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Sustainability Transitions in University Food Service—A Living Lab Approach of Locavore Meal Planning and Procurement

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Abstract: Due to its purchasing power, the public food service sector is viewed as a potential transformative driver towards sustainable food systems. Organic meal planning and regional procurement may be a vital implementation strategy towards Planetary Health Diets in the communal catering arena. Capable of unleashing desirable synergies within local foodsheds, this transition pathway can potentially benefit all stages of the value chain, while also positively influencing consumer dietary behavior. Transformation, however, poses complex challenges to caterers, as it demands a shift in mindset regarding the philosophy, organization, and management of cafeteria systems as well as the need for affordable and aggregated supplies of source-identified local organic foods. This action research case study engaged the public caterer of a German University, undergraduate students, and additional stakeholders in a Living Lab to develop a weekly farm-to-table cafeteria menu, including its actual preparation, based on a conceptual sustainability standard. Hence, through an iterative process, involving two feedback cycles, an ambitious set of nutritional and procurement criteria were devised, inspired by the external input from exemplary practitioners in the field of green cuisine and procurement. The resulting meal plan was then subjected to an evaluation vis-á-vis its compliance with (1) dietary recommendations, (2) seasonality, (3) organic certification, (4) a defined foodshed boundary, (5) budget neutrality, and (6) life cycle assessment.

Keywords: living lab; public procurement; planetary health; organic; local

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1. Introduction

Public food service or communal catering as a subset of "out-of-home consumption" refers to all eating activities that take place outside the home, including canteen settings of schools, universities, or other public institutions [1,2]. According to Pfeiffer et al. [3], the out-of-home sector in Germany represents a market share of 40% and is the second-largest market for food products, with a total sale of EUR 83 M in 2019 [4]. Within the EU, the public procurement sector represents around 14% of the gross domestic product [5]. Due to its tremendous purchasing power, the communal catering/public procurement complex could be a transformative driver towards sustainable food systems [6–9]. Planetary healthy nutrition, as well as the adoption of relevant criteria fostering green procurement, can benefit small and medium farmers as well as local food value chains [10,11].

Examples of sustainable nutrition are the Mediterranean and New Nordic Diets, which address local food production, nutrition, biodiversity, and sustainability [12,13]. Consumers are showing increasing interest in regionally produced food for a variety of motivations, including health and quality reasons, environmental concerns, and a desire to support local farms and communities [14]. Seasonal eating habits involving foods from source-identified local origins have become known as "locavore diets" [15].

The Planetary Health Diet (PD) is a dietary concept that aims to protect human and ecosystem health alike. Developed by the EAT-Lancet Commission, the PD is based on the conceptual framework of the Planetary Boundaries and models sustainable diets based on safe operating spaces for food systems [16]. The safe operating space for food systems is

defined as being below the uncertainty range within the Planetary Boundaries. The PD concept proposes flexitarian eating habits that include global dietary recommendations that can be regionally adapted [17]. A typical meal based on the PD can be broken down by volume as follows: half of the plate consists of fruits and vegetables, while the other half contributes to the calorie supply, primarily in the form of wholegrains, plant protein sources, unsaturated plant fats, and, optionally, a very small amount of animal protein sources [16].

We regard local organic diets in communal catering settings as a vital contribution toward the PD concept, which, along with the respective procurement and meal planning strategies, can have positive effects on local foodsheds but can also positively influence consumer dietary behavior [18]. A foodshed describes the geographic area supplying a specific population with food [19]. Diets for planetary health and nature-positive food production are vital components for achieving a more sustainable food system. Principles ought to include a preference for organically produced, local and seasonal, low-processed, plant-based, and fairly traded foods [20,21]. Based on the 2017 Global Nutrition Report, all 17 UN Sustainable Development Goals (SDGs) are linked to nutrition [22]. Therefore, the promotion of organic agriculture and short supply chains through the consumption of local organic food in the out-of-home eating sector is important for the acceleration of the transformation towards a sustainable food system and healthier lifestyles [23,24].

Higher Education Institutions (HEI), as a subset of the public food service/communal catering sector, represent an important stakeholder for promoting sustainable development in the nutrition arena [25–27]. As stated by Chambers [28] and Omrcen et al. [29], higher education is fundamental for securing a sustainable future. Higher Education Institutions (HEI), such as universities, have the opportunity to promote sustainability as they teach the coming generations of decision-makers and influencers that can contribute towards the endeavor of the SDGs as well as aiding in the improvement of the food system [30]. Moreover, universities also represent a significant arena for leveraging sustainable food procurement as they manage a large range of food and catering outlets for students and staff [25].

Universities in Germany usually contract with public caterers that organize and operate their entire food environment, including canteens, while providing services to many students and staff [25]. As stressed by Teitscheid et al. [31] (p. 32), these state-run non-profit organizations, typically called "Associations of Student Affairs and Services" (ASAS), were responsible for total annual sales worth EUR 415M in 2013, which makes them one of the largest segments of the communal catering sector in Germany.

The German Nutrition Society (DGE) has established dietary guidelines for both communal and corporate catering, which the public food service sector is supposed to adhere to [32]. These recommendations are calling for increased proportions of fruit, vegetables, legumes, and wholegrain cereals in people's diets [30]. The DGE recommendations include nutritional reference values geared toward communal catering specifying how much of each food category should be consumed in a typical workday lunch. The guideline recommends more plant-based foods, wholegrains, and pulses and fewer animal products, sugars, and saturated fatty acids [33]. The PD, on the other hand, conveys guidelines as to how much of each food category should be consumed per day [16]. While the PD also recommends primarily plant-based food, wholegrains, pulses, and fewer animal products, sugars, and saturated fatty acids, its proportion of macronutrient intake for each food category varies from the German DGE standard. The food categories themselves also differ. The PD includes the food categories (1) vegetable and fruit, (2) wholegrains, (3) starchy vegetables, (4) dairy foods, (5) animal-sourced protein, (6) plant-sourced protein, (7) fatty acids, (8) added sugar. The DGE, on the other hand, includes the food categories (1) wholegrains and potato, (2) dairy products, (3) animal protein, (4) fatty acids, (5) vegetables and salad, (6) fruit. The German DGE merged the two PD categories "wholegrains" and "starchy tubers" into a single group called "wholegrains and potatoes". Likewise, the group "plant

protein sources" under the PD is included in the group "vegetables and salad" under the DGE classification.

Commitment to sustainability transitions in the public food service sector poses complex challenges to communal caterers, as it requires not only a change in sourcing and procurement purchasing but also a shift in mindset regarding the philosophy, organization, and management of the respective canteen system or food environment [18,34]. The search for local vendors who can offer economically priced and adequate supplies of organic food in an aggregated manner, as well as the adapted meal planning, often involving additional kitchen equipment and staff as well as training and sensitization, can be time-consuming and requires cost-intensive planning [35].

Typically, public sector food service organizations receive a mix of funding, including government grants [36]. In the case of the ASAS canteen system at Kassel University, costs are covered through a revenue mix, consisting of (1) subsidies by the state of Hesse, (2) a portion of the semester fees that students pay each term as well as by (3) revenue generated from actual food sales [37]. The fact that, according to a social survey, commissioned by Kassel ASAS, students only have an average of EUR 161 for monthly food purchases at their disposal further necessitates the provisioning of affordable lunch options at university cafeterias [38].

If catering companies want to offer organic food options, certification of the kitchen is mandatory, which can be a deterring factor due to the additional bureaucracy and inspection visits [36]. Organic certification may be granted based on individual meals or on behalf of the entire segment of organic ingredients employed by the canteen, which also necessitates a strict separation between organic and conventional ingredients throughout the entire logistical process, including storage.

Many smaller canteens/cafeterias usually do not have the appropriate infrastructure for the preparation, processing, and storage of fresh foods, which leads to higher use of convenience products, rather than fresh produce [36]. So-called "just-in-time logistics", the common supply chain management system, whereby products are delivered on the day they are needed, may at times alleviate this problem [39] but, at the same time, is not without controversy.

Another challenge is the lack of consistent supply, aggregation, and delivery of organic food from local farms, compounded by the fact that it is more difficult for smaller farms to become listed as vendors in the Germany-wide inventory management system that catering companies use. Here, it would be important for local vendors or farms to form logistical alliances or initiate the creation of a Food Hub so that value chains become less fragmented and caterers may receive the consistent quantities they require [36]. Food Hubs can lead to more trustworthy relationships between producers and caterers, as well as reducing time and costs by using scale effects [40]. A Food Hub is defined as "a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesaler, retail and institutional demand" according to Barham et al. [41] (p. 4). Specifically, the US model of Food Hubs has become known to aggregate and deliver mostly farm-fresh but also "fresh-cut" vegetables under "co-packing" arrangements with a high degree of diversity and consistency that far exceeds the capabilities of individual farms [41,42]. With the help of Food Hubs, producers are relieved from the burden of time-consuming marketing and promotion of their local products and can tap into the growing market segment of communal caterers, who, at the same time, prefer fewer but effective vendors.

The European Commission recently launched its "Farm to Fork" strategy as the foundation of the European Green Deal [43,44] to create a more sustainable European food system. This food system action plan encompasses all stages from production to consumption, envisioning equitable livelihoods for smaller primary producers, a transition towards sustainable practices, as well as promoting healthy and sustainable diets for

consumers [45]. The strategy acknowledges the inseparable links between a healthy population and a healthy planet [43,46].

The European Commission also developed environmental procurement criteria in the form of voluntary tools such as the Green Public Procurement (GPP) or the Sustainable Public Procurement (SPP) agendas, intended for the development of short food supply chains and regional food production systems [46,47]. To prioritize the use of healthy, regional, and organic food in public institutions and to facilitate a transition towards sustainable food systems, such protocols should be applied across national scales, encompassing all levels of the public sector [34,48]. This notion stands in contrast with the EC Treaty and other conventions that call for the "free movement of goods and equal rights for all market participants" [49] (p. 1).

The EAT-Lancet report displays a food system model based on a lemniscate, where the Planetary Boundaries intersect with human health boundaries at the center of the infinity symbol. It reiterates an insight that had previously been conveyed by the Double Pyramid model of the Barilla Foundation, demonstrating how the least environmental impact can be achieved via peasant-inspired locavore diets such as the Mediterranean Diet, which, at the same time, happen to exert positive effects on human health [50,51].

This socio-ecological linkage is based on a physical lawfulness, which the prevailing food system paradigm has strayed away from. Likening "eco-agri-food system" health with human health or emulating natural systems and cycles by working with nature as opposed to against nature are notions that have been advanced through Organic Food Systems (OFS). Since its inception, the organic food and farming movement has been cultivating values fostering regeneration and localization. The four principles presented by the International Federation of Organic Agriculture Movements (IFOAM), "Health, Ecology, Fairness and Care" [52], provide a paradigmatic context and enabling source for FAO's definition of Sustainable Diets [53], which are described as "diets with low environmental impact, which contribute to food and nutrition security and healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources".

A recent study identified a global driver pattern among OFS, irrespective of socio-economic gradients between global north and global south countries. The study revealed a set of environmental and social norms and narratives that are propelling what the authors call the "Organic Mindset". It consists of a deep commitment to sustainable development by value chain actors across food system elements. The identified motivational drivers from OFS around the world circumscribe a coherently ethical agenda comprising the following correlates: (1) transformative learning and collective impact, (2) equitable growth and community empowerment, (3) resilient production and ecosystem services, and (4) moderate consumption and healthful lifestyle [54].

This paper aims to present a methodological framework by which to involve a Higher Education Institution (HEI) in potential transition pathways toward sustainable public procurement and meal planning. This Living Laboratory approach against the backdrop of Participatory Action Research involved students and the Kassel ASAS as key stakeholders over six months in an attempt to optimize green sourcing through organic meal planning at the canteen location of the School for Organic Agriculture in Witzenhausen, according to selected sustainability criteria.

The concept of sustainability transitions is defined as "long-term, multi-dimensional and fundamental transformation processes through which established socio-technical systems shift to more sustainable modes of production and consumption" [55] (p. 956). Food sustainability transitions refer to socio-technical transformation processes that guide food practices towards sustainability [56]. Food transitions refer to the processes of structural change that allow the emergence and diffusion of new modes and practices of food production and consumption that are more sustainable. These transformation processes

regard the whole food chain, from food production through processing, distribution, to consumption [57].

While primarily aiming at the development of a practicable and methodological approach of involving key stakeholders in a transformation process toward local organic meal planning and green procurement in the HEI food service sector, our study pursued the following additional objectives:

1. to develop a coherent set of sustainability criteria or conceptual standards regarding procurement and meal planning;
2. to develop actual meals for a weekly menu;
3. to evaluate the potential of organic "locavore" menu planning and procurement against the goals of budget-neutrality and the PD recommendations.

2. Methods and Approach

We have embedded our research questions into a Living Laboratory experimentation setting, in which key stakeholders shape "public-private-people-partnerships" [58] (p. 19) within institutions, such as universities, to take part in "open and distributed innovation processes in a real-life context, aiming to create sustainability values" [59] (p. 3).

An internal multi-stakeholder committee at Kassel University, convened by the European Eco-Management and Audit Scheme (EMAS), was interested in several sustainability transitions across relevant areas, including procurement and meal planning aspects, at its canteen food service locations. EMAS is a management and environmental audit instrument that aids organizations of all kinds in improving their environmental performance and, as a public law instrument, is based on the EU Regulation No. 1221/2009 [60,61]. The tool can also be applied to public food service, as has been shown in the facilities of the Berlin ASAS, where several dining facilities have met the EMAS requirements [62]. Hence, a couple of researchers from the School of Organic Agriculture at Kassel University approached ASAS to use the opportunity for implementing a Living Lab transition experiment. Hence, a university course was designed specifically to engage some of the key stakeholders of the university food service context in solution-oriented experimental research.

Participatory Action Research (PAR) is a collaborative, action-based process between researchers and participants, who work together in making change within the community [63,64] by promoting in-depth and multi-faceted understanding of a complex issue in its real-life context [65] (p. 1). It combines action and reflection so that the team of researchers and participants can understand and improve these issues [66]. Baum et al. [67] describe PAR as a reflective cycle, by which participants define a problem, gather and analyze data, and iteratively take and reflect upon action. To increase a team's functionality and to ensure realistic interventions, both quantitative and qualitative components in the form of mixed methods may be incorporated within the same research design [68,69]. The mixed-methods approach within the overarching PAR/Living Lab framework included both quantitative and qualitative methods that were applied sequentially. We have adapted the PAR approach from Velasco [70] (p. 2), exhibiting two consecutive feedback cycles with repeating phases of action planning, stakeholder engagement, and reflection (see Figure 1). The action was carried out through practical experimentation, followed by reflection and analysis [71,72]. Action analysis consisted of feedback from the Kassel ASAS canteen director as a key stakeholder on one side, but also through the continuous effort of aligning the students' proposed meals with the jointly elaborated conceptual standard. As a final analytical step, the meals were run through a browser-based life cycle assessment application called "NAHGAST".

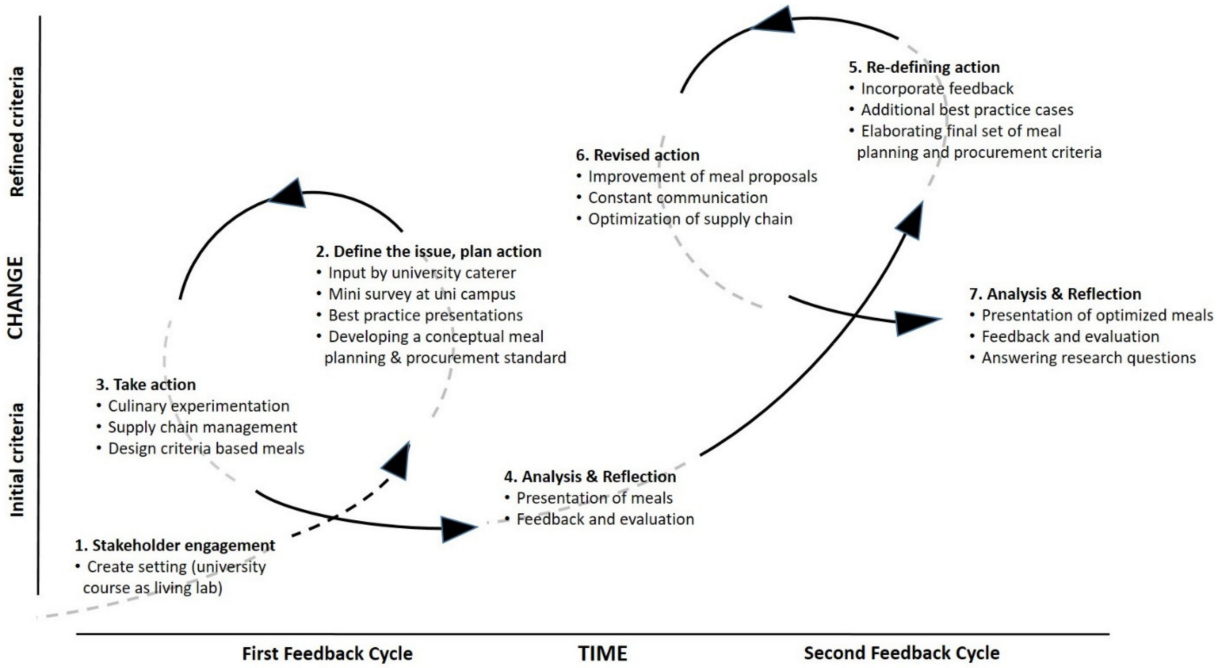

Figure 1. Action research methodological framework, involving two cycles of repeating phases involving action planning, stakeholder engagement, and reflection (adapted from Velasco [70] (p. 7)).

2.1. First Feedback Cycle: Stakeholder Engagement

Key stakeholders were sensitized about the structure and purpose of this project. The undergraduate university course "Eating and drinking as drivers of change" was conceptualized as a PAR Living Lab for piloting transition pathways regarding green procurement and local organic meal planning at one of the food service locations within Kassel ASAS. It provided the setting to initiate interaction and dialog among key stakeholders, including researchers and students as the primary clientele of the campus cafeteria/canteen and the Kassel ASAS as the public catering company. The research project consisted of (1) a team of two researchers, who provided the main scientific input, (2) the gastronomical director of ASAS, who is responsible for all the canteens and cafeterias at the University of Kassel, (3) five external experts providing best practice case studies, and (4) a group of 20 undergraduate students (divided into five groups) from the School of Organic Agriculture at Kassel University. Since this project was carried out at the School of Organic Agriculture, we mainly focused on the cafeteria at this campus.

2.2. First Feedback Cycle: Defining the Issue, Planning the Action

The Kassel ASAS canteen at the School of Organic Agriculture started serving organic food as of 1985. According to Krieger (2019), ASAS's cost of goods for organic products at the canteen of the School of Organic Agriculture makes up approximately 40% of all procurement expenditures for this campus. Around 20% of these ingredients are sourced locally from North Hesse. In 2003, the ASAS canteen was awarded an organic certificate and has been able to use the organic seal for designated meals since 2004 (code number: DE-ÖKO-039). Since the specific type of organic certification is based on entire meals, as opposed to individual ingredients, all the ingredients of a given meal have to be organic or else it cannot be labeled as such [73,74].

The mission of Kassel ASAS is to support students economically, socially, and culturally based on target and performance agreements made between Kassel University and the state of Hesse, as anchored in Hessian student Union Law. Regular meetings with state and university representatives, student surveys, and feedback management mechanisms serve to identify student needs [75]. This involves, for example, offering a range of nutritionally balanced, inexpensive, and tasty meals and snacks at all university

locations, taking into account omnivorous, pescatarian, ovo-lacto-vegetarian, and vegan options. Organic meals, consisting of the main plate and two side dishes are offered in vegan or ovo-lacto-vegetarian qualities at approximately EUR 3.20, versus EUR 2.80 for conventional options. Extra side dishes cost EUR 0.80 [75].

According to the gastronomical director of Kassel ASAS, reliability and good-quality food are not the only decisive factors for purchasing from registered vendors. Reasons for the relatively high amounts of processed foods currently used by the canteen have to do with certain space restrictions prohibiting the storage of larger quantities of fresh ingredients, compounded by the fact that the organic wholesaler from the area requires minimum order volumes, which is customary in the industry. To make the vicious cycle complete, it is the personnel costs arising from the receipt of too many individual deliveries of fresh products from single farms that force ASAS to resort to aggregated deliveries by a conventional wholesaler. Furthermore, they are bound to transparent, rule-compliant, and corruption-proof contract awards. This means that no direct contracts can be awarded to suppliers without prior comparison through price bidding or tendering procedures. In addition, many hygiene and other food law regulations must be taken into account in the preparation, plating, and serving of meals, including the return of dishes, which make it very difficult to use unprocessed, farm-fresh vegetables or to control food waste [75].

Quantitative research in the form of a mini online survey was conducted to obtain feedback from additional students, who were not enrolled in the course, about their willingness to support organic locavore food choices at the cafeteria. Enrolled students from the course each were responsible for finding two students who would digitally take the survey. Eventually, a group of 40 randomly selected students took part in the survey. The structure of the survey was adapted from Kumar [76], Lülfs-Baden, and Spiller [77]. It consisted of five closed-ended questions with a three-point Likert scale. Closed-ended questions on a Likert scale prove to be answered more easily and can be analyzed more quickly [78,79]. Since the entire research project was primarily conducted online, due to the COVID-19 pandemic, this quantitative method proved to be beneficial, as it provided an easy way to gain an impression from student clientele as to whether the planned action would be supported.

Next to the mini survey, additional qualitative research in the form of brief case studies conveying best practices in the field of local sourcing and green procurement was carried out to share with the whole group. A total of four cases were sampled during the first feedback cycle, including (1) the certified organic private catering company called "Biond", serving 100% organic school lunches nationwide, (2) the "Diet Unit" from Stockholm County in Sweden, procuring close to 100% organic food for 35 public canteens in the municipality of Södertälje, (3) the certified organic "U-Boot" cafeteria of Dresden University, serving 100% organic food, and (4) the certified organic locavore vegetarian "Adelhaus" restaurant, of the initiative "Regionalwert" from Freiburg Germany.

Applying a case study approach promotes "in-depth understanding of an issue in its real-life context" [65] (p. 1) and relating to a variety of variables about the units of analysis under investigation [80]. The structure and presentation of best practice examples were adapted from Fletcher et al. [81], whereby the most important learning outcomes that are essential for the planned action were identified and adopted.

The research problem and issue at hand were jointly clarified and criteria regarding sustainable procurement and meal planning, such as regional sourcing, seasonal organic ingredients, budget-neutral procurement as well as compliance with the DGE and PD guidelines, were formulated by juxtaposing principles derived from the best practice case studies with the literature. As the term "seasonal" can be associated with regionally produced goods [82], this study equated the two terms and treated them synonymously. Since this project took place during the winter semester, the meal proposals developed by students had to consist of ingredients that were in season between December and March, which, considering the climate of the midland low mountain ranges of North Hesse, presented an extra design challenge.

2.3. Development of a Conceptual Standard for Sustainable Meal Planning and Procurement

Based on the input that was provided by the gastronomical director of Kassel ASAS regarding the mechanics, operational realities, and path dependencies of both the university-wide and campus-specific canteen system at the School of Organic Agriculture, a preliminary set of meal planning and procurement criteria was devised to serve as our experimental standard.

Firstly, and since the project primarily aimed at composing organic meals that conformed with PD recommendations, but since Kassel ASAS adheres to the German DGE standard, it made sense to include both sets of reference values in the experimental sustainability standard that this study was pursuing. Since the PD guidelines present macronutrient intake based on a full day's nutrient intake, we recalculated them to reflect the macronutrient intake for a lunch meal (Table 1), based on the DGE reference for nutrient intake, which states that lunch in communal catering is supposed to constitute 35% of a full day's nutrient intake [83].

Table 1. Original PD macronutrient intake per day adapted to macronutrient intake only for lunch.

Food Groups	Planetary Health Diet (Per Day) Macronutrient Intake Ø % Day	PD on a Lunch Basis (35% of Total) Macronutrient Intake Ø % for Lunch
Wholegrains (rice, wheat, corn, etc.)	17.5	6.1
Tubers/starchy veg. (i.e., potatoes, cassava)	3.8	1.3
All vegetables	22.7	8
All fruits	15.1	5.3
Dairy foods	18.9	6.6
Animal protein sources	6.3	2.2
Plant protein sources	9.4	3.3
Unsaturated oils	3.0	1.05
Saturated oils	0.9	0.3
Added sugars	2.3	0.8

To design a sustainable meal planning and procurement standard for HEI food service, we decided to superimpose OFS principles on the Planetary Health Diet. Through this process, multiple OFS converging qualities, such as 100% certified organic ingredients, moderation in the use of animal products, gentle processing, territorial value chains, and nature-positive production, intuitively coalesced into our conceptual standard.

Our conceptual standard, consisting of six interrelated parameters that had been gradually elaborated throughout this Living Lab research, has been derived from the Organic Mindset, which perceives food quality as a direct result of its multi-faceted sustainability approach.

The innate affinity for systems thinking and capacity for ecocentric responses to food system vulnerabilities that have developed from the OFS niche has proven to serve as viable transition pathways toward regenerative food systems and should be mainstreamed as such [23,84,85]. The alignment of normative horizons between the OFS Mindset with its innate SDG trajectory and the emerging consensus regarding necessary transformation responses can be observed by way of certain scientific discourses such as "The Economics of Ecosystems and Biodiversity" in the Eco-Agri-Food System [86]. The matching qualities also become apparent when juxtaposing OFS emerging properties with some international agendas, such as the EU's System Change Compass [87], the Collaborative Framework for Food Systems [88], and other UN protocols. This convergence is also reflected in numerous European lawsuits launched by civic society and directed at national governments, due to the negligence of committing adequate climate and biodiversity action, which food systems, among other sectors, would technically be able to tackle [89].

On the other hand, we are now experiencing the feedback driving forces coming from the breaking boundaries of the planet's ecosphere [90]. For our food system not to fail us, renewed innovation endeavors toward eco-efficient and nature-positive production are

required. The planet is holding up the mirror, signaling the unsustainability of current food system trajectories. Due to the mismanagement of these global commons, planetary feedback mechanisms have been unleashed, which are exerting a driving force of their own, forcing the food system to adapt.

We propose a conceptual standard for sustainable meal planning and procurement in the public food service arena that is cognizant of both the emerging trend toward localization and generation, which co-evolved with OFS and the feedback drivers that were unleashed by breaking planetary boundaries. Both driving forces are converging on the joint nexus of nature-positive production and aligned natural and social capital bases, enabling homeostasis of the food system (Figure 2).

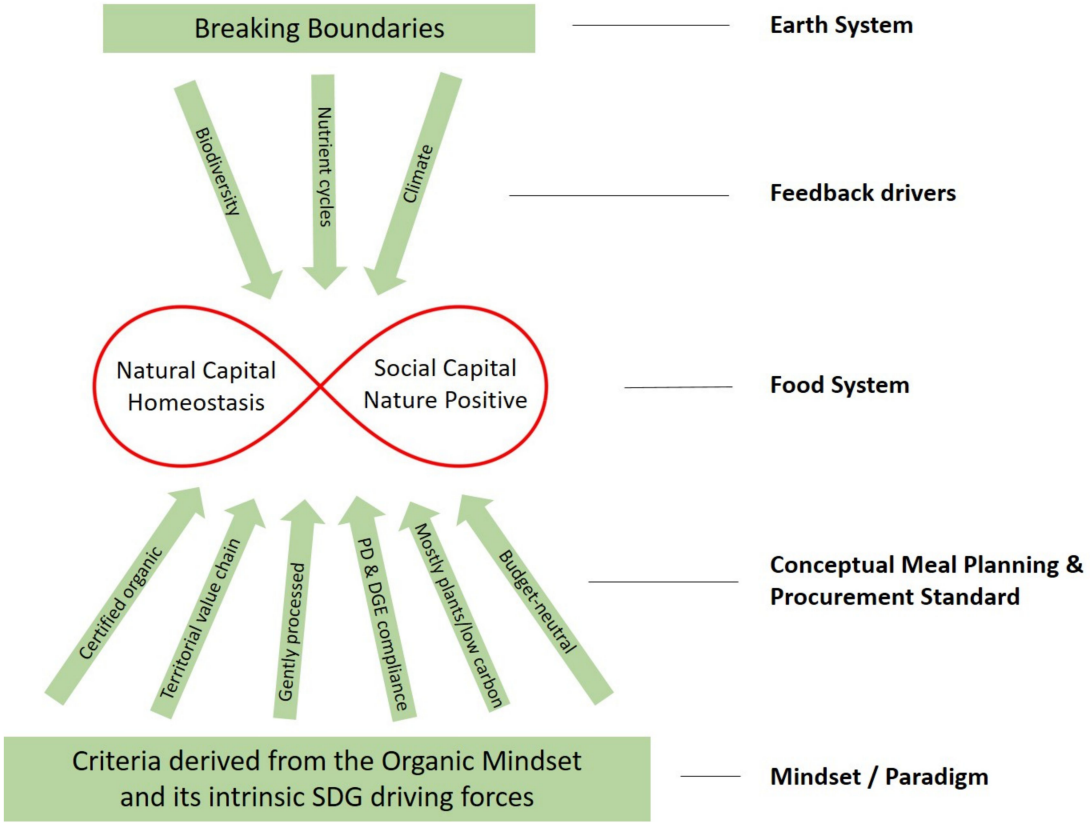

Figure 2. A food system-based conceptual framework aiding the design of a sustainable meal planning and procurement standard for the HEI public food service.

2.4. First Feedback Cycle: Taking Action

After learning from best practice examples, the five student groups then started with the design of their meal proposals by engaging both in culinary experimentation and supply chain management. Students were reaching out to farms and wholesalers from the region while staying in close communication with the gastronomical director of Kassel ASAS about availabilities from existing vendors within the inventory management system. Subsequently, each group prepared, tasted, and documented their meal, to convey a culinary impression of it. Each meal consisted of the main component as well as two side dishes.

2.5. First Feedback Cycle: Analysis and Reflection

At this phase, toward the end of the first cycle, students presented their meal proposals to the gastronomical director of Kassel ASAS. The presentations included a short description of their recipes, an account of what inspired the design of their meal proposals, as well as how the meals performed according to the list of preliminary criteria. Each meal

was reflected upon by providing feedback, including optimization suggestions regarding both meal composition and the procurement of ingredients. It is important to note that during the first cycle, each of the five meals was presented and evaluated as individual lunch meals and not in the form of a weekly menu plan.

2.6. Second Feedback Cycle: Redefining the Action

After the analysis and reflection phase of the first cycle was concluded, the ensuing feedback and analysis informed the optimization cycle, which served for the refinement of both the meals and the criteria. An additional best practice case, called the "Food for Life" program by the British Soil Association, was presented to provide further nuance to the defined problem. Thus, a final set of meal planning and procurement criteria was elaborated.

Finally, through the input of the researchers, life cycle assessment (LCA) as an additional analytical tool, to be performed on individual meals, was added to the set of sustainability criteria, using the scientifically devised "NAHGAST" calculator [7,91] to help visualize the socio-ecological impacts of the meals.

2.7. Second Feedback Cycle: Revised Action

Each group of students again worked independently on improving both the design of their meal proposal and the procurement of ingredients. While communicating with Kassel ASAS and local vendors to consolidate supply chains, the procurement, and taking into consideration the full set of criteria and prior feedback, all meals were again prepared and documented to delineate the changes that were made.

2.8. Second Feedback Cycle: Analysis and Reflection of Revised Action

The refined meal proposals were re-presented to ASAS. The presentations included a short description of what was improved and how the meals performed against the final conceptual standard. Again, each meal was reflected upon and final feedback (if any) was given.

3. Results

3.1. First Cycle Results: Mini Survey

All 40 respondents answered the questions, apart from one question, which was left unanswered by one respondent. Overall, the results show that the aspects "Regionality", "Organic Farming", and "Vegetarian/Vegan" options were important to the respondents. They also indicated that they would be willing to pay a higher price for such meal options (Figure 3).

3.2. First Cycle Results—Best Practice Case Studies

Table 2 presents the best practices of four selected cases regarding their implementation of sustainable menu planning and procurement. According to these best practice examples, the main standards include locally produced fresh, seasonal, and organic foods with an emphasis on vegan or vegetarian meal options. In addition, constant exchange with producers and suppliers has been mentioned frequently, as well as having a flexible meal plan, placing high value on food waste mitigation, following dietary guidelines, and adhering to a fixed budget.

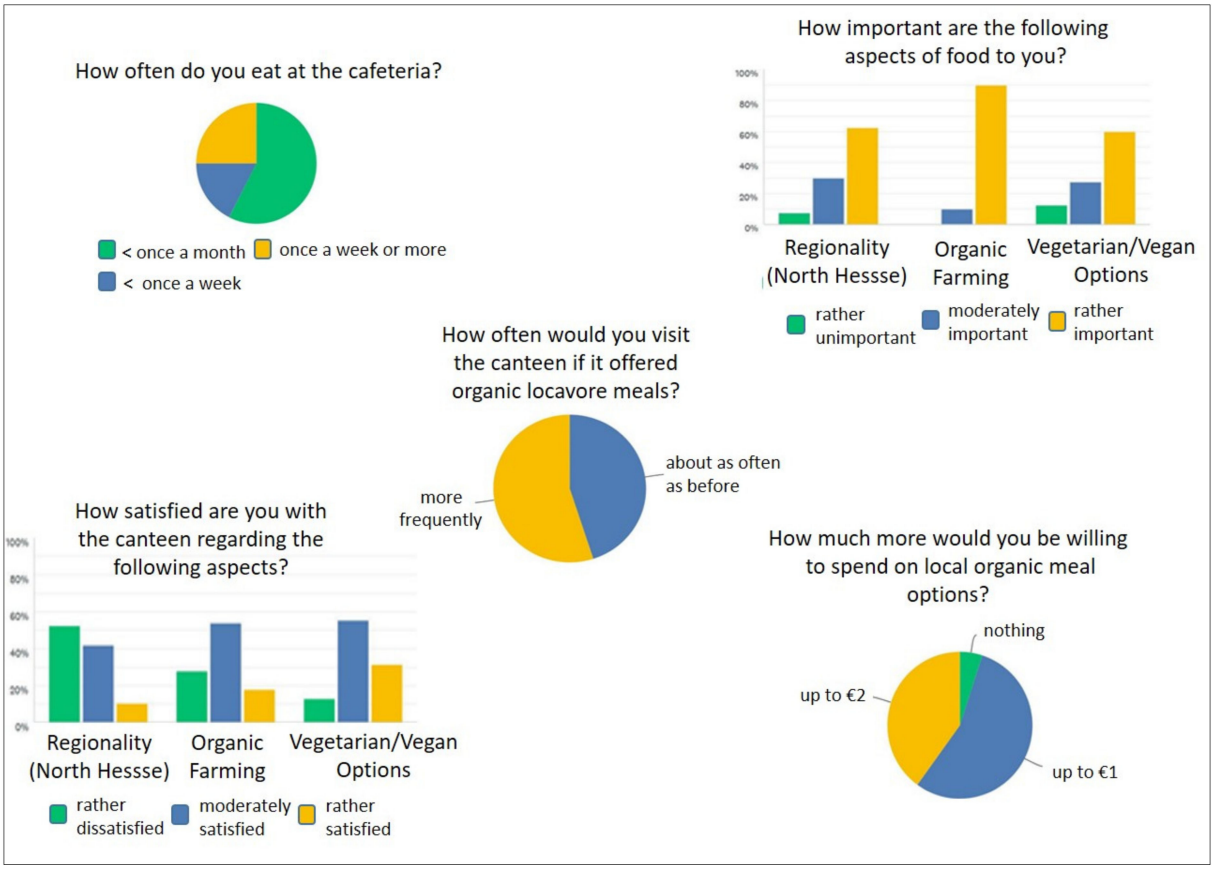

Figure 3. Mini survey results based on five quantitative questions.

Table 2. Case studies and their standards for sustainable procurement and healthy meal planning.

Case	Standards
BIOND—organic catering service for schools and kindergarten, operating nationwide	• Fresh, seasonal, organic, and regional products • Avoiding food waste by producing the right amounts, utilizing leftovers • Using the concept of "just-in-time" delivery • No GMOs or flavor enhancers • Uses "cook and chill" method • In constant exchange with suppliers (What is in stock? What will be harvested? What has to go?) • Plan meals according to the German Nutrition Standards for kindergarten and schools • Methods that increase the attractiveness of the cafeteria (workshops on nutrition, health, and environment, offering tasting portions, meals based on motto weeks)
The "Diet Unit" of the Municipality of Södertälje, Sweden	• Based on the Baltic, mostly plant-based "Diet for a Green Planet" concept in the public meal sector • Sourcing primarily local, organic, and seasonal products • Animal products reduced by 20% • More vegetables, legumes, and wholegrains • Reducing waste during production, processing, distribution, and when cooking • Good relationships with students (integration into the kitchen) • Follows guidelines from the Swedish Food Agency • Has proven a budget-neutral transformation of meal planning and procurement

Table 2. *Cont.*

Case	Standards
BioMensa U-Boot—100% organic cafeteria at the Dresden Technical University	• Fresh, unprocessed, and organic food products • Meat: mainly beef and pork • No fish • Flexible meal planning: What is available from producers? What can be substituted? • Avoid food waste (utilizes leftovers) • A lot of "gut feeling" and experience on how many portions are needed of which options (vegetarian/vegan or meat) • Open kitchen, customer contact important • Invite constructive criticism • Fixed limited budget to maintain
Adelhaus—locavore organic vegetarian restaurant in Freiburg	• Vegetarian/vegan menu • 100% organic and directly from regional suppliers • Fresh and seasonal products • A buffet restaurant where everything is paid by weight: customers can put together their dishes (reduces food waste) • The menu is designed based on what farms have to offer • In constant exchange with producers and suppliers

3.3. First Cycle Results—Preliminary Criteria

Table 3 displays the set of preliminary criteria that were compiled throughout the problem definition and action planning phase. The cost of goods that was determined for each meal had to remain within 50% of the student price for an organic meal. An organic meal for students costs EUR 3.20. Hence, the cost of goods in terms of procurement expenses was not to exceed EUR 1.60 per meal.

Table 3. Set of preliminary criteria for meal planning and procurement.

1.	100% local sourcing of ingredients within the Kassel Administrative District (North Hesse), which includes the city of Kassel as well as the following counties: (1) Werra-Meissner, (2) Kassel, (3) Hersfeld-Rotenburg, (4) Waldeck-Frankenberg, (5) Schwalm-Eder, and (6) Fulda (=6 counties + the independent city of Kassel).
2.	Organic ingredients from certified organic farms, shops, or wholesalers, but also from farms in transition to organic certification as well as from "member-certified" CSA farms (Community Supported Agriculture).
3.	Compliance with the Planetary Health Diet (PD) concept.
4.	Compliance with the DGE dietary guidelines for communal catering.
5.	Only gently processed foods up to convenience level 3.
6.	Budget neutrality with the cost of goods not to exceed EUR 1.60 per meal.
7.	Respect for limiting factors in the kitchen (preparation time, limitations of kitchen equipment, and know-how of staff).

According to the German Nutrition Society (DGE), value-added industrial foods are typically classified into six processing levels that include level (0) unprocessed, i.e., unwashed vegetables; level (1) "kitchen ready", i.e., washed vegetables; level (2) ready to cook foods, i.e., frozen or fresh-cut vegetables; level (3) already savored "prefab" foods, i.e., dehydrated mashed potato; level (4) reheatable products, i.e., ready to eat individual components, and level (5) ready to serve products, i.e., cold sauces or finished salads. It is important to note that as of convenience level 2, an independent recipe implementation by the chef is usually not required anymore [92].

3.4. First Cycle Results—Recipe Description

Table 4 displays a short description of the initial meal proposals that each group designed. All the meals were innovative, delicious, and included a variety of vegetables. Meals #2, 3, and #5 were vegetarian, meal #4 was completely vegan, and meal one included a small portion of cross-cut veal shank.

Table 4. A brief description of the initial meal proposals.

Meal	Description
(1) Main dish: North-Hessian Ossobuco Side dish 1: Boiled potatoes Side dish 2: Savoy cabbage and apple salad	North-Hessian Ossobuco is a stew of braised seasonal vegetables, herbs, and a small portion of cross-cut veal shank that gives the stew a deep aromatic flavor. The side dishes include salted boiled potatoes and an apple savoy cabbage salad seasoned with salt, apple vinegar, and linseed oil.
(2) Main dish: Golden brown mozzarella patty Side dish 1: Potato wedges Side dish 2: Endive salad	A mozzarella patty coated in flour and breadcrumbs, fried on both sides until golden brown, and garnished with jam. A side dish of baked potatoes and endive salad seasoned with finely chopped onions, vinegar, oil, and salt.
(3) Main dish: Beetroot and green spelt patty with a herb quark dip Side dish 1: Lentil soup with smoked tofu Side dish 2: Red cabbage salad	Beetroot and green spelt patty with a herb quark. Lentil soup with regional lentils and smoked tofu and a red cabbage salad seasoned with oil, salt, sugar, and apple cider vinegar as side dishes.
(4) Main dish: Savoy cabbage roulade filled with lentils, vegetables, and oats Side dish 1: Pumpkin and oat "risotto" Side dish 2: Carrot mash	Oven-baked savoy cabbage roulades filled with lentils, naked oats, and vegetables with a side dish of pumpkin and oat "risotto" and a carrot mash.
(5) Main dish: Savoy cabbage stew Side dish 1: Lentil salad Side dish 2: Quark with apples and walnuts	A savoy cabbage stew with vegetables and potatoes and seasoned with salt. Side dishes include a lentil salad with vinegar and oil vinaigrette stretched with apple juice and an apple quark with honey, cinnamon, and walnuts.

3.5. First Cycle Results—Feedback from Kassel ASAS

Table 5 presents the key feedback given by ASAS. The importance of adhering to the budgetary constraints regarding the cost of goods was stressed along with the clear request to avoid sourcing from too many individual suppliers. Instead, it was communicated that fewer, but trustworthy, vendors within the defined region were desired. Further criticism was expressed regarding the meals' lack of seasoning, leading to potentially jeopardized acceptability by canteen customers. This was because, even though salt was able to be sourced from local production, other spices apparently could not be sourced locally by the students. Furthermore, it was stated that due to a lack of appropriate equipment, the preparation of meals could only be done on the day of their consumption, which ruled out any recovery of leftovers for the following day as well. All fresh ingredients had to be procured pre-processed (washed, peeled, or diced).

Table 5. Key feedback from Kassel ASAS.

Meal	Feedback
(1) Main dish: North-Hessian Ossobuco Side dish 1: Boiled potatoes Side dish 2: Savoy cabbage and apple salad	• Cost of goods higher than EUR 1.60 • Very little seasoning used • Not allowed to cook the day before • Not a stew but rather a ragout (therefore cannot be called "Ossobuco") • Nice combination of colors • Side dishes look good as well and fit the main dish
(2) Main dish: Golden brown mozzarella patty Side dish 1: Potato wedges Side dish 2: Endive salad	• 4 suppliers outside of Kassel administrative districts (further than 100 km) • Cost of goods higher • Delivery costs and toll have to be included in the cost of goods • Very little seasoning used • Endive salad could be too bitter. Add a light sweet component • The meal looks good, has a nice combination of colors • High fat content; therefore, it will taste good and have high acceptability
(3) Main dish: Beetroot and green spelt patty with a herb quark dip Side dish 1: Lentil soup with smoked tofu Side dish 2: Red cabbage salad	• Very little seasoning used • Red cabbage difficult to prepare (not the right equipment available, requires manpower, and could be too time-consuming • The portion of lentil soup is too much as a side dish • The meal looks good, has a nice combination of colors • Acceptability of green spelt may not be high in students
(4) Main dish: Savoy cabbage roulade filled with lentils, vegetables, and naked oats. Side dish 1: Pumpkin and naked oat "risotto" Side dish 2: Carrot mash	• Not allowed to utilize leftovers (leftover vegetables to make vegetable stock) • Carrots have to be peeled • Cost of goods must be calculated on a gross basis (here, cost of goods calculated on a net basis) • Very little seasoning used • Acceptance of wholegrain cereals (naked oats) is not high amongst students • A good variety of vegetables, nice combination of colors
(5) Main dish: Savoy cabbage stew Side dish 1: Lentil salad Side dish 2: Quark with apples and walnuts	• Cost of good too high • Very little seasoning used • Too many vendors • Potatoes have to be delivered already peeled • Is cinnamon regionally produced? • Apples for dessert have to be marinated in lemon or grated into dessert • The portion of the main dish is too small • Nice combination of colors

3.6. First Cycle Results—Evaluation of Meals According to the Preliminary Conceptual Standard

Only one group (meal #5) managed to source all the ingredients consistently from suppliers within the Kassel Administrative District, whereas the other four groups were sourcing from distant counties that were outside of the defined region. Three groups managed to source 100% organic ingredients, whereas the two other groups included ingredients sourced from CSA farms and farms currently in conversion toward organic certification. Meals only partially met PD reference values. Some food categories were not included in the meals, some were in excess, and others had adequate proportions. Likewise, the comparison against the German DGE standard resulted in some of the food categories being either included or not included.

None of the groups exceeded the maximum convenience level 3. Most of the ingredients were of convenience level 1 and 2. The recipes were easy to prepare in the kitchen and required no extra work since most of the vegetables would already come washed, peeled, and cut. No dish required more than one hour of preparation time and one hour of cooking time. Only two out of the five groups managed to conform to the limited cost of goods, whereas the other three groups exceeded the limit of EUR 1.60.

3.7. Second Cycle Results—Additional Best Practice Presentations

Table 6 presents an additional case study, which offered insights regarding its transition pathway towards healthy and sustainable meal planning and the standards it created to achieve this.

Table 6. The "Food for Life" case study and its renowned meal planning and procurement standard.

Case Study	Standards
Food for Life program (British Soil Association) works with public and private sectors in promoting healthy and sustainable school lunches	• Fresh, organic, local, and seasonal food (with high welfare standards and low climate impact) • No heavily processed ingredients • Less meat and thus better quality • Reducing energy, water, and waste • Constant engagement with communities • High transparency of food supply chain • Educational workshops that integrate children and communities • 4 FFL pillars: food quality, food leadership, food education, food communities • Supports nurseries, children's centers, schools, universities, hospitals, residential care, cafes, restaurants, and workplaces in finding certified food suppliers and facilitates collaboration with communal catering • Different awards can be achieved by applying for catering standards → certain criteria need to be fulfilled to receive standards • 3 catering standards: bronze, silver, and gold • Bronze (basis of menu planning and can be applied to all caterers): 75% of dishes freshly prepared, seasonal use of ingredients, no GMOs, no additives (Southampton six) or trans fats, no endangered fish, free-range eggs, meeting animal welfare standards, nutritional standards, and safety standards, meeting dietary and cultural needs of customers • Silver and gold (assessed using a points-based system → silver: 150 points, gold: 300 points): meet all bronze standards, environmentally friendly and ethical food (MSC, free-range poultry, RSPCA assured, Fairtrade, leaf marque, organic (silver: 5%, gold: 15%), Championing local (locally grown and produced products), making healthy eating easy (sustainable palm oil, minimizing sugar and salt, reducing food waste, promoting consumption of fruit, vegetables, wholegrains) • Southampton six food colors: undesirable additives → a group of E additives that cause hyperactivity in children

3.8. Second Cycle Results—Final Set of Criteria/Conceptual Standard

Table 7 outlines the final set of criteria that were elaborated after reflecting on the first feedback cycle and obtaining additional expert input.

Table 7. The final set of procurement and menu planning criteria.

1.	100% sourcing of ingredients strictly from within Kassel Administrative District and adjacent counties
2.	100% certified organic ingredients, no exceptions
3.	Compliance with both PD and DGE recommendations
4.	Lightly processed foods with a maximum convenience level of 3
5.	Budget neutrality: procurement cost per meal not to exceed EUR 1.60
6.	Meals must yield "Recommendable" ratings on the "NAHGAST" Life Cycle Assessment Calculator

3.9. Second Cycle Results—Improvements in Refined Meals and Final Feedback by ASAS

Table 8 presents the refinements that were made in each meal. Three groups changed a few ingredients during the optimization process. One group changed the whole meal and one meal was not changed at all. Table 8 also presents the final feedback by Kassel ASAS regarding the menu proposals. While minor improvements still had to be considered, overall, the university caterer was happy with the proposals. Each dish displayed an attractive color combination and looked appetizing. However, to find out if the meals would be accepted by the canteen clientele, further sensory analysis and acceptance testing would have to be carried out.

Table 8. A brief description of the refined meals and final feedback from Kassel ASAS.

Meal	Description	Feedback by Kassel ASAS
(1) Main dish: North-Hessian Ossobuco Side dish 1: Boiled potatoes Side dish 2: Savoy cabbage and apple salad	• Some root vegetables and herbs were taken out • Linseed oil was replaced with rapeseed oil • The portion of cross-cut veal shank was reduced	• Unfortunately, the main dish cannot be called an Ossobuco, as there is too little meat included. Could be considered a stew • Other than this, the meal has an attractive combination of colors
(2) Main dish: Golden brown mozzarella patty Side dish 1: Potato wedges Side dish 2: Endive, carrot salad	• The jam was left out • Added carrots to the salad • Added honey to the salad dressing	• The cost of goods was higher than EUR 1.60, which, in rare cases, would be permitted • The meal looked tasty and attractive. Salad more colorful due to carrots • Fulfilled most criteria, except price
(3) Main dish: Beetroot and naked oat patty with a herb dip Side dish 1: Potato wedges Side dish 2: Carrot salad	• The whole meal was changed • A beetroot and naked oat patty with sour cream and herbs. Potato wedges and a carrot salad with sour cream and apple vinegar dressing	• Acceptance of naked oats remained questionable • Would have to conduct an acceptance analysis • The meal had a nice combination of colors. Looked tasty and attractive
(4) Main dish: Savoy cabbage roulade filled with lentils, vegetables, and oats. Side dish 1: Pumpkin and oat "risotto" Side dish 2: Carrot mash	• Meal remained the same	• Acceptance of naked oats remains questionable • Would have to conduct an acceptance analysis • The meal looks tasty and attractive. Colorful combination of ingredients
(5) Main dish: Savoy cabbage stew Side dish 1: Lentil salad Side dish 2: Yoghurt with apples and walnuts	• More seasoning added • Portion size increased • Quark replaced with yogurt • Cinnamon left out • Apple grated into dessert • Muesli added	• The meal looks tasty and attractive. Has a nice combination of colors

3.10. Second Cycle Results—Evaluation of Meals According to the Final Conceptual Standard

The following section evaluates the refined dishes according to the final set of criteria from Table 7.

3.10.1. Criteria 1: 100% Locally Sourced from North Hesse

All the ingredients were now sourced from vendors within the Kassel Administrative District and adjacent counties, as shown in Figure 4. The green balloons represent suppliers from within the defined foodshed and the yellow balloons represent vendors from adjacent counties. The majority of suppliers are located within the target region.

3.10.2. Criteria 2: 100% Certified Organic Ingredients

All the ingredients were 100% certified organic ingredients, with the exception of one group that had one ingredient procured from a Community Supported Agriculture farm, which operates according to organic farming principles.

3.10.3. Criteria 3: Dietary Recommendations Based on the PD and the DGE Standards

The following Figures 5–7 juxtapose recommendations regarding food group frequencies and nutrient content by both PD and DGE with the respective combined average values from the student meals. The values used by both PD and DGE are based on a single lunch meal. The values of the student meals represent the average values of the five meals combined. Upon comparison, we observed that the combined average food group frequencies of the student winter season meals do not conform with the recommendations of the PD (Figure 5). For vegetables and fruit, the student meals scored 17% higher than

the PD recommendations. For wholegrains, scores were 65% lower; for starchy vegetables, they were 576% higher. Within the food category of dairy foods, the student meals scored 24% lower than the reference values; for animal-sourced protein, scores were 86% lower; for plant-sourced protein, they were 46% lower; for fatty acids, they were 13% lower, and, lastly, for the food category "added sugar", the student meals scored 78% lower than the PD reference values.

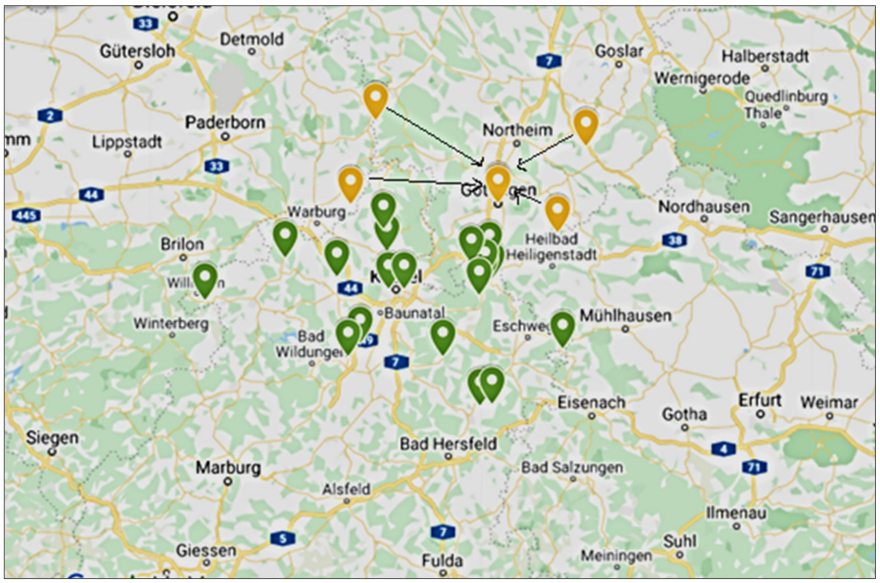

Figure 4. Vendors within Kassel Administrative District and from neighboring counties.

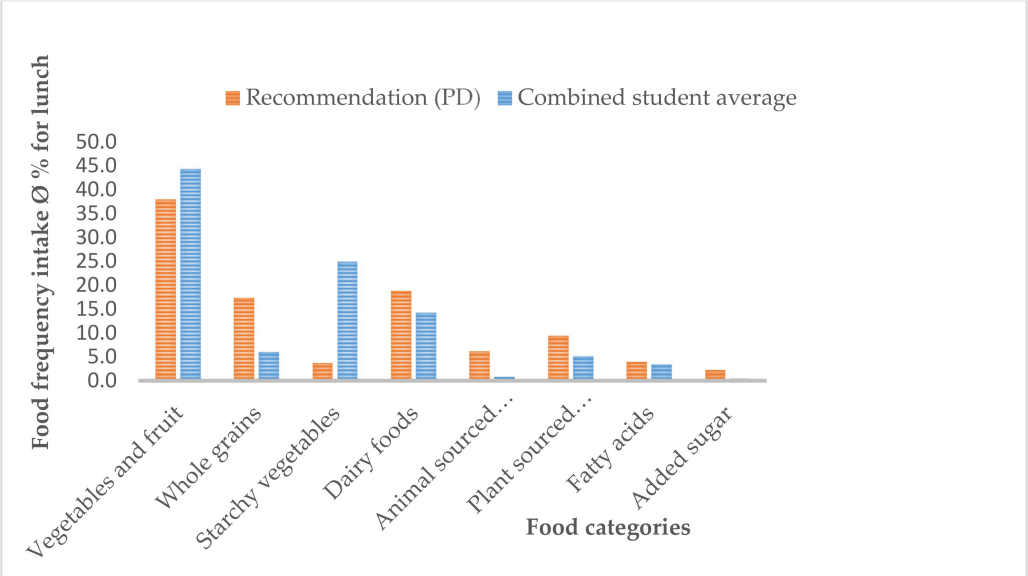

Figure 5. PD food frequency recommendations vs. combined average food frequencies of meals.

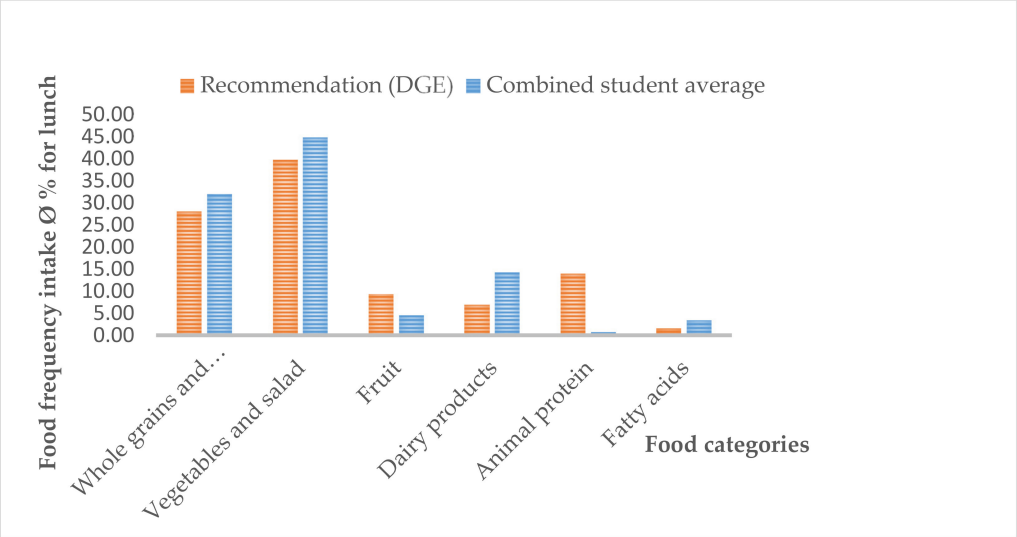

Figure 6. DGE food frequency recommendations vs. combined average food frequencies.

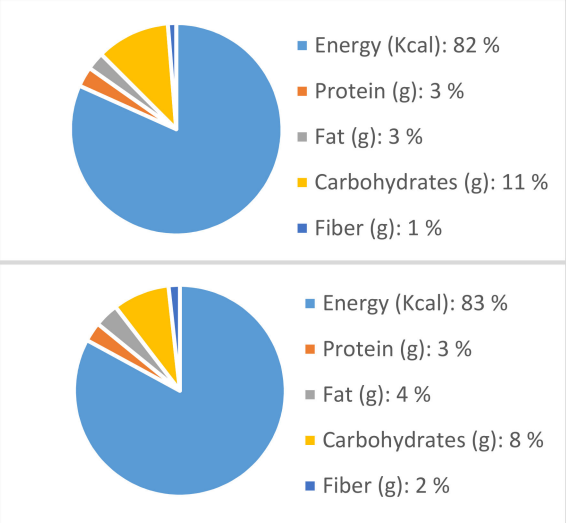

Figure 7. DGE nutrient content recommendations vs. combined average nutrient content of meals.

Figure 6 compares the food frequencies of the student meals with the recommended DGE rates. Within the food category "wholegrains and potato", the student meals scored 14% higher than the DGE reference values. Vegetables and salad showed an increase of 13%. Fruit was decreased by 51%, which can be considered an outlier due to the winter season and the resulting lack of local fresh fruit. Within the food category of dairy products, the students' winter season meals showed an increase of 103% compared to the DGE recommendations. The food category animal protein of the student meals scored 94% lower while fatty acids had an increase of 107% compared to the DGS reference values.

Figure 7 compares the DGE nutrient content reference values with student meals, which matched well. The student meals showed a percentage difference in energy (Kcal) compared to the DGE recommendations of 1%. In terms of protein (g), no difference could be found. The student meals scored 33% higher in fat (g) and 27% lower in carbohydrates. The percentage difference in fiber was 100% higher in the student meals compared to the DGE reference values.

3.10.4. Criteria 4: Lightly Processed Foods with Maximum Convenience Level Three

The majority of meal ingredients complied with processing level one (20 ingredients) and level 2 (22 ingredients), with only a few ingredients from processing level zero (3 ingredients) and level three (2 ingredients). Most of the ingredients were vegetables that were "fresh-cut". Since the ASAS kitchen has limited equipment to prepare farm-fresh (processing level zero) ingredients, many ingredients are already procured lightly processed.

3.10.5. Criteria 5: Budget Neutrality—Cost of Goods per Meal Not to Exceed EUR 1.60

As seen in Table 9, meals # 1, 3, 4, and #5 were able to keep within the limit and not exceed the procurement cost of EUR 1.60 per meal. Meal #2, however, exceeded it, which, in rare cases, can be acceptable, but generally, the caterer will exceed the cost limit only for special motto meal plans.

Table 9. Procurement expense for each meal.

-	Meal 1	Meal 2	Meal 3	Meal 4	Meal 5
Cost of goods/portion (EUR)	1.60	2.25	1.28	1.54	1.59

3.10.6. Criteria 6: Life Cycle Assessment

The NAHGAST calculator assesses a meal's compatibility concerning specific indicators of the three overarching sustainability dimensions "Environment", "Health", and "Fairness to Humans and Animals." The underlying LCA algorithm assigns a color code to these indicators: green = recommendable, yellow = partly recommendable, and red = not recommendable. The calculator then computes an overall sustainability performance score based on the combined average of all indicators within each of the three sustainability dimensions, which are marked in blue [7,93]. Within the sustainability dimension "Environment", the menus #1, 3, 4, and #5 received the overall rating "recommendable", while meal #2 received the overall rating "partly recommendable" because the indicator "material footprint" received a "not recommendable" rating, but the indicator "greenhouse gas emissions" received a "partly recommendable" rating since menu #2 had been slightly over 800 g CO2 equivalent that is allocated to a meal [7,91]. Within the "Health" dimension, meals #1, #2, #3, and #4 received the overall rating "partly recommendable", while meal #5 received the overall rating "recommendable". The reason that menus #1–4 received a restrictive rating is that some of the individual indicators only scored "partly recommendable" as well as "not recommendable". Regarding the indicator "energy content", for example, a meal should not exceed 670 Kcal [7,91]. However, meals #2 and 4 received the rating "not recommendable", which suggests that they had an energy content higher than 670 Kcal. The indicator "fat" content should not exceed 24 g per meal. Based on the NAHGAST calculator, meals #2 and #3 had higher fat content. A meal's energy content should consist of 50% of carbohydrates; however, containing too many carbohydrates, which can happen in vegetarian meals, can lower a meal's rating as well [7]. This can be noted with meal #4, which received a "not recommendable" rating in the indicator "carbohydrates". Less than 10% of the energy content of the meal should come from sugar [91]. This is, however, not the case with meals #1 and #5, which received a rating of "not recommendable" within this indicator. The salt content should be less than 2 g per meal [91]. Meals #1–4 received a "not recommendable" rating within this indicator, which indicates that they have a high salt content. For the sustainability dimension "Fair for Humans and Animals", all five meals received the rating "recommendable", which suggests that the ingredients were all of fair origin. Overall, all the menus performed quite well within the three sustainability dimensions (Table 10).

Table 10. A life cycle assessment of all meals based on the NAHGAST calculator.

LCA Categories / Menus	North Hessian Ossobuco with Boiled Potatoes and Savoy Cabbage and Apple Salad	Golden-Brown Mozzarella Patty with Potato Wedges and An Endive Carrot Salad	Beetroot and Naked Oat Patty with a Herb Dip, Potato Wedges, and a Carrot Salad	Savoy Cabbage Roulade Filled with Lentils, Vegetables, and Naked Oats with a Pumpkin and Naked Oat "Risotto" and a Carrot Mash	Savoy Cabbage Stew with a Lentil Salad and Yogurt with Apples and Walnuts
Environment					
Material expense					
GHG emissions					
Water requirement					
Space requirements					
Health					
Energy content					
Dietary fiber					
Fat content					
Carbohydrate					
Added sugar					
Salt content					
Fair for human and animal					
Animal welfare					
Fairtrade					

Note: green (recommendable), yellow (partly recommendable), and red (not recommendable).

4. Discussion

This research project aimed at designing a PAR Living Lab methodological framework to accelerate the shift toward green procurement via local organic meal planning within public food service at universities. To this end, the objectives of this study included the conceptualization of a sustainable meal planning and procurement standard based on the principles of the Organic Food System, matched with dietary reference values from both DGE and PD, including the culinary composition of actual meals for an exemplary weekly menu. The approach also served as a feasibility case study to investigate the viability of harmonizing the concept of organic locavorism with the specification of budget neutrality.

By adapting the methodological framework of Participatory Action Research (PAR) to the food domain, we were able to create a practicable Living Lab approach, capable of tackling this sustainable transition pathway, which has been attempted similarly through one other study thus far, by Speck et al. [71]. Our framework engaged key stakeholders, including students from the School of Organic Agriculture at Kassel University as well as its public catering company ASAS, local organic farms and wholesalers, and best practice organizations, by following the iterative steps of action planning, reflection, and revision within two consecutive feedback cycles [66]. Through its feedback-based research cycles, PAR proved to be an effective method that can be used in diverse settings of sustainable development by establishing transformative frameworks of problem-solving [94].

Next to the input received by Kassel ASAS regarding its operational structure, results were gathered through a set of mixed quantitative and qualitative methods, which informed the establishment of relevant meal planning and procurement criteria. The mixed-methods portfolio consisted of an initial mini online questionnaire, surveying attitudes around the campus, as well as a series of brief case studies presenting best practice examples, helping to further establish and validate the selected criteria as an experimental standard. The resulting meal proposals were cooked and documented by the student groups and then evaluated, first via feedback from the university caterer (ASAS), followed by an objective assessment vis-á-vis the selected criteria.

Based on the results of the mini survey, interest in regional and organic ingredients is increasing at the university and students are willing to pay more for regionally and

organically produced products. This is supported by a survey carried out in 2017, where 34% of cafeteria users were willing to pay an additional EUR 0.50 to EUR 1.00, as an acceptable surcharge for organic meal options [95]. In addition to this, another survey conducted in 2021 mentioned that 48% of its participants found it "rather important" to obtain organic food directly from the region [96].

The inspirational sources that were incorporated into our design showcased that a sustainable transformation of meal planning and procurement is possible, considering even the strictest of criteria. These criteria represent a coherent and holistic set of transformative responses enabling positive synergies within foodsheds. They are supported and mentioned in several studies [18,34,97]. They highlight the fact that a reduction in animal products leads to increased use of locally and organically sourced green products, with multiple health, social, economic, and environmental benefits. Similarly to the setting at Kassel ASAS, the criterion of price plays an important part in communal catering, where fixed purchasing costs are common [31,98]. Since local and organic ingredients are more costly than conventional products, often, a reduction in meat or other animal products on the plate needs to be taken into consideration [8,32].

The first cycle meal composition and proposal phase was guided by a preliminary list of criteria that had only been partially met. The individual specifications of consistent local sourcing and procurement, full compliance with both DGE and PD dietary requirements, as well as budget neutrality turned out to be challenging each by themselves, let alone as an integrated whole. A number of ingredients were procured from suppliers outside the defined foodshed and three out of the five meals incurred procurement expenses higher than the agreed-upon EUR 1.60 (Table 3). While there tend to be organic farms and local food suppliers in many regions, there are still relatively few organic suppliers that are capable of managing consistent supply chains at an economic price point, which is a key prerequisite of food service actors [36].

While municipalities and local government have the potential to move the needle toward transformation by serving as role models for green public procurement and organic meal planning in the food service sector, this investigation highlighted the vital aspect of aggregation in the food supply chain [99]. According to the feedback from Kassel ASAS, too many suppliers were listed in the elaborated meal planning and procurement concepts. According to the caterer's evaluation, this would result in high transportation costs and a disproportional logistical burden on behalf of their kitchen staff, having to deal with numerous deliveries per week, especially considering the lack of storage capacities at the specific canteen location. Steinmeyer [36] contends that in order to tackle these challenges, intermediary organizations such as Food Hubs need to be promoted to support small regional suppliers. Food Hubs can bridge gaps between small producers and consumers in agri-food markets [100]. They facilitate the choice of local and organic products in meal planning because of the aggregation and just-in-time logistics service that most large kitchens require. As highlighted by Arens-Azevedo [101], Food Hubs offer the convenience of providing source-identified, aggregated products and more transparency throughout the supply chain.

As brokers in both businesses-to-business (B2B) and business-to-consumer (B2C) value chains for sustainable local food, Food Hubs provide a missing link for effective foodsheds and therefore serve as catalysts for sustainable development [102]. Food Hubs can therefore aid in facilitating Farm-to-Table value addition processes that are less susceptible to supply shortages and that can empower local economies [100,103]. It is, however, important to note that regional food systems left to their own devices will not necessarily promote sustainable development, but a combination of inclusive governance approaches and a commitment to nature-positive agricultural production and wise use of resources may very well be a recipe for territorial revitalization [34,104]. Unfortunately, such infrastructure has not yet been sufficiently implemented in the Kassel region.

Such an approach can, however, be seen in the Eco-Region program that originated in the Italian Bio-Distretto, where the resource relating to the place identity is reflected

in the collective commitment and accompanying governance processes of food system stakeholders to promote organic farming and value chains [104]. This virtuous cycle leads to more coherence between the underlying mindset and the resulting actions within food systems [105] as well as the accumulation of social capital within the region. This will ultimately contribute to a shared identity and the synchronization of food system elements.

As illustrated by Berti and Mulligan [100], the public sector and policymakers have neglected support for Food Hubs and the positive influence that these can have in Europe. The authors suggest that more research and awareness need to be promoted to initiate this kind of vital infrastructure. There are, however, efforts being made in North Hesse to establish digital infrastructures, such as the initiative "Nearbuy", which has advanced a browser-based application that can connect local farms with food service buyers in the Kassel region [106]. To this point, however, it remains questionable to what degree a digital platform may deliver the concrete logistical contribution that brick and mortar Food Hubs have become known for.

Trying to align meal planning with PD and DGE reference values and proportions also proved to be a challenging task within the first feedback cycle. Certain food categories were either being used excessively or sometimes not at all. Regretfully, the first experimental cycle did not produce a single meal proposal that would conform 100% with the requirements of the Planetary Health Diet or even with DGE. It must be said, however, that the Planetary Health Diet is not carved in stone, but serves as a recommendation, leaving room for flexibility, both temporally and geographically [107]. Thus, while the recommendations were only partially met, the primarily plant-based meals overall included positive healthy, nutritional, and environmental aspects, which can aid in the improvement of both personal and ecosystem health, as noted by Clark [108], Fanzo [109], and Fresán and Sabaté [97].

Throughout the second feedback cycle, the criteria were revised and a final set was compiled. Through feedback and further input, the meal proposals were reflected and improved upon and eventually fulfilled the majority of the criteria. Since the term "regional" cannot be uniformly defined [110], it was difficult at first to precisely delineate what determines a local or regional product. Regionality may be defined as a fixed geographical radius concerning a given location, or it may be defined as a certain district, province, state, or country [7]. Through a redefinition of the intended foodshed to stick with the jurisdictional boundary of the Kassel Administrative District plus contiguous counties, all the ingredients were eventually able to be sourced locally and organically within the determined price range. While the meals still only partially fulfilled the PD and German nutritional recommendations, we saw no failure in this. As stressed by Macdiarmid et al. [82], to fulfill the aspects of health and environment, increasing the nutrient intake of healthier categories (fruit, vegetables, plant protein) may be regarded as the "lesser of two evils", since intakes of unhealthier categories (animal protein, milk, saturated fatty acids, added sugars) were used less in the students' meal plans, therefore mitigating the impact on the environment.

Informed by the Organic Mindset and the SDG driving qualities of Organic Food Systems [54,84], our meal planning and procurement model was able to comply fully with 5 out of 6 criteria, while partially complying with the PD and DGE dietary guidelines. Full compliance was achieved regarding (1) 100% certified organic ingredients, (2) procurement from within the defined foodshed, (3) gently processed meal ingredients, not exceeding convenience level 3, (4) budget neutrality, and (5) favorable LCA ratings. In terms of the expected food system outcomes resulting from this transition pathway, the literature is clear. The positive effects of organic agriculture on both the eco and social sphere, while being able to feed a growing world population and benefitting local economies, have been abundantly confirmed [86,104,111–113]. The positive effects of an organic diet on human health have been explored also [114,115].

Trying to align our organic locavore approach with the two dietary guidelines, PD and DGE, was inevitably going to create some discrepancies regarding compliance, due to the different compositions of food groups but also the different reference values applied

by the two systems per group. Moreover, while the DGE recommendations specifically were designed for lunch meals, we had to translate the PD references to a respective 35% proportional share of nutrient intake, which represents a lunch meal [116]. In this regard, the PD leaves some adaptive leeway. As a more general pattern in the comparative analysis, one could argue that the student meals struck a balance between the two. While for the food group "vegetables and fruit", our meals far exceeded the PD and DGE recommendations (by 17% and 13%, respectively), for animal protein, the student meals scored below both PD and DGE reference values (86% and 94%, respectively), which are both beneficial aspects considering the climate impact. Vis-á-vis PD wholegrains, our meals scored 65% lower, while exceeding the PD starchy tuber reference by 576%, which may be attributable to the constraints of the winter season and the fact that potatoes are a staple for Germans, which is reflected by the DGE, where our meals exceeded the combined group "wholegrains and potato" reference only very slightly, by 14%. In our assessment, deviations in both directions $\leq$50% regarding any one food group were acceptable. Further evidence that our meals were somewhere in the middle between both guidelines may be taken from the fact that, regarding both the food groups "dairy products" and "fatty acids", our student meals scored below the PD but higher than the DGE reference values. The difference in DGE was 103% and 107%, compared to 24% and 13% with PD. Again, we refer strictly to seasonal winter meals. Astoundingly, our meals only deviated by 1% in the caloric energy fraction, compared to the German DGE standard.

Life cycle assessment calculators, such as the NAHGAST tool employed in our study, can be useful for caterers to obtain a better understanding of a meal's nutritional attributes as well as its impact on the ecosphere. When sharing results with customers, improvements can be made objectively and transparently [7]. Juxtaposing the comparative analysis of the final meals in terms of the PD and DGE recommendations (Figures 5–7) with the NAHGAST analytical results, similar findings can be detected, which suggests that the LCA algorithm converges with both PD and DGE logic. As stated earlier, meals #1 and #2 scored less favorably in the dimension "Environment" (Table 10), due to the higher degrees of animal products used in these meals. Regarding the dimension "Health", the indicators "fat content", "added sugar", and "salt content" show "not recommendable" for two of the meals, respectively (Table 10). Regarding "fat content", this may be reflected in the comparisons of the student meals with the DGE guidelines, where the food categories "dairy products" and "fatty acids" contained in student meals exceeded the DGE reference values by 103% and 107%, respectively (Figure 6). However, for the category "added sugar", no correlation could be found in either the DGE or the PD reference values. The DGE does not even list "added sugar" as a food category and, compared to the PD recommendations, the student meals' "added sugar" scored 78% lower. Concerning the "salt content", which was flagged by the LCA-based NAHGAST calculator, again, no correlation could be found in the PD or DGE reference values. The NAHGAST tool must have a very low threshold concerning this category, or perhaps the students were too generous with the salt since they could not procure other seasonings from within the region. In defense of the student meals, it could be relevant to state again that this was a wintery seasonal menu designed for December until March. Therefore, the high fat content can perhaps be excused.

Throughout the project, we noticed that all the criteria are connected. For example, conforming to dietary requirements involving a low proportion of animal products can reduce costs for public food service, especially considering the high expenditures associated with organic animal products. This, in turn, allows the opportunity to invest more in fresh, regional, organic, plant-based products, further resulting in decreased use of convenience and other heavily processed products, which are all factors that benefit human and planetary health. This can be confirmed through our study and is also supported by Arens-Azevedo [101]. This author mentions that the procurement of local products results in less processed ingredients and therefore in more fresh and seasonal meals. Teufel and Gensch [32] also support the statement that a reduction in meat quantities in communal

catering is beneficial and can be used to compensate for the additional costs incurred by a shift towards organic products.

Even though the meals could not be served in the cafeteria within the course of this study, due to the second German lockdown, which was imposed on the public food service sector, starting 1 February 2021 in the wake of the COVID-19 pandemic, the Kassel ASAS leadership has already committed to ongoing collaboration within the Eco-Management and Audit Scheme (EMAS) process and through another edition of this particular university course, which will be reinstated starting in the fall semester of 2021.

A possible novelty that was discovered through this research is the prospect of successfully fulfilling a highly ambitious agenda of simultaneously implemented sustainability criteria within an HEI food service context. Many studies on sustainable transitions within the catering industry emphasize either only local products or organic products, but usually do not incorporate both criteria at the same time. The use of organic products in catering organizations has been widely researched [117], specifically in the education sector, where organic school lunches are considered an important instrument for teaching students about sustainability [34,118]. The same is true regarding local products [101,119,120]. To date, only one study from Munich, Germany has examined the transformation of catering in kindergartens through the local/organic tandem [121]. Further initiatives are being undertaken for incorporating local and organic products in communal catering, as stated by the Federal Agency for Agriculture and Food [122].

Adapting our objectives to the methodological constraints of PAR proved difficult at first, particularly since many studies run three or more feedback cycles, to reach the desired outcomes [69,71,123]. Due to its inherent feedback structure, PAR worked to our advantage in the end, since it enabled respectful dialog, effective interaction, and mutual acknowledgment of respective needs. We see a potential transfer value regarding its implementation across other HEI multi-stakeholder contexts such as ours.

Even though the collaboration among participants was fruitful, it required some rigor at times to gather the data necessary for presenting the results. In many cases, when conducting a PAR, participants can occasionally be less enthusiastic or have no time for the project [124]. However, we were quite fortunate, especially considering the digital format of the entire interaction, insofar as the key stakeholders engaged in our PAR framework were keen enough to solve the challenges at hand.

A learned lesson from the experiment is the improvement of the dishes' culinary quality. Being aware of the innate bias that comes with the territory of Organic Agriculture students' affinity toward locavore diets, our findings may not be conducive to a universal model or generalization but may well serve as a kind of gold standard inspiration. For the upcoming course in the fall semester of 2021, the awarded chef will accompany students during the meal planning phase, to provide professional guidance and support to improve the palatability of the meals.

Another limitation of this research project is that many studies documenting sustainability transitions in the food service sector tend to include aspects of food waste, which, in our design, only occurred as part of the best practice examples presented to the participants. While the notion of food waste does not yet seem to be a priority for the Kassel ASAS, a stronger emphasis ought to be placed on this aspect as part of the next iteration of this PAR, including also a final sensory and acceptance analysis when introducing the meals to the canteen.

The Living Lab framework of this study has proven the possibility of sustainably transforming catering and procurement within HEI public food service locations, based on a set of ambitious sustainability criteria. Even though one might think that such goals can only be realized through policy changes, this project showed that transformation is also possible by designing an inclusive governance mechanism capable of generating goodwill among all participants. The challenges that communal caterers are facing with regard to organic local meals and procurement can be overcome if enthusiasm is instilled. The Living Lab approach was met by all participants with a sense of joint satisfaction and continued

interest to keep employing this framework for the ongoing sustainability transition of the Kassel ASAS.

The strongest arguments by the Kassel ASAS leadership against converting the entire canteen system to our experimental standard were related to the higher prices, more complicated logistics, the amount of food processing that would be necessary to exclusively cook with gently processed ingredients, and, lastly, the potential lack of acceptance of such locavore menus on the part of the canteen clientele. Therein, one can observe the kinds of path dependencies that pubic caterers become locked into through the adoption of "just-in-time" logistics, reduced labor forces, and food budgets, all in the name of efficiency and justified by the public service mandate that these associations of student affairs and services, which are public companies, have to abide by.

The public service mandate that Kassel ASAS has to fulfill also contributed to the cognitive dissonance that meat-containing meals have to be accessible and affordable to all students, while the climate implications are widely acknowledged [125]. This conflict between microeconomic business administration and its self-interest, on the one hand, and the macroeconomics of our global commons must be better understood. The capital bases (natural, human, social, and produced capitals) are the origin of driving forces in food systems, and when they are not aligned, because ecosystem services are not valued monetarily, the respective driving forces and their vectors start to stray from engendering desired outcomes and instead produce adverse impacts and externalities [86].

However, to advance with such deeply entrenched issues and to take action requires multi-sectoral, inclusive approaches that can adjust several leverage points at the same time [126]. Change agents are well-advised to bring the right actors to the table to devise practicable transition pathways because caterers, similarly to farmers, know exactly what they need and it becomes irritating for them to be confronted with unfounded demands that do not deliver know-how or viable proposals.

Future research on this topic might be well spent on exploring aspects that will be necessary to incite canteen clientele's excitement about such new menu options. Since dietary changes tend to be accompanied also with changes in mindset, such transition pathways toward more ecocentric catering and procurement can have a multiplying effect on many levels. It is not merely a substitution exercise, but rather a transformation that can induce the emergence of multiple benefits. Research could also be invested in the economics of local foodsheds and how territorial supply chains affect the regional food system [126]. Furthermore, effort should be made in analyzing and communicating the external or true costs of conventional food procurement. A recent study on the true costs of food items from Germany revealed that organic products entail less additional costs than their conventional counterparts [125].

Transition pathways in the public catering industry may well be likened to known transformation processes taking place on the agricultural side of the value chain, such as transitioning farms from conventional to certified organic production, which typically takes several years. Essential ingredients for inducing transformation in the public food service sector consist of investment in culinary staff through education, the adoption of resilient methods and techniques, and the ongoing engagement of leadership personnel, in order to induce the necessary shift in mindset [122]. In order to introduce organic locavorism into the mainstream within the public food service sector, new types of alliances and support systems have to be created, which offer non-threatening, respectful, and helpful guidance to HEI and other public caterers, including help in navigating certification bureaucracy and renegotiating the public service obligations with the respective state departments that oversee the ASAS network in Germany.

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