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OPINION PAPER

Addressing Grand Challenges in Sustainable Food Transitions: Opportunities Through the Triple Change Strategy

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Abstract
Despite emerging consumer trends and policies promoting sustainable food consumption, the transition towards societal tipping points for sustainable food systems remains protracted due to multifaceted challenges such as consumer misconceptions, value chain inequalities, and policy fragmentation. Addressing these challenges requires a comprehensive approach that considers all actors within the food system. The present paper follows the paradigm set by the Consumers' Understanding of Eating Sustainably (CUES) Horizon Europe project and introduces CUES' Triple Change strategy. This strategy highlights Consumer and Cultural Change, Industrial Change, and Policy Change as interconnected dimensions essential for driving behavioral change and ensuring a successful transition to sustainable food systems. By leveraging persuasive communication and interventions for transparency, fostering value chain reform, and advocating for policy transformations, the Triple Change aims to overcome existing barriers and create opportunities to accelerate the shift towards a resilient food system. This paper explores the grand challenges and opportunities within each of these dimensions and offers a holistic framework for academics, stakeholders, and policymakers to contribute to sustainable food transitions.

Keywords Sustainable food consumption · Triple change · Consumer and cultural change · Industrial and policy reform · Persuasive communication · Food system interventions

Introduction

The current food system experiences one of today's most urgent challenges. It produces approximately 30% of global greenhouse gas emissions, is a leading cause of deforestation, and significantly pollutes our increasingly scarce water resources [36]. Beyond greenhouse gas emissions, modern food systems contribute heavily to the depletion of natural resources; 70% of global freshwater is used for agriculture, and food systems

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are leading contributors to soil degradation and biodiversity loss [89]. The environmental consequences of these processes are further impaired by food waste, as approximately 1.05 billion tons of food—about 19% of global food production and amounting to 132 kg per capita —was wasted in 2022 [88]. As the global population continues to grow, with food demand expected to rise by 35–56% by 2050 [91], transitioning to more sustainable food production and consumption patterns is critical for mitigating the negative climate impact of the current system. Addressing these issues to achieve the Sustainable Development Goals (SDGs) requires transitioning towards more sustainable food systems, guided by the principles of a circular economy and a comprehensive understanding of the interdependencies of different actors. Despite emerging consumer trends and rising policy incentives promoting sustainable food, the transition towards societal tipping points in sustainable food consumption (henceforth: SFC) remains slow [26, 77].

The present opinion paper aims to explore grand challenges and present opportunities for accelerating the SFC transition. Achieving this transition necessitates the engagement of all key actors—consumers, actors in the value chain, and policymakers [72, 77]. Unlike existing research focused on defining and operationalizing sustainability through one or a few actors in isolation, the CUES ('Consumers' Understanding of Eating Sustainably') Horizon Europe project, led by researchers at Erasmus University Rotterdam, the Netherlands, advocates for a holistic 'Triple Change' encompassing all critical dimensions towards consumer empowerment: *Consumer and Cultural Change*, *Industrial Change*, and *Policy Change.* The CUES project seeks to pilot test interventions that can accelerate environmentally, socially, and economically sustainable food transitions, using persuasive communication strategies to achieve SFC behavioral change. Aligned with this approach, we adopt the Triple Change strategy to provide a comprehensive framework of challenges and opportunities for SFC transitions.

Investigating the three dimensions of Triple Change is crucial, as they have often been underexamined despite their potential to drive consumer empowerment and meaningful change across the food system (e.g., [42]). Consumer and Cultural Change is essential because altering consumer behavior and perceptions can enhance the acceptability of sustainable food products and, alongside improved accessibility and affordability, make sustainable options more viable across diverse food cultures [42, 71]. Industrial Change can foster sustainability at every stage of food production, packaging, and distribution by enhancing transparency, traceability, and trustworthiness [86]. Policy Change involves coherent and integrated policies that support small and medium-sized enterprises (SMEs) through multi-participatory approaches and promote food democracy in relevant, respectful and reliable food systems [26]. Together, the three dimensions aim to facilitate reaching the SFC societal tipping point through consumer empowerment (see Fig. 1).

In terms of methodology, we conducted a comprehensive review of primary scientific research alongside existing market and policy practices related to sustainable food transitions. We drew on literature on sustainable consumer behavior, value chain, and policy to finetune the proposed opportunities. This multifaceted approach enabled us to capture a broad spectrum of perspectives on the Triple Change and inform our recommendations with diverse insights.

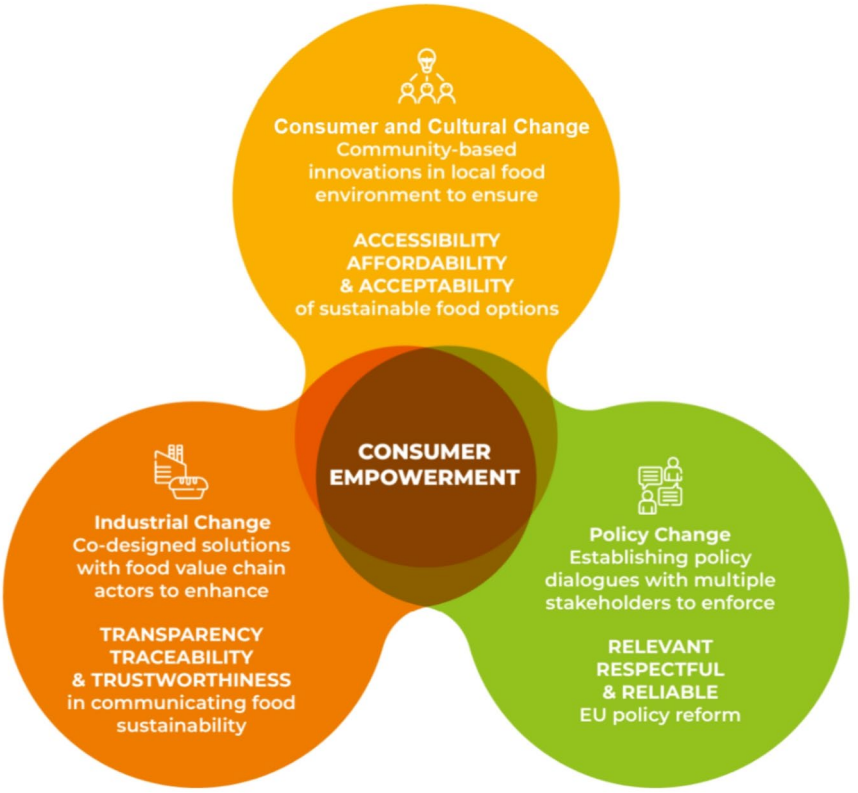

Fig. 1 The three dimensions of the Triple Change strategy towards consumer empowerment in sustainable food consumption. Source: authors' own work, developed in the context of the CUES project

The paper addresses the three dimensions of the Triple Change strategy, with each dimension explored in separate chapters. The second section focuses on Consumer and Cultural Change, the third section delves into Industrial Change, and the fourth section examines Policy Change. Each chapter identifies specific challenges within its respective dimension and proposes opportunities to address these challenges, aiming to facilitate a successful SFC transition. The fifth section summarizes the Triple Change potential, with meaningful implications for the stakeholders involved in driving sustainable food transitions.

Consumer & Cultural Change

Consumer Awareness and Attitudes

Challenges

The use of a goal-directed approach for understanding sustainable food consumption is quite common (e.g., [75, 96]). This approach builds on the premise that food consumption is directed at attaining goals such as minimizing adverse environmental impact, but also signaling social status, or complying with norms and reference groups [96]. In a review on green consumption, ElHaffar et al. [31] identified that most studies modeling the effect of individual factors (e.g., attitude, intention, behavioral efficacy, and personal norms) on green purchase behavior build upon the Theory of Planned Behavior [3]. This stream of literature posits that the initial steps in changing consumption patterns are understanding, awareness of, and attitudes towards sustainable food. Despite the growing interest, consumers' understanding of the environmental and societal impact of their food choices seems to remain limited [17]. Consumers not only lack awareness of the impact of their food, but also hold several misconceptions about the healthiness, environmental impact, and quality of sustainable food (e.g., [13, 47, 48]). These misconceptions have been shown to undermine the effectiveness of an environmentally friendly choice label [48], thus preventing consumers from choosing more sustainable food options.

Even when consumers have a positive attitude towards sustainable food consumption behaviors (e.g., protein alternatives, organic food, reducing meat intake), there is an apparent gap between attitudes towards these behaviors and the uptake of the behavior itself. This phenomenon is called the *attitude-behavior gap* [95]. Although the gap is often referenced, it remains unclear how it should be closed. Moreover, there is a lack of clarity in the arguments and issues surrounding the accessibility of information related to sustainable food products. This lack of transparent and accessible information contributes to confusion and mistrust among consumers [70]. Greenwashing, in specific, involves misleading claims that further erode consumer trust [19]. For example, Vayona et al. [94] found that greenwashing plays a mediating role in consumers' perceptions and behaviors.

Opportunities

The above challenges in consumer awareness and attitudes present many opportunities for researchers and organizations. One key task is to augment consumers' knowledge of the environmental impact of their food choices while overcoming common misconceptions. In addition, it is imperative to create a more positive perception of sustainable food products. We believe that educational initiatives are necessary to increase food literacy (i.e., proficiency in food-related skills and knowledge among consumers; [87]). The CUES project aims to develop different interventions that will focus on increasing food literacy, such as workshops and cooking classes. Moreover, affordability of sustainable food diets (i.e., diets that focus on promoting human health while minimizing environmental impact, emphasizing plant-based foods and reducing the consumption of animal products and processed items; [4]) can play a key role in bridging the attitude-behavior gap. Furthermore, digital tools can be effective in clarifying the benefits of sustainable food consumption, aligning

these benefits with consumers' values through targeted communication. For instance, within CUES, several digital interventions will be developed, and pilot tested to gain a better understanding of beneficial communication means to affect consumers' knowledge and attitudes. Additionally, integrating sustainability information into mainstream education and media can help normalize sustainable consumption practices and enhance consumer trust [42].

Cultural and Social Norms

Challenges

Dietary choices do not operate in a vacuum but are embedded within cultural and societal norms. The preference for traditional yet often unsustainable foods is deeply ingrained in many societies, as established food practices enable construction and maintenance of cultural, racial, and ethnic identities [71]. This is one of the reasons why shifting towards sustainable consumption is challenging. Furthermore, there is often reactance to adopting new food technologies or diets perceived as unconventional or unfamiliar [95]. It is imperative to change the cultural and social norms to successfully change consumption patterns. According to the social norms theory [12], there are two types of norms to consider: (i) descriptive norms (i.e., beliefs about what others do) and (ii) injunctive norms (i.e., beliefs about what others approve and disapprove). In their study on food choice, Salmivaara et al. [74] showed that descriptive norms are positively associated with actual sustainable food choice, whereas injunctive norms are not.

Opportunities

Leveraging social influencers and public campaigns can play a significant role in reshaping social norms towards sustainability [96]. Promoting community-based initiatives and workshops highlighting the local and cultural relevance of sustainable practices can also enhance cultural acceptance [72]. The CUES project aims to develop community-led interventions which can reinforce social norms. By adopting a community-led approach we also leverage the power of social desirability: consumers tend to act in a socially desirable manner in public contexts in which others can observe and evaluate their sustainable behavior [40, 67, 69].

Second, the role of culture is essential within CUES. Interventions and sustainability communication need to be tailored to fit within cultural narratives to resonate with the targeted communities and align with the collective mnemonic significance [1]. For example, emphasizing family health and well-being can be more effective in cultures with strong family values, while highlighting the efficiency and cost-effectiveness of sustainable products may appeal more in economically oriented cultures. Additionally, to bridge the gap between current and new food consumption patterns, we can leverage local culinary traditions and cultural food patterns that are inherently sustainable (e.g., gastronationalism; [62]).

Consumer Behavior

Challenges

Although theories such as the Theory of Planned Behavior [3] suggest that changing knowledge, attitudes, and norms can alter behavior, there is evidence that this hierarchy-of-effects reasoning is not as effective as sometimes believed [97]. Furthermore, behavioral inertia and the perceived risk associated with new foods, such as plant-based or cultured meat, create skepticism, neophobia, and reduce trial rates [44, 63]. A key challenge in changing behavior is thus to change habitual food behaviors. The habit discontinuity hypothesis suggests that habit change can occur by changing the behavior context in combination with habit formation techniques [98]. Previous research has focused on nudging and choice architecture as a means of changing consumption habits [93]; however, there is currently a strong debate on the effectiveness of nudging– particularly regarding backfiring effects [9], the effect sizes of nudges [64], and the ethics of nudging [92].

Opportunities

The challenges in changing sustainable food consumption present significant opportunities for future research. To design effective behavioral interventions, it is crucial to enhance understanding of consumers' current behavior [64]. After doing so, tailored marketing and communication strategies can be identified that cater to specific markets, thereby accelerating the adoption of (innovative) sustainable products. As part of these strategies, cognitive and affective persuasive cues can be operationalized to encourage the transition to sustainable food products (e.g., [23]). For instance, specific sociodemographic groups might be more susceptible to the environmental versus health benefits (intrinsic versus extrinsic appeals; also see [30]). The primary goal of initiatives such as the CUES project is to conduct a cross-cultural overview of consumers' current understanding of sustainable food consumption.

Moreover, behavioral interventions, such as social modeling or feedback can effectively promote sustainable consumer behaviors by making sustainable choices more accessible, observable, visually appealing, and the default option [2, 68, 69]. Additionally, gamification and reward systems can incentivize and sustain consumer engagement with sustainable food choices [96]. These strategies might be more easily implemented within digital environments (e.g., [11]) and with the potential use of virtual reality applications [57].

Industrial Change

The Integration of Cues to Enhance Transparency and Traceability

Challenges

In the food sector, increasing pressure from customers, the government, and other relevant stakeholders has resulted in a high demand for transparency in food value chains [18, 61]. Transparency in this context refers to "the extent to which all its stakeholders have a shared

understanding of, and access to, the product-related information that they request, without loss, noise, delay and distortion" ([27], p.22). Achieving high transparency is essential to ensure food quality, traceability, and ethical sourcing, aligned with the interests and expectations of modern consumers [86]. For example, consumers are increasingly interested in tracking their food from 'farm to fork', allowing them to trace the production process from the farm where it begins, through the shipping companies used, and the storage locations, until it reaches supermarket shelves [7]. Meanwhile, consumers require clear, accessible, and credible information to confirm or disprove the claims made by companies [22], implying that simply communicating non-traceable information to consumers may not benefit actors in the food value chain and can pose a risk to consumer trust [18].

Opportunities

Signaling theory [82] is widely adopted to explain how companies communicate product information to reduce perceived uncertainty among consumers. According to this theory, actors in the food value chains can utilize a variety of cues, also known as signals, to convey information about the food production process [50]. These cues typically include intrinsic cues relating to the quality of food products, and extrinsic cues involving food production, manufacturing, packaging, and distribution, as well as social and environmental impacts in these processes. The cues can help reduce information asymmetry—where specific sustainable innovations and management of food production are not visible to consumers—by providing reliable information that consumers can trust. If the cues are judged by consumers as relevant, valuable, and trustworthy, they can mitigate consumer suspicion and skepticism [65, 66], thus positively influencing their purchasing behavior [22, 45, 50]. Recently, the need to reduce information asymmetry has been driving the increased interest in transparency and traceability in food value chains. Consumers now demand clear, accessible, and credible information about the production, manufacturing, packaging, and distribution of the food products they purchase [61]. Cao et al. [18] argue that integrating cues to enhance transparency and traceability in food value chains can foster business viability in the long run, serving consumers' interests, but also enabling food value chain actors to embark on a journey toward a sustainable transition.

The rapid technological advancement of society contributes to new ways for food value chain actors to reduce information asymmetry [16]. Blockchain technology (i.e., a decentralized transaction and data management system providing security, anonymity, and data integrity without third-party control; [101]) is one such innovation that facilitates the integration of cues to enhance transparency and traceability [61]. Currently, most information in food value chains is managed from a highly centralized space where a single organization is responsible for information management, requiring a significant amount of trust in that organization [73]. As a disruptive information technology, blockchain can help secure data and verify the sustainable production, and distribution processes of food products [61]. Practically, this technology's implementation in a consumer-accessible way can be achieved through a QR code on product packaging [56]. Scanning the QR code provides consumers with information on all actors and activities involved, from the primary producer up to the retailer. For instance, Nestlé has integrated a blockchain-based system that allows consumers to access real-time information about a product's production journey, including access to verified payments

made to the farmers involved in the process [59, 103]. CUES will develop interventions in food value chains, facilitating access to information about sustainable food choices through innovations such as barcodes and QR codes. The value of blockchain technology in guaranteeing transparent and traceable information makes it well-suited for the food sector, where a lack of credible information is a significant obstacle for consumers [18, 73].

Empowering Farmers and SMEs

Challenges

Farmers and SMEs are vital components of food value chains, yet they often face significant challenges that hinder their sustainability and growth [76]. Dominated by prominent players, food value chains typically exhibit an unequal distribution of power and profits, leaving smaller entities at a disadvantage [53]. Farmers and SMEs struggle primarily with limited access to markets and high barriers to entry, often lacking the negotiating power necessary to secure better prices and terms. This imbalance makes it difficult for more minor players to compete effectively and can marginalize them from valuable market segments [54].

Additionally, the costs associated with compliance with standards and regulations disproportionately affect smaller food value chain actors, exacerbating their challenges. On the other hand, large corporations often control significant stages of food value chains, from production inputs to distribution networks, allowing them to set conditions that others must follow [95]. This control can limit the visibility of smaller players in the market, restrict their access to consumers, and diminish their role in decision-making processes. Also, while modern consumers increasingly demand transparency, sustainability, and fairness in food production, the complexities and power dynamics of food value chains can obscure the origins of products and the conditions under which they are produced [90].

Opportunities

Despite these challenges, there are opportunities to drive change toward more equitable and sustainable food value chains, as these chains can positively impact the economy by supporting local production and job creation, reduce environmental harm through sustainable practices, and improve food security and access, fostering long-term resilience in communities [49, 58]. One of these opportunities is increasing consumer awareness about the origins of their food and the conditions under which it is produced [100]. This can shift consumers' buying habits toward supporting smaller producers and sustainable practices. Also, creating networks and cooperatives among small farmers and SMEs is equally important as it can enhance their bargaining power through collective action, as well as help reduce costs and improve access to markets [90]. Developing short value chains is another effective approach to enable small producers to capture a greater share of the profit margin and build loyalty with consumers through personal engagement [90].

Further, local, national, and European Union governments need to support fairer practices through policies that level the playing field, such as subsidies for small farmers, regulations on fair trade practices, and support for sustainable agriculture [80, 83], creating a balanced and sustainable food value chain. CUES will contribute by co-designing solutions

that specifically address the challenges faced by farmers and SMEs, enhancing their market access and bargaining power through innovative business models and organizational practices that promote equity and sustainability.

Leveraging Innovations for Sustainable Global Food Supply Chains

Challenges

The production of food has significantly expanded through globalization and industrialization processes [81]. This growth has globally contributed to lower food prices and improved food accessibility [34]. At the same time, industrial food production and a widely dispersed supply chain structure have resulted in high greenhouse gas emissions, the overexploitation of natural resources, and ecosystem degradation [39, 81]. The predicted increase in urbanization is likely to further exacerbate these environmental problems. The reliance on imported resources can lead to longer supply chains, which in turn can promote more food loss and waste along the way [24, 104]. Food supply chains also face challenges in terms of other sustainability dimensions. Societally, both hunger and diet-related diseases have been observed to increase, thus suggesting that the affordability of food does not necessarily translate into the accessibility and adoption of healthy, nutritious diets [4]. At the economic level, inequality exists in the distribution of profitability, with a few large corporations benefiting at the cost of many fragmented small suppliers [35].

Several of these issues can be alleviated through the implementation of circular and technological innovations in food supply chains, which can, for instance, improve food waste management and food security [55, 102]. Nevertheless, the adoption of such innovations tends to be hindered by various barriers [37]. Organizational culture barriers (i.e., lack of experts, lack of change management capabilities, risk-averse culture) have been identified as one of the critical concerns that need to be addressed to pursue more sustainable food supply chains [79]. Organizational change is often accompanied by internal resistance among employees, as diverging from the status quo can increase uncertainty about the value that a new strategy can offer for the future of the company [43]. Other barriers to the implementation of food system innovations include but are not limited to a lack of technological expertise and knowledge, and the required investment to collaborate with other stakeholders in the supply chain [37, 79].

Opportunities

The urgency to achieve the SDGs demands the implementation of innovative approaches throughout the food supply chain. It is no longer a viable option for stakeholders to solely center on their own business practices in isolation [78]. Instead, a more holistic and dynamic business ecosystem approach is required, in which the interplay between stakeholders and institutions is incorporated to achieve mutual value creation [8, 24]. This involves the sharing of knowledge with other stakeholders to stimulate and enable co-creation processes that drive transformation [14].

Also, the mapping of drivers and barriers (e.g., financial, legal, market) of Circular Business Model Innovation models [38] throughout their stages (visioning, sensing, seizing, and transforming; [15]) can lead to improved global supply chain efficiencies. Systemic

shifts towards more decentralized food systems can facilitate this process [51]. Furthermore, while research and development results are traditionally not disclosed with other stakeholders, the use of more open and collaborative practices would benefit the innovativeness across a business ecosystem [52]. With its focus on co-designed solutions, CUES aims to overcome barriers to innovation by identifying synergies, interdependencies, and risks among stakeholders, enabling them to co-create solutions that drive sustainability and efficiency in (global) food supply chains.

Policy Change

Public and Stakeholder Engagement

Challenges

Environmental and social challenges are often a top priority in policy agendas [60]. The food system is characterized by uncertainty via a plethora of drivers, impacts, and interconnected sectors, requiring trade-offs, for which policies play a critical role. A disconnect between policymakers, consumers, producers, and other stakeholders has hindered the development and implementation of optimized food policies [26, 72]. Moreover, policies do not always adequately reflect the needs or capacities of various stakeholders or can be perceived as top-down mandates that disregard the practical realities faced by actors within the food system, leading to limited impact. Importantly, policies may lack coherent and tailored instruments that are inclusive of food democracy principles [26].

Opportunities

To support the consumers and food value chain actors effectively (see Chaps. 2 and 3), policies should consider the economic positions of these groups and foster robust and inclusive Responsible Innovation principles [25]. Enhancing public and stakeholder engagement can significantly improve the development and execution of food policies. Involving all relevant parties in the policymaking process—from conception through implementation—can result in policies that are more likely to be well-received and effective. Public consultations, inclusive policy forums, stakeholder living labs, pilot studies, and collaborative policymaking are essential for increasing stakeholder engagement and ensuring that policies are both practical and impactful [21].

Additionally, leveraging citizen science and engagement initiatives can empower communities to contribute to policy development and implementation, ensuring that policies are grounded in local contexts and address specific needs and challenges. In a similar vein, consumer-driven initiatives, such as citizen assemblies and participatory budgeting, can help inspire policies with public interests and foster a sense of ownership among stakeholders [5]. For instance, CUES will conduct dialogues with key actors (i.e. stakeholders, citizens, policymakers) to enhance citizen science and science-informed policymaking, bridging the gap between these groups and fostering a sense of ownership and commitment to sustainable food practices. These approaches serve the principles of food democracy, namely deliberation, knowledge, food choice, civic co-planning, and rights protection [10] where

consumers and citizens play a direct role in shaping food policies that promote transparency in the food system.

Regulatory Support and Incentives

Challenges

Current food policies often lack coherence, integration, and implementation, focusing on isolated aspects of food systems without addressing broader sustainability impacts [26]. This fragmentation often leads to ineffective regulatory frameworks that fail to support comprehensive sustainable food consumption practices. For example, the emphasis on production efficiency often overlooks the environmental degradation instigated by conventional farming practices, including deforestation and biodiversity loss. Furthermore, regulations frequently neglect the socioeconomic dimension of sustainability [28], such as the viability and health of small-scale farmers and the distribution of food resources with respect to minority groups. This disjointed approach results in policies that are fragmented and misaligned with the overarching goals of sustainable development.

Opportunities

There is significant potential to develop integrative and cross-sectoral policies that align environmental, societal, and economic sustainability objectives. Designing policies that incentivize sustainable agricultural practices and enforce stricter regulations on unsustainable food production can reshape the landscape of food sustainability [46]. More intrusive policy instruments, market-based measures, or the regulatory elimination (e.g., through taxes) of the most unsustainable food products, are more effective and therefore needed to achieve substantial sustainability transitions, especially in combination with less intrusive, information-based instruments such as nudging [5]. Moreover, by providing clear guidelines for consumers (e.g., through food labels and packaging; [6, 29]) industries can promote more market-driven sustainable practices and foster an informed and equitable food system.

The Ecosystem Pie Model (EPM) can play a critical role in this context. The EPM is a strategic tool for mapping, analyzing, and designing food innovation ecosystems by capturing how actors interact to create and capture value [41, 85]. This model can help policymakers understand the complex interdependencies between stakeholders and design policies that support robust and responsible innovation ecosystems. By identifying these interdependencies and ensuring that all actors, including economically weak producers and marginalized groups, are considered in the policymaking process, the EPM can empower decision-makers to balance trade-offs. CUES will utilize this model to guide policy dialogues, ensuring comprehensive stakeholder engagement. This approach can optimize the distribution of resources and benefits across the food system, thus developing more inclusive and resilient policies [85].

International Standards and Cooperation

Challenges

Global food systems are hindered by inconsistent policies and standards across different countries, complicating efforts to harmonize globally sustainable practices [20]. For example, European farmers often face stricter regulations compared to their non-EU counterparts, making it harder for them to compete and potentially increasing the cost of locally produced food for consumers [32]. International trade laws, transnational conglomerates, and national interests often clash, posing significant challenges to the implementation of effective sustainability measures on a global scale. This inconsistency leads to barriers in enforcing globally acceptable sustainability standards and regulations. Also, Black Swans—highly disruptive and unpredictable crises inherent in our complex global systems, such as wars and pandemics [84]—pose significant threats to sustainable food transitions by undermining global systemic stability and resilience.

Opportunities

Establishing universal standards through responsible standardization principles (e.g., [99]) and fostering international cooperation can streamline efforts and enhance the global management of food sustainability. Collaborative initiatives, such as the European Union's Farm to Fork Strategy, part of the European Green Deal [33], can provide a robust framework for harmonizing standards and practices across borders. The Farm to Fork Strategy aims to create a sustainable food system by addressing key areas including sustainable food production, sustainable food processing and distribution, sustainable food consumption, and the prevention of food loss and waste (see Fig. 2).

Successful examples as such necessitate the establishment of Common Food Policies and intercontinental cooperations for promoting sustainable agricultural practices and reducing environmental impact [26]. By adopting universal standards, countries can facilitate smoother trade relations and ensure that sustainable practices are consistently applied globally. Governance for transition is essential for facilitating these changes. Transition governance involves creating frameworks for adaptive and flexible policy measures, enabling countries to respond to evolving sustainability challenges and opportunities [5]. Moreover, international standards must be designed to accommodate and mitigate the impact of Black Swans. Policies, therefore, must incorporate resilience-building measures to address these unpredictable disruptions. By integrating international standards and cooperation for systemic resilience [105], such as enhancing the dynamic stability of circular food systems, we can mitigate the impacts of unforeseen challenges. CUES aims to achieve this through emphasizing the importance of policy assessment, facilitating stakeholders to align local practices with international standards towards achieving sustainable food systems.

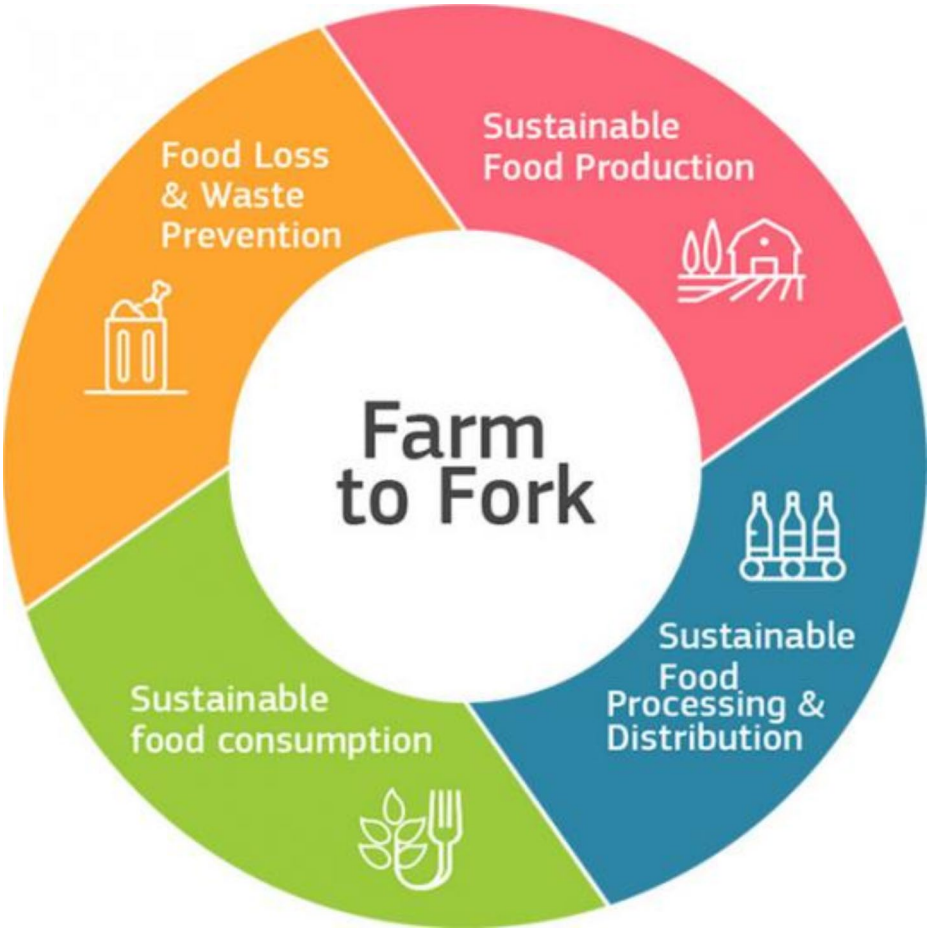

Fig. 2 European Commission [33]. Farm to Fork Strategy. Retrieved June 11th,2024, from https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

Conclusion

The transition towards societal tipping points in SFC is hindered by significant challenges, including consumer misconceptions, distorted food value chains, and fragmented policies. These challenges are compounded by the inherent complexity and the interconnected nature of food systems, where addressing one often influences multiple others. Addressing these issues through comprehensive systemic strategies, particularly Triple Change (Consumer and Cultural Change, Industrial Change, and Policy Change), offers significant opportunities. The CUES project, focusing on persuasive cues, stakeholder engagement, and policy reform, aligns closely with these dimensions and aims to offer practical pathways to foster consumer empowerment and drive the SFC transition.

Moreover, it is essential to enhance support for farmers and producers, who play a vital role in sustainable food systems but face significant challenges, such as market access and high compliance costs. Financial incentives like subsidies, alongside the creation of coop-

eratives, can empower producers by improving their bargaining power and reducing costs. Policies promoting fair trade and market access for small-scale producers are also essential in ensuring equitable and sustainable practices across the food value chain. These measures could enable farmers to engage in sustainable practices while securing economic viability, ultimately fostering more resilient and inclusive food systems. Designing sustainable food value chains can support economic development, reduce environmental harm, and improve food security and community well-being.

The present paper has drawn extensively from existing literature to develop the Triple Change strategy for sustainable food transitions, yet future research is essential to strengthen its applicability and adaptability to real-world complexities. Empirical studies, in specific those incorporating quantitative and qualitative methodologies, can provide valuable insights into how this framework can be refined and tailored to diverse socio-political contexts. Quantitative research could involve, for instance, cross-national surveys or longitudinal studies to track the outcomes of specific sustainable food interventions, analyze their impact, and measure environmental benefits, such as reductions in greenhouse gas emissions or improvements in biodiversity. On the other hand, qualitative research, such as interviews and focus groups with key stakeholders (e.g., producers, policymakers, and consumers), can offer in-depth perspectives on the behavioral, cultural, and policy-related challenges that influence sustainable food system transitions. A mixed-methods approach, combining data-driven analysis with context-specific insights, can create a more dynamic framework with respect to emerging trends and evolving challenges in sustainable food systems. This approach will not only enrich the academic understanding of sustainable food transitions but also provide practical pathways for policymakers and stakeholders to foster the long-term sustainability of food systems.

While the complexity of global food systems and varying socio-political contexts present significant structural limitations, the collective commitment to sustainable practices can pave the way for more resilient food systems. The Triple Change strategy can inspire academics, organizations, and policymakers, and serve as a model for similar initiatives towards fostering long-term sustainable food systems.

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Declarations

Ethics Approval and Consent to Participate NA.

Consent for Publication All authors agree to publication.

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