associated strategies and technologies (i.e., public education, redistribution, digesting-composting technology adoption). As noted earlier, our research methods entailed several schemes but largely involved food audits in diverse campus locations and also recordings from student food diaries.

The second stage (Accommodating) allowed the integration of data and perspectives from the previous stage of Appreciating. In addition to conversations with stakeholders during the intervention, and as best as possible, we assembled a *Rich Picture*. This captures our learning insights about the food situation on campus. At the later project stage (Designing), we presented this Rich Picture to project stakeholders (managers and students) for their reflection and commentary. Additionally (and to respond to an emerging set of concerns from the Project Advisory Board), we elaborated a "*Relationships" Diagram*. This further enabled reflective practice, as we encountered a range of views about project goals and stakeholder influence. Critically, this reflection process also helped to guide the way forward.

Finally, we have undertaken a stage of Designing. To this end, we crafted and shared a campus vision of the future (Ackoff, 1981). The vision includes on-site composting or AD as well as several "nudge" food practices (Reisch et al., 2021; Thaler & Sunstein, 2022). We defined these as offering inexpensive, diverse and simple choices to help campus consumers prevent wasting edible food. This also translates as helping to simplify the upstream recycling of inedible leftovers. We have delivered several presentations to new and relevant stakeholders, sharing accrued insights. Throughout all the project stages, we maintained a dedicated project website where selected information could be publicly accessed.

It is worth noting that during all these stages we thrived on engagement and open conversations. This method is in the spirit of Reynolds (2024) stance which values, encouraging and nurturing dialogue among all stakeholders. Moreover, these conversations became a vehicle to foster what Reynolds calls Systems Thinking in Practice (STiP). According to Reynolds, there are three levels in which such conversations need to be developed:

> "Conversation Level 1 (conversing with reality): understanding inter-relationships (associated with the situations of interest); 'getting the bigger picture' or 'seeing the forest through the trees' (in avoiding reductionism).
>
> Conversation Level 2 (conversing with other practitioners about reality): engaging with multiple perspectives (amongst practitioners); 'joined up thinking and practice' and not 'talking at cross purposes' (in avoiding dogmatism).
>
> Conversation Level 3 (conversing internally by reflecting on the two prior conversations): reflecting on boundary judgements (of the systems constructed); adjusting viewpoints on previously treasured framings of reality and treasured 'best'

> practices or preordained 'targets', in dealing with reality (in avoiding managerialism)"
>
> Altogether, the above three levels of conversation help researchers to build their STiP bricolage. They are also a platform from which to "speak to the dimensions of systemic sensibilities that need to be addressed with any intervention" Reynolds (2024, 8).

In the next section of the article, the activities and actions of the three phases (*Appreciating, Accommodating* and *Designing*) of the proposed CST methodology are presented.

4. The "somebody's food" project in a university campus

4.1. Background

The project "Somebody's Food" started at the end of 2022 when external funding was secured to explore in more detail how food and its waste were managed in a university campus. Prior to this, a university lecturer (now project PI) had been in contact with an engineering company specialising in building anaerobic digestion (AD) solutions for food. After a campus visit, the PI and the company's Managing Director (who was interested in systems thinking ideas and became the project industry partner) secured and supervised two undergraduate management students' summer internships. The interns interviewed the campus Accommodation Services Manager (who later became a member of the Project Team) and fellow students about their perceptions regarding food provision and food waste recycling on campus. Several possibilities to improve these processes then surfaced.

Later on, one of the interns presented her internship and dissertation findings to an audience of campus administrators and the campus Waste Management Contractor. The presentation raised a general interest in exploring ways to reduce waste (including food). The PI and industry partner then enrolled a group of three external academics to form an inception Project Advisory Board and subsequently, applied for external funding. When funding was obtained, a research assistant was internally recruited to help conduct most of the project activities reported in this article. A project webpage was also set up at the university's website.

4.2. Appreciating

This is the first phase of the methodology and includes three activities: *Conversations, Food Audits* and students' experiences, as compiled in their *Food Diaries*.

4.2.1. Conversations

As a startup activity, the Project Team (then constituting: the PI, Research Assistant and Accommodation Services Manager) contacted several campus managers to elicit their views about how food was being delivered, consumed and disposed of on campus venues (mainly coffee shops, restaurants and residences). Together with the Accommodation Services Manager, those who accepted being interviewed comprised: the Food Production Manager of the campus (also acting temporarily as Head of Catering); one of the campus' restaurants' managers; the university Health and Safety Manager; the Head of the university volunteering services; and a senior campus gardener.

From our conversations with these stakeholders, we learned that significant volumes of weekly food waste were being produced on campus- approximately 65 gr per daily student meal. Each week, contractor trucks would collect waste (including food) from campus bins and transport it to a composting-digestion plant. In practical terms, this generated valuable outputs (i.e., electricity) for themselves and also avoided waste incineration.

We also learned there were a variety of campus efforts to adequately cater to the varied food (and menu) needs of student populations. First year undergraduate students were also being provided with meals in residences. To support students in residences (and monitor their behaviour), the university had a special organisational *unit (Hall Life*) which was partly run by students. Our Project Team prepared and contributed an article with a general description of our mission. It was sent to all residential students *via* electronic messaging. Additionally, the Project Team visited some of the student residence blocks where there were food recycling bins (some of them quite small) in each kitchen. There were already mounted posters to encourage food waste prevention and recycling. Notably, at the time of the visit, there was one poster with a generic version of the hierarchy of waste prevention presented earlier in this article.

At some other food venues managed by the university, we also learned that managers had already started to prepare and display messages on tables or screens. This messaging was to remind students not to waste food or to dispose of scraps in the corresponding bins. One campus restaurant had started to grow some of its own herbs and spices to be used in the preparation of menus.

In terms of food waste regeneration, the senior campus Gardener had a trial to produce compost from green waste. This manager also wanted to achieve a better eco-system balance of green areas on campus, which "did not require much compost"

to be maintained. Another group (from health and safety and a campus café) were leading the re-use of coffee grounds in one of the coffee shops. As with the senior Gardener, they were of the view that any innovation to reduce food waste on campus needed to respect existing health and safety guidelines and be allocated adequate managerial resources (i.e., staff). Their argument was that these conditions were vital in order for such efforts to succeed.

There were other discoveries too. For example, we found that volunteers were running free food events for students. Community gardening, also meant there was an open invitation to school children from around the campus neighbourhood. This allowed these non-HE students to appreciate the garden and occasionally, to participate in growing herbs. During a conversation with the Head of Campus Volunteering Services, we were surprised to learn that there was a food bank run by the Student Union's shop. Although operating intermittently, it was also led by student volunteers. Linked to this finding, we also noted a healthy degree of rivalry between the volunteering and catering personnel. In the former context, when sounding a possible collaborative CE strategy to redistribute edible food leftovers from daily catering events, the response was: "There needs to be an interest in pursuing an accreditation for them to take an interest".

4.2.2. Food audits

In the project, we wanted to know more about people's behaviour regarding food waste. We therefore conducted several food audits with the guidance and logistical support of both the project industry partner and the campus Accommodation Services Manager. Food audits are a proven research method to gather first-hand information, leading to better understanding about people's behaviour concerning food (Wilkie et al., 2015).

A food audit requires that food and non-food bins are inspected. Samples of food waste (not food loss) are taken, food is categorised, and these categories are weighed. As seen at Table 1, most of the campus food waste in both audited venues were meat, vegetables and pasta/bread. The high percentages of food in these categories indicate that possibly too much food was being prepared or bought, both within and outside campus. The Project Team considered that these food waste types could be reused for animal feed or other circular economy processes.

Furthermore, when inspecting a general waste bin at one of the students' accommodation sites, on two separate occasions, **43–58% of the waste was food.** This finding helped the Project Team to realise that perhaps some edible food was just being dumped. Yet, this wastage could have been prevented, redistributed or upcycled. This was if campus implemented CE strategies like: food repurposing, digesting-composting or through formal education (curricula).

4.2.3. Food diaries-student experiences (2022–2023)

The above data from conversations and food audits seemed to show the effects of existing food consumption habits or practices on campus. However, to better identify their underlying causes or factors, the Project Team also designed and administered a series of student diaries. These were handed out to undergraduate Management students in two consecutive academic years.

Diaries are a useful way to help identify contextual or relational factors that contribute to or are affected by individuals' behaviours in organisations (Plowman, 2010). More specifically, diaries can also reveal why people do or choose not to recycle food (Amicarelli & Bux, 2021). During the academic Spring Term lectures delivered by the project PI, students were presented with an optional task of filling diaries with their own experiences with food. This was for a period of two weeks. Those students who were willing to participate were asked to sign an informed consent form or send an email confirming their participation. They were also briefed about different categories of "experience" that they

Table 1. Overview results of food audits.

Location	Restaurant area (HUB) Audit 1	%	Restaurant area (HUB) Audit 2	%	Residential building Audit 1	%	Residential building Audit 2	%
Fruit	0.25	2.3	0.08	3.0	1.28	18.5**	1.372	30.7**
Coffee waste	0.00	0.0	0.00	0.0	0.00	0.0	0	0.0
Vegetable waste (+ beans)	5.20	48.1**	0.69	26.0**	2.62	37.9**	0.79	17.7**
Bread/ pastry/ cereal/ pasta	2.60	24.1**	1.07	40.3**	0.94	13.6**	0.473	10.6**
Meat	2.50	23.1**	0.47	17.7**	1.02	14.7**	0.288	6.5
Dairy	0.05	0.5	0.08	3.1	0.00	0.0	0.98	22.0**
Compostable (+ bones)	0.10	0.9	0.26	9.8**	1.00	14.5**	0.561	12.6**
Non-recyclable	0.10	0.9	0.00	0.1	0.06	0.9	0	0.0
Total Sample (Kg)	10.80	100.0	2.65	100.0	6.92	100.0	4.464	100.0
Percentage of Food in General Waste (1 bag sample)						58%*		43%*

*one 1kg bag sampled.
**considered worth inquiring about as explanation at the end of the table.

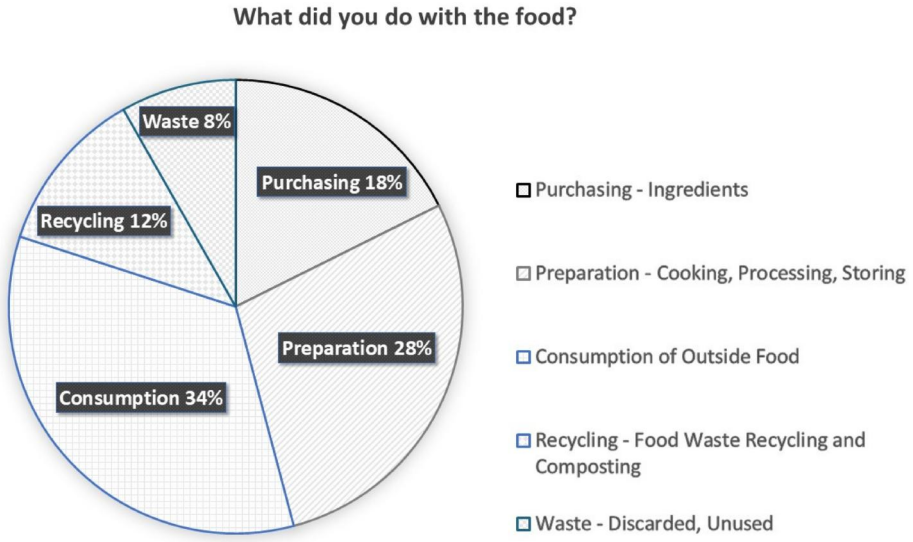

Figure 3. A summary of recorded student food diaries 2022–2023 entries (53 responses).

could use. For example: shopping for food inside or outside campus; cooking and eating; recycling food or disposing of food waste losses (i.e., due to food expiration date).

The eating food category included ordering take-aways and eating out. In their diaries, students were also encouraged to record their feelings or specific emotions associated with their diary entries. It should be noted that these diary entries were anonymised, and students were assured that their information was only used for research purposes (i.e., this article and for related project information).

Figure 3 shows that in the academic year of 2022–2023 students mostly reported experiences regarding: purchasing food ingredients (18%), storing and preparing food (28%) as well as consuming outside food (34%). They also recycled food (12%) and discarded unused food (8%). Recycling was seen in terms of eating all available food. The following are some compiled responses:

a. *Ordering out usually implies that there is very little food waste, as all the food is already cooked and there is nothing extra to discard. The only problem is consuming the whole quantity of food ordered. This is as sometimes you might order more than what you want and intend to eat.*
b. *Simply distributing the vegetables scraps in the garden can also work, as after a couple hours they were being eaten by snails and other smalls insects. That is also a part of the composting cycle.*

Diary excerpts from the academic year 2023–2024 confirmed that students were cooking their food and enjoyed having takeaways from or eating out at their favourite outlets- including the campus caterers. They also planned their food shopping and cooking menus to make the most of any food purchases. A sample of the excerpts shows the following:

a) I bought lunch from the food truck on campus… It is my favourite place because they give you the most food, which I feel is worth the money.

b) I buy groceries from [supermarket] because it is cheaper, and they give out a lot of coupons. Another reason is because I must buy halal chicken which is not available on campus.

c) I bring my own food [to campus] as it is cheaper, and I know I will like it… For dinner I cooked penne pasta with sausages (butter and grated cheese. I have pasta most nights as I have always enjoyed it, it is cheap and easy to cook.

d) After being on campus, I went food shopping for the week with my friend. I like going with friends since it feels like more of a fun trip… I made a large batch of the meal so that I will eat it tomorrow… I cooked quite a lot, so I had to share the pasta with my friend to prevent waste.

These and the following excerpts align with extant literature surrounding key factors (i.e.,: the availability of food and recycling facilities, visual knowledge of recycling and food waste, participation in social life, peer pressure and existing habits) that could affect students' food choice and subsequent waste behaviour (Akhter et al., 2024; Davison et al., 2022; Dixon & Parker, 2022; Lazell, 2016). Moreover, students acknowledged several challenges when trying to prevent food waste:

e) I had to work on Sunday, so I did not eat anything for breakfast… I ordered a takeaway because I was too lazy to cook even though I had groceries with I could have made a meal with, but I did not.

f) I find it easy to throw out food waste but still feel guilty when doing it. We do not have a compost bin, so the waste was put into the general bin.

g) *I started cleaning out my fridge. I have not cleaned it in over two weeks because of reading week and exams, social events…*

h) *Takeaways are not good for me and my goals… I hate eating sandwiches from the students union shop. After a long time, I discovered that they were the ones making me sick… Sometimes by making my own [foreign] food I really miss home.*

4.3. Accommodating

Three activities were conducted during the Accommodating second phase. In this case, Accommodating entailed: Further *conversations*, elaborating a *Rich Picture* of the situation and developing a *Systems Thinking Diagram*.

4.3.1. Conversations

Information from the first phase (Appreciation) suggested to the Project Team that there was a divergence of views and habits about food, regarding its availability, its taste and its recycling. Whilst campus managers were striving to ensure food diversity and waste management in venues, some students resorted to outside outlets or cooked their own food. This was to save money or simply to enjoy their own food creation. This contrasted with the view expressed in an interview with one of the managers: "*We still do not know what students want: some students complain about being served little food, others about being served too much!*" The recycling of food and its waste was having mixed results across campus venues and residences. Unfortunately, this was despite efforts to help students avoid dumping edible waste.

In other conversations with managers, other CE oriented ideas came up. Some examples included; growing our own food in the campus community garden or having food on-site composting or digestion facilities. Even so, the team noticed concerns about the lack of institutional resources available. We were told that: "*Any project needs to be properly assessed [in terms of resources]… The community garden is run by volunteers, and its purpose is mainly educational [not to grow own food]*" (brackets added).

4.3.2. Rich picture

With these multiple responses from campus managers and other stakeholders, the Project Team agreed to draft a Rich Picture of the situation (Figure 4). This entailed collating and reflecting on the different sources of information reported above. The Rich Picture is a method or technique derived from Checkland's Soft Systems Methodology (SSM) (Checkland, 1999). It aims at depicting the messiness and uneasiness of a situation (as perceived by its stakeholders), thus, helping create a shared understanding of it.

The elaborated Rich Picture shows relevant processes or human activities, supporting organisational structures, and the relationships between these two arenas. We focused on showing the circularity of food delivery processes, preparation and food consumption in campus venues or residences. This was

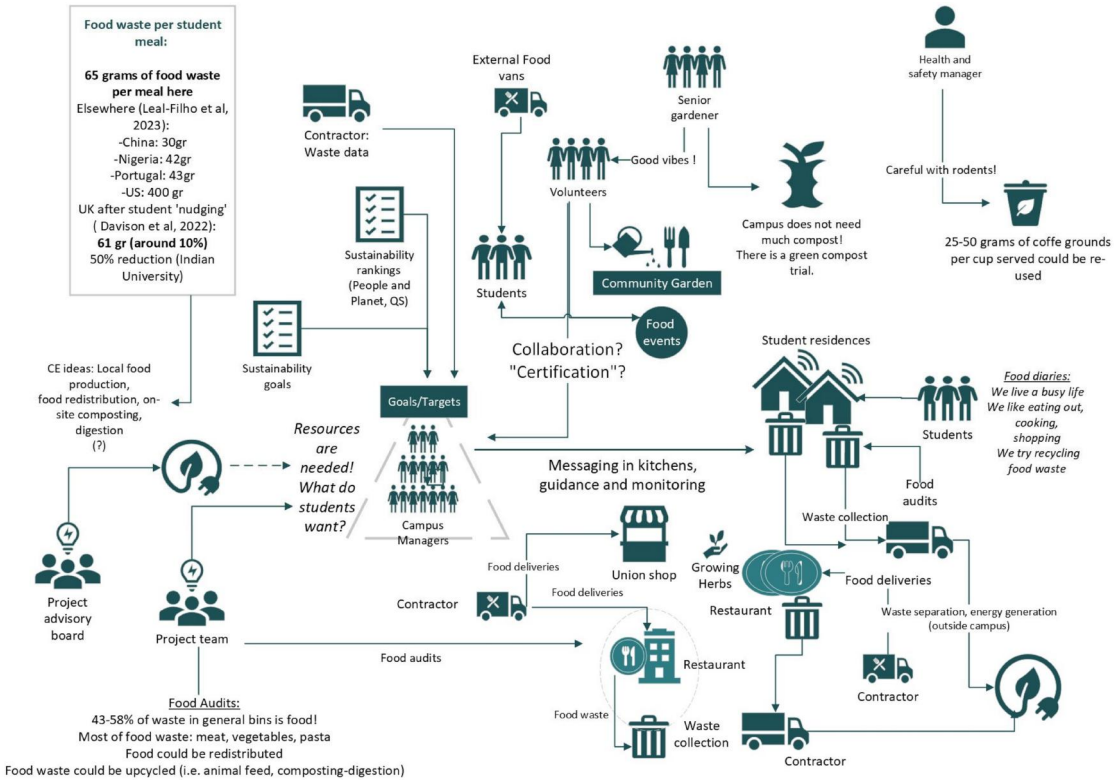

Figure 4. A rich picture of the food situation on campus.

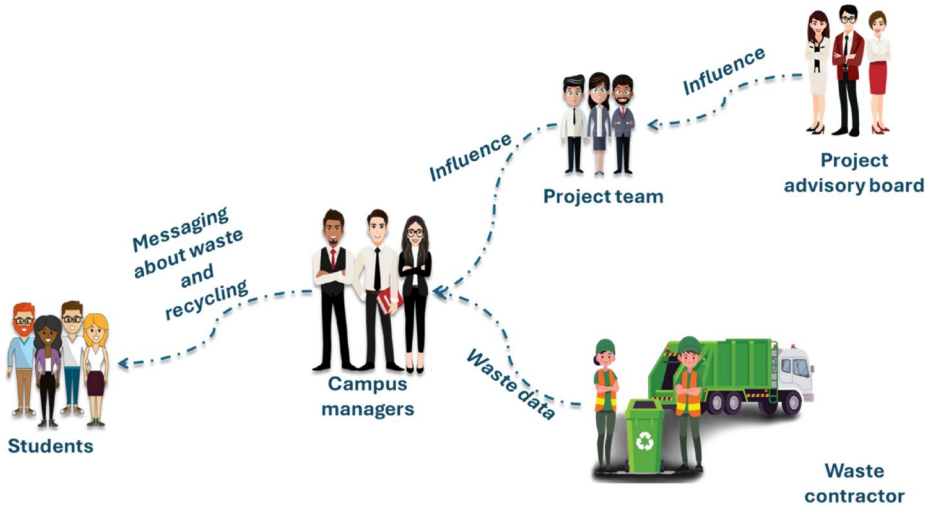

Figure 5. A "Relationships" diagram to depict the food waste situation and its inquiry by the project team.

together with waste collection by external contractors. We also showed the diversity of views and initiatives related to food and waste on campus.

As can be seen in Figure 4, the Rich Picture illustrates how food and food waste are circulated from supply to waste management, including data reporting (both undertaken by the external contractor). There is a hierarchical (pyramid) managerial structure contributing to and overseeing food delivery, consumption, collection, disposal and service payment. Each hierarchical level has defined targets or goals. These are also related to sustainability goals and rankings (e.g., the People and Planet University Guide®, QS®). Individual managers or units must make their achievements more visible and safer, so that the university has greater chances of going up in such esteemed rankings. As stated earlier, there were expressed concerns about lack of resources.

The Project Team and related dynamics are represented in the left-hand side. This spanned conversing with campus managers (pyramid), bringing in and sounding CE ideas or strategies. Students are portrayed in the right-hand side of the picture. They are shown as being or feeling "disconnected" or "distant" from the diversity of food related initiatives or actions, including food waste recycling. At the same time, some students are also projected as making efforts not to waste food-shopping and cooking responsibly, while enjoying campus life with their peers (right hand side). This finding confirms that there may be opportunities to "nudge" students and other food consumers on campus to improve reduction of food waste (Davison et al., 2022; Leal Filho et al., 2023; Reisch et al., 2021) (top left side of the rich picture).

4.3.3. A "Relationships Diagram"

When presenting an early version of the Rich Picture to the Project Advisory Board, some members expressed a concern about the value of using a CST methodology: "*Due to the perceived 'messiness' of the situation, should not be enough or more relevant to gather and show data from food audits and diaries, and convince campus managers of the need to firmly adopt CE ideas or technologies like compost-digestion?*"

Pressed to respond to this question and following intuitive artistry (Chowdhury, 2022), the Project Team prepared and presented at a subsequent meeting what they called a "Relationships' Diagram" (Figure 5). It features an oblique use of causal loop diagrams. The diagram intended to show delays (dotted arrows) in the contributions to influence (from both campus managers and the Project Team) students.

This visualisation helped the Project Team and Advisory Board to realise that perhaps our project efforts could be interpreted as trying "too hard," "too narrowly" or "too quickly" to positively influence managerial and student behaviour, regarding food waste and recycling. Even though campus managers seemed to be at the centre of influence, there could be other factors at play. As with the Rich Picture, this "Relationships" Diagram also showed that current efforts to reduce waste (including those of the Project Team to share data and suggest improvements) were having quite mixed results.

It was agreed that rather than detailing possible activities that could be undertaken to reduce food waste on campus, we needed to first show the full Rich Picture to managers. This was so that they could acknowledge the "messiness" of the situation, as reflected in the perceived divergence of views and initiatives, surrounding food and food waste. In this way, we hoped we would gain their views about relevant issues or next steps to move forward.

We also agreed to design several generic initiatives under a campus vision of the future, to help

this formulation. A final project workshop was to be organised with the Project Team, Project Advisory Board and campus managers to show the project insights-including the Rich Picture and a proposed campus vision.

4.4. Designing

The final stage of the methodology involved three activities: Design of a *vision*, active participation of stakeholders in *workshops* and further *meetings*.

4.4.1. Vision

Elaborating a vision is a method or technique from Ackoff's Interactive Planning systems methodology (Ackoff's 1981). It can help stakeholders idealise a future scenario of affairs in which perceived problems in a situation are *dissolved*, so that the overall quality of life of humans and non-humans is improved.

A vision shows different properties of an ideal situation (conceived of as a system) to cater to the *needs* of diverse stakeholders (ibid). As a source of creativity or innovation, a vision is also valuable because it could also help organisations rethink or realign their purposes and activities with what goes on in wider social, economic or technological systems of activity (ibid; Midgley & Lindhult, 2021).

With the help of the project's industry partner (who had previous experience in helping organisations implement composting-digestion solutions), the Project Team designed a future vision of the campus (Figure 6). This visualisation made it explicit that a 'whole system' was to be created and maintained, if not further developed, with the help of partnerships inside and outside campus (Ackoff, 1981). As seen in Figure 6, the vision includes on-site composting-digestion to help manage food waste (produced by stakeholders including students) and convert it into useful products or services, for the campus and its surrounding communities.

Additionally, the vision suggested that on-site digesting-composting could help reduce carbon emissions from food waste transport (Piadeh et al., 2024). And it could also enable and be supported by other activities. These examples include: hydroponic growing of food (in campus buildings' terraces), food portion re-sizing, coffee grounds recycling, community farming and education (Ibid). As a way of continuing "accommodating" ideas, the Project Team recognised that some of these ideas (i.e., coffee grounds recycling, reducing single use plastics) were already being implemented on campus.

In order to help the university begin to move towards the desired vision, the Project Team also researched and proposed several behavioural "nudges" (Thaler & Sunstein, 2022). As mentioned earlier in this article, "nudges" are inexpensive designs of behavioural choices which could aid or orient campus food consumers towards better food waste awareness or recycling (Babbitt et al., 2022; Davison et al., 2022; Reisch et al., 2021; Thaler & Sunstein, 2022). Food "nudges" that were proposed in the vision included the following:

1. Establishing a default menu option-for example, planning meatless or trayless days in some campus restaurants whenever appropriate, and in consideration of diverse food tastes and social behaviours (Lazell, 2016).

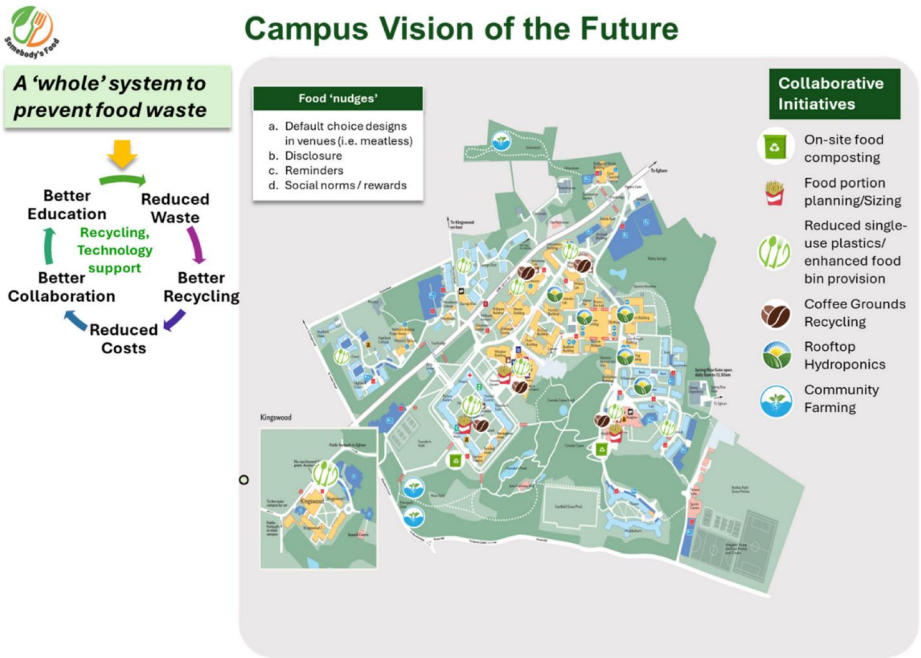

Figure 6. A future vision of circularity for better managing food waste on campus.

2. Disclosing and displaying information (i.e., weights or amounts of food being wasted and redistributed or re-used periodically on campus) at the same venues, initially using data from the waste management Contractor.
3. Having reminders (i.e., weekly food waste collection time, food waste facilities or locations) in student residences and other relevant venues.
4. Gently nurturing and working towards establishing 'new' social norms about food. For example, this could mean encouraging peer-based or collective awareness about recycling (i.e., "*7 out of 10 students dispose of food waste in allocated bins on time, and you…?*"). Another example could be organising student residence competitions to award good food recycling behaviour. This would be in collaboration with campus accommodation and endorsed by Hall Life.

The above "nudges" could also be expressed *via* social media. One example would be setting up and managing an institutional Instagram® account. This could also connect with the student societies, or adopt existing food sharing applications, as mentioned earlier in this article.

4.4.2. Workshop and further meetings

Workshop. Prior to the final project workshop (and with internal help from administrators), the project website was finalised. Draft versions of data gathered from food audits (and a video showing the process), food diaries, a version of the Rich Picture and, the proposed Campus Vision were uploaded and made available online.

The aim of the workshop was to show the project findings and to elicit feedback about net step possibilities for the campus. Versions of the food audits and food diaries, the Rich Picture and the Vision were included in a presentation to be delivered by the Project Team. There were also a summary of project findings and recommendations as follows:

- *There is a healthy degree of awareness/action about food waste on campus*
- *More could be done in terms of food diversity, planning, infrastructure (i.e., storage), education, redistribution, use of apps or technologies to continue minimising food waste on campus*
- *If the Circular Economy (CE) paradigm is to be adopted in various forms (i.e., the vision), methodologies to evaluate them need reviewing, with a wider/more inclusive boundary of analysis.*
- *Any future CE strategy requires more explicit degrees of inter-connection/collaboration between different administrative (managerial, student, volunteer, academics) levels/groups.*

During the presentation, the Project Team was praised for having reflected the comprehensiveness and complexity of the campus situation in the Rich Picture and its underlying information (audits, diaries, conversations). The participants also acknowledged that there was a lot of food related campus activity going on which was valuable.

Not all campus managers who were invited could attend. We learned that one of the meeting absentees was working with others to prepare and present a business case for the installation of onsite food composting-digestion. One individual had referred to this previously as "a food digester." Furthermore, the project PI was encouraged to speak to senior and newly appointed managers, some of whom had delegated and supported others in their project participation when we started. It was felt that any idea to move forward clearly required senior manager support and resources. A view was expressed at the meeting that any business case of composting-digestion and long term (and non-financial) costs or benefits (like decarbonisation or experiential education portrayed in the vision), should be considered: "We must keep trying [convincing the senior managers of the benefits of on-site composting-digesting]," someone said.

The Project Team thanked the Advisory Board, campus managers and the students who filled in their diaries. After the workshop, we helped the Campus Accommodation Manager to prepare and send a reminder email to students; who would soon be vacating their campus residences. In this message, we included several (socially acceptable) "nudges" like; "*Please remember to leave your accommodation in a good state for others to use.*"

Since this meeting took place, the university under study has appointed a new Vice-Chancellor (the position was vacant during the project), a new Executive Director of Campus Services and a new Campus Sustainability Director. We learned that the business case of an onsite food digester was prepared (the Accommodation Services Manager was invited to contribute), submitted and later *rejected* by senior officials. The university has now formulated and adopted a fresh plan towards 2030, with sustainability as a key pillar. Waste reduction continues to be among the goals.

The PI has contacted these newly appointed managers and presented the project findings. There was valuable feedback and invitations have already been received to meet senior managers to further showcase project insights. Some of this feedback is referred to in the next section of the article.

5. Reflections

This Section presents our reflections from the project, in relation to recent developments in CST. They are divided into: general reflections; reflections from further meetings; and reflections about critiquing and accommodating stakeholder interests.

5.1. General reflections

The CST methodology formulated in this article has helped some stakeholders gain a richer appreciation of the dynamics of university campus surrounding food waste, as a potential circular resource. The project also exposed some challenges and possibilities related to adopting circular economy (CE) principles and practices, within this institutional setting. We established what could be considered a generic process to comply with the funding requirements. The issue of food waste could help organisations mobilise action towards meeting diverse sustainable development goals (SDGs).

Furthermore, we were able to integrate several Soft OR methods from systems methodologies (i.e., Rich Picture, "relationships diagram," vision) with other schemes (i.e., food audits, food diaries). Following recent CST methodological developments about being open and responsive to emerging issues of concern (Chowdhury, 2022; Jackson, 2019, 2020), the Project Team was able to identify and respond to emerging concerns. These included queries raised within the team, about the direction of the project.

5.2. Reflections from further meetings

Admittedly however, promoting some of the strategies drawn from the CE literature presented in this article (including adopting on-site AD or preventing food waste) was met with a degree of resistance. Some stakeholders acknowledged the need for change. Nevertheless, change was not seen as straightforward or linearly oriented. Tensions about change were made more evident when the PI contacted and presented project findings to the newly appointed senior personnel (who had asked the Food Production Manager to join one of the meetings). Feedback about the project findings from the rich picture and its vision were as follows:

> *I have had unpleasant previous experiences with AD in my previous university*
>
> *Paradoxically [from student diaries and the rich picture], there are students who throw away food, whilst others cannot afford it*
>
> *From the business case [of an on-site food digestor], there is little in the way of cost [transport] savings … investments in additional [composting accelerators] resources and transport were also needed … so, we renewed the contract for waste management with the existing supplier …*
>
> ***Food waste is waste** … Besides, food is not directly included in the [sustainability] rankings … It would be best if you [our project] could focus on addressing student behavioural aspects*
>
> *We do the best we can … we now manage the [food] waste responsibly before it leaves campus [using electric vehicles]* (brackets and bold added)

These comments reveal a prevailing managerial mindset in this situation. Jackson (2019, 2020) recommends exploring a situation with open eyes, using a variety of systemic perspectives: "machine," "organism," "cultural/political," "societal/environmental" and "inter-relationships." These can be used as interpretive devices to gain insights into what goes on and, what issues seem to be dominating discussion or perception.

One such perspective is that of a *machine*. In any one situation, there could be a goal or set of specific goals that are defined (normally from the top). The machine works at " … passing instructions down a hierarchy and setting rules" (Jackson, 2020, 850). It often resulted in isolated, rigid, unconnected thinking and action. This means there is potentially little room for externally driven innovation, flexibility or effectively satisfying customer/citizen demands (Jackson et al., 2008).

It follows that such dominant machine-thinking could also affect how resources are allocated. This may be evident in institutions such as universities, when commitments or plans for social responsibility potentially obscure or relegate other initiatives or actions. Grolleau et al. (2024) holds this view. In our case, it seemed as if our efforts to help stakeholders reconsider the idea of food waste as a resource seemed to have been affected by this type of (well intentioned) mentality. It focused on achieving existing and specific (cost reduction, efficiencies, sustainability rankings) goals.

Despite acknowledging the propensity for machine-type thinking in our situation, we also encountered a degree of hope. Feedback from the above and other conversations suggest this:

> *Food waste has diminished in our restaurant [where we conducted food audits and reported their results to managers] … The [final project] presentation is really informative and I'm happy for you to forward on any info you might have to help me with ideas around food waste and student habits.*
>
> *The [waste] contractor has promised to enhance education about recycling to us … they are a good contractor … **slow progress is good progress** … they are a good [waste] contractor.*
>
> *We could improve our follow up of [institutional] plans.*
>
> *I have also asked [one of senior managers] to meet with you [Project Team] at some point to discuss current efforts and your ideas* [bold and brackets added].

5.3. Reflections about critiquing and accommodating stakeholders' interests

From our project, it could be said that the concept of Circularity (being explored through a Critical Systems Thinking (CST) methodology) could also be generating emerging tensions.

These are between resistance to and "slow" progress, towards adoption. Yet, how does one make sense of such tensions?

Systems Thinker; Jake Chapman (2004, 53, 68) would regard resistance to change as a double-edged sword when he says:

> *The resistance to change is a measure of an organisation's ability to adapt; it is a measure of its* ***resilience****. This resilience is therefore expected to be greater the longer the institution has existed and been required to adapt – which is broadly the case …* (bold added)
>
> *Systems thinking does not offer a silver bullet that will enable policymakers*
>
> *miraculously to achieve intended outcomes. Rather, adopting a systems*
>
> *approach will require a radical reappraisal of what can be achieved as well*
>
> *as the means whereby it might be achieved…*

In Chapman (2004)'s view, resilience could be actively addressed, with Systems Thinking (ST) helping managers visualise and act on this perceived resilience. Perhaps resistance to change does not need to be fully marginalised from systemic inquiry, but rather positively understood and embraced.

Smith and Midgley (2025) bring the above duality of resistance/change to a phenomenological, philosophical orientation that we think could help Critical Systems Thinking (CST) or Soft Operational Research practice in addressing circularity issues. These authors identify a *continuous* tension that emerges when practitioners pursue or follow the commitments of critical awareness and improvement. For them, *the tension is inevitable*. In other words, there cannot be critique without accommodation and vice-versa (Ibid). Instead of discarding perspectives in a situation that could be considered as uncritical (i.e., machine-like), these authors invite practitioners to accept that in any situation, accommodation of perspectives always emerges (even with or without practitioners' control). Therefore, it is reasonable to acknowledge and to manage this.

For our study, the above would mean that our attitude to obtaining mixed results is not a negative sign that we failed in our efforts to visualise or discuss challenges and possibilities for adopting CE. Rather, it could be seen as an opportunity to continue (if motivations and circumstances permit) working to bring about positive and systemic change.

There would need to be a careful balance between critique and accommodation though. This is so that any future effort does not simply align with organisational agendas but also contributes to their systemic innovation. Conversely, too many or unrelated CE ideas could instead contribute to their rejection. In this instance, it could be in working to achieve this balance and in using CE and Soft OR methods, that researchers, managers, stakeholders, and universities may contribute to the expressed United Nations Sustainable Development Goals (UNSDGs), by exploring the potential circularity of resources like food.

Moreover, when encountering machine-like thinking (like we have done during our project), there might be scope for discussing organisational efficacy (doing the right things) or efficiency (doing the things, right), as Critical Systems Thinkers advocate (Ackoff, 1981; Jackson, 2020). Grolleau et al. (2024) suggest the need to "find the right moments" to "speak up" and bring the attention of university managers or other stakeholders to potential connections and consequences. This is between social responsibility related ideas or initiatives, such as those focused on sustainability (i.e., going up in the rankings, complying) and, others that could be driven by circular economy (CE) principles. In keeping with this line of thinking, it may also be necessary to rename or even "drop" some of the initiatives that researchers consider essential to bring circularity to organisations – at least temporarily.

In addition to refining and including other systems and Soft OR methods to explore circularity, it might therefore be possible to adopt and to reflect on a strategy of "slowing down" of university life (Berg & Seeber, 2016; Córdoba-Pachón, 2023). This could entail allowing campus activity to unfold (as opposed to being driven by perceived urgencies), whilst critically supporting it "from a distance." For example, this may entail promoting strategic possibilities like: "who to [locally] negotiate with about food resilience issues" (Hansen et al., 2020, brackets added); providing valuable information to managers about food waste or relevant initiatives and overall; not taking things "too seriously" (Córdoba-Pachón, 2023).

In practice this could also suggest that researchers and managers could actually meet for "Slow Coffee." This would accommodate micro-converse to celebrate progress and to talk about things that *really matter* in their minds. During coffee (or tea), they may then keep abreast of and report new CE innovations, strategies or initiatives, their connections or their failures. If invited to "seriously" discuss or to

formulate managerial plans (i.e., in planning committees or working groups), this could be done by raising important issues and highlighting any connections between them. We also propose that "Slow Coffee" could entail using our intuition, improvising on the way (Chowdhury, 2022).

6. Conclusions, limitations and further research

This article has proposed a critical systems-thinking (CST) methodology to respond to concerns and opportunities about combining circularity as a paradigm and soft OR as a set of methods. The main agenda item is to tackle the complexity of campus food waste management in universities. We have followed the CST commitments to critical awareness, pluralism and improvement and use these to underpin our methodology, in the best possible ways. The proposed methodology incorporates soft OR (Rich Picture, vision) and other (food audits, student food diaries) methods. It has helped to create valuable knowledge about the situation under study. We have also responded to emerging concerns with a "Relationships" Diagram, showing insights and reflections that helped to keep our project on track. By applying this approach in a university setting, we realised that managing food and its waste in circular fashion is far from being comprehensively or rapidly addressed. This is partly because of the presence of machine-like mindsets and initiatives, some of which aim at similar and well intentioned goals or targets.

It could also be attributed to our own enthusiasm to bring CE to fruition in a short time span. In this regard, the proposed attitude of slowing down could help Soft Operational Researchers and Critical Systems Thinkers to manage tensions between stakeholders and their own improvement ideals, when it comes to promote CE principles or practices. Adopting this "Slow Coffee" approach might require continuous aligning of innovative efforts with campus managers' agendas and mindsets. This is while still playing a key role in noticing connections between theirs or other people's ideas, as well as "circulating" new and valuable insights, when deemed appropriate. In a nutshell, this indicates overall acceptance that "progress" is not only up to our own efforts. We can keep trying, whilst admitting that change often happens in different and unexpected ways.

As a major contribution, the proposed methodology could be considered one of the first to bring together circularity and Soft Operational Research (Soft OR). This was through a critical (and pluralistic) insider perspective. By so doing, it has enabled researchers and external stakeholders to jointly problematise a situation. Reflection took place while considering possibilities for improvement and, even while illustrating and addressing tensions between accommodation and critique. In the emerging literature of Critical Systems Thinking (CST), this gradual stance has already been proposed – for example by exploring a situation *before* planning and intervening in it (Jackson, 2020).

Hence, our methodology opens possibilities to further discuss the meaning of critique versus accommodation, by including reflections regarding thinking about or doing things "slowly" as "patiently," or "letting them go." Soft OR and CST could benefit from further research into how to facilitate change, with these methodological practice features or attributes in mind.

In terms of limitations, it can be said that our CST methodology adopted the CE paradigm as a given, without questioning its potentially machine-like underlying assumptions or unintended consequences upfront. In this regard, we could have adopted an approach less driven by the easily considered "mechanistic" notion of circularity. As noted earlier, these include Jackson's EPIC approach (Jackson, 2019, 2020), or the use of Boundary Critique and Critical Systems Heuristics (CSH) to surface different boundaries (Weaver et al., 2025).

If a situation requires it, the use of these approaches is worth considering for future research, but also in the light of our proposed attitude of "slowing down," which can also be seen as an important contribution to knowledge. In relation to this, one key point to consider in the context of university campuses is the cyclical, seasonal nature of campus life. For example, it is a given that there are transient student populations. Campus managers and researchers also need to follow this system, its milestones, timeframes and issues surrounding current (or anticipated) financial availability.

Arguably, we could have also audited other food venues on campus or broadened the list of stakeholders to talk to (i.e., representatives from the student's union, students' shops, campus take-aways vans or outlets) and consider food losses (i.e., those involved in food preparation). We might also have made more use of social media to generate awareness about CE in both campus managers and student populations. Yet, these too would have had their own limitations. Managers, students and other stakeholder's time or seasonal availability were issues which would be better ascertained for future interventions. In short, getting close to food loss or waste requires some "stomach"; as our Project Research Assistant could testify!

Additionally, we might have expanded on the use of other systems methodologies or methods. For instance, we would have entailed elaborating and reflecting on systems models of human activity (HAS) . It would be to help us ground more clearly possible changes, derived from our vision. In the future, HAS could be used to foster conversations with *specific* stakeholder groups or communities (i.e., outside campus). Any feedback might then refine the proposed vision, processes and "nudges." This would be so that boundaries of analysis and data to be gathered could be reflected upon and debated (Brooker et al., 2025; Córdoba & Midgley, 2006; Midgley, 2000). Ideas about eliminating different types of waste service could also be introduced and critically tested (Jackson et al., 2008; Weaver et al., 2025).

That said, we do see an important opportunity to continue integrating Soft OR and other methods from the circular economy (CE) paradigm, in critical and in accommodating ways. From our experience in this project, doing so would require appropriate doses of creativity, "Slow Coffee," dialogue, patience and understanding. On this basis, meaningful progress or improvement (albeit unhurried), could truly unfold.

The hope is that this article inspires Soft OR and CST practitioners to venture in exploring further how food resources are managed on university campuses. An additional hope is to determine how to improve thinking, relevant action and timeliness, towards UNSDG Target 12.3 and other related goals. These are all with the notion of circularity in mind.

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Author contributions

JR-CP led the conceptualisation of the article in Systems thinking terms and helped with the data collection, analysis and presentation, initiating and supervising paper versions and resubmissions. A.P-C. edited and integrated paper insights of the different sections with the broader systems thinking, Critical Systems Thinking (CST) and soft OR literature, advising on revisions. T.B-C also edited the paper several times and added conceptual insights into collaborative and practical systems strategies, to address food waste, also proofreading the draft manuscript. A. B. generated the hierarchy of CE strategies for food on campuses section of this article and proofread initial submission. R.S led the writing of this article in its early stages, assisted the collection of data from food audits, and provided integrated and multimedia data templates for both this article and the project's website. MW and KB engaged in several project discussions leading to the formulation of the framework, reflections and conclusions of the article. MW also provided advice on the techno-economic assessment of AD.

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