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Deliberating justice in food systems transformation pathways: a transdisciplinary approach applied in Finland

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Keywords: just transformation, pathways, sustainable food systems, transdisciplinary research, boundary object

Abstract

The need for transformation in food systems is acknowledged broadly. Persisting lock-ins and systemic interactions require research going beyond disciplinary approaches. Transdisciplinary research has the explicit aim to contribute to solving complex sustainability problems. In this article, we present a transdisciplinary framework for incorporating justice considerations as a normative compass into the deliberation of transformation pathways, and apply it to the context of the Finnish food system. The results show how justice can act as a boundary object that brings different disciplines and food system actors together to create a shared language for food systems transformation. At the same time, it makes visible conflicting interests that require ethical reflection by researchers and other societal actors. In future, a well-balanced mix of short- and long-term actions is required to co-produce transformative change while extending the group of engaged actors to address deeper vulnerabilities. This invites transformative research to develop novel procedural and methodological approaches for ethical reflection.

1. Introduction

The need for substantive sustainability transformations in food systems is acknowledged broadly. Among environmental problems, climate change and biodiversity loss (Pörtner *et al* 2023), water sufficiency and quality, and degrading agricultural soils (Richardson *et al* 2023) all deserve attention. Globally food systems have also failed to ensure adequate nutrition for all, resulting in the triple burden of malnutrition (FAO 2023). Livelihood issues, on the other hand, show themselves in impoverished rural landscapes and lacking opportunities for rural jobs such as small-scale farmers and processors in sustaining food systems diversity (Woodhill *et al* 2022). These environmental, social and economic problems are closely entangled

with imbalances of economic and political power in the current functioning of food systems (Jacobi *et al* 2021, Clapp 2023).

Recently, calls for disruptive (Benton 2023) and transformative (Béné 2022, Brunori *et al* 2024) research have been put forward to address the persistent food system challenges (Weber *et al* 2020, Juri *et al* 2024). Importantly, transformative research is needed to address the systemic lock-ins in the functioning of food systems (Conti *et al* 2021, Béné 2022, Clapp 2023). Unless the systemic interactions are addressed, actions in one part of the complex food system may influence other parts in, often, cascading and uncertain ways (Ericksen 2008, Béné *et al* 2019, Bustamante *et al* 2024). For example, improving and increasing resource-efficiency of livestock production may act to lock the system into a fundamentally unsustainable state, unless efforts to reduce the consumption of animal-based products are carried out simultaneously (Herzon *et al* 2024). The latter, however, may be difficult due to political interests and financial investments within highly specialised livestock systems (Vallone and Lambin 2023). Similarly, it will remain difficult for farmers to compete in environmental quality, unless the concentrated pricing mechanisms in current food markets are transformed (Jacobi *et al* 2021).

Research on just food systems transformation has emerged as one attempt to find solutions to the lock-ins (Kaljonen *et al* 2021, Whitfield *et al* 2021, de Bruin *et al* 2023, Baudish *et al* 2024, Marrero *et al* 2024, Conti *et al* 2025). In this research, ecological sustainability and social justice are considered as intertwined components of food systems transformation (Kaljonen *et al* 2023). This means that any suggested solutions to climate change mitigation, for example, should be aware of existing social injustices in food systems and avoid creating new injustices (Kaljonen *et al* 2021, Maluf *et al* 2022, Baudish *et al* 2024). Likewise, potential economic or social impacts of climate actions should not be perceived as an obstacle for action, but rather as an impetus to seek novel combined solutions that allow food systems to operate within planetary boundaries whilst fulfilling the social and nutritional needs (Stavis and Felli 2020, Kortetmäki *et al* 2025).

Understanding the intertwined components of ecological sustainability and social justice, and their interactions, necessitates research that extends beyond disciplinary boundaries (Kaljonen *et al* 2023). Transdisciplinary research aims to involve different types and sources of knowledge to the understanding of complex sustainability problems. It is suitable in settings where conflicting normative understandings about desirable outcomes or the drivers of problems make the search for solutions challenging (Lang *et al* 2012, Dedeurwaerdere 2014). When engaging in just food systems transformation, several transdisciplinary questions arise: What are the systemic interactions and in/justices in current food systems functioning? How do they manifest in different contexts? How do visions for just food systems differ and how to reconcile them for joint targets? What justice questions need to be resolved for achieving the targets? How to give recognition to the most vulnerable groups when designing the actions? How to support transformative capacities of people?

Transformation pathways are one useful way for addressing these questions (Turnheim *et al* 2015, McDermid *et al* 2023, Mosnier *et al* 2023). Pathways have been applied to find cost-effective, feasible routes to address food system challenges, but to date, justice concerns have received little attention in the analyses (e.g. Conti *et al* 2025). In this article, we present a transdisciplinary framework for incorporating justice considerations into deliberation of food systems transformation pathways. We propose a framework which systematically incorporates justice thinking into the different phases of pathway designs. The novelty of the approach is the normative compass (Tribaldos and Kortetmäki 2022) introduced as a boundary object (Star and Griesemer 1989) for weaving different types of transdisciplinary knowledge together.

In what follows we present the framework and discuss the experiences gained from piloting and contextualising the framework to the Finnish context. We start by explaining the ways in which the framework aims to co-produce the different types of transdisciplinary knowledge, and explain how the normative compass can guide the deliberation of pathways. The results from the Finnish case show how the normative compass allowed to bring together different actors and create a shared language for addressing just food systems transformation. However, it was also prone to harnessing the concept of justice for promoting actor-specific interests and for disclosing conflicts that require ethical reflection by the researchers. We close the article by discussing the further development needs when applying the normative compass to other contexts.

2. Transdisciplinary framework for deliberating justice in food system transformation pathways

Pathways have proven helpful in describing transformation processes and to systematically analyse unfolding patterns of change, especially when combining strengths of quantitative systems modelling and

qualitative understanding of systems functioning (Turnheim *et al* 2015, Gaupp *et al* 2021). Quantitative modelling assists in developing future projections of planned initiatives and their impacts (Mosnier *et al* 2023). Systems modelling can reveal interdependencies and trade-offs between the different food systems activities, drivers and outcomes (Ericksen 2008, Lehtonen *et al* 2022, Virkkunen *et al* 2025). In-depth qualitative analysis is required to understand lock-ins, momentum for change and power imbalances among the different actors and activities (Mylan *et al* 2019, Huttunen *et al* 2024). The diverse assumptions and expectations of different actors, established power structures, and resolving trade-offs between the different societal targets can however make the negotiations of feasible pathways challenging (Ciplet and Harrison 2020, Rööös *et al* 2023).

Introducing a normative compass for these negotiations can help to focus on salient issues, distinguish between well-grounded justice concerns and personal claims, and place different justice concerns on a same map (Kortetmäki *et al* 2025). By a normative compass we mean a specific set of questions that can assist in identifying and weighing justice issues to be taken into account in transformation processes (Tribaldos and Kortetmäki 2022). For doing that, we have developed a normative set of principles and criteria specific to food systems (figure 1, *ibid.*). The principles and criteria rely upon a multidimensional understanding of justice that characterizes justice as including distributive, procedural, and recognitional dimensions common in environmental justice theories (Schlosberg 2007). The principles also pay specific attention to the capacities and the recipients of justice, including global fairness, intergenerational justice, ecology and non-human beings. These additional aspects help support the visibility of groups that might otherwise remain invisible and thereby misrecognised (Tribaldos and Kortetmäki 2022) due to the nation- and human-centric framings of justice that tend to downplay intergenerational matters (Huttunen *et al* 2024). The principles and criteria offer guidance for deliberating which justice issues are the most important for different pathways, and where the gaps are, and help actors keep a diverse set of viewpoints on table instead of narrowing justice framings in misrecognitive ways.

Star and Griesemer (1989) have underlined how boundary objects are required in research to serve as instruments to consolidate divergent viewpoints and to produce generalizable findings while speaking to different actors and keeping their perspectives at the same time. We have developed the normative compass (figure 1) with this goal in mind. It is designed to serve as a robust, but flexible enough boundary object for designing transformative pathways for food systems transformation. The grounding of dimensions and principles of justice to the long tradition of philosophical research on justice makes the compass scientifically robust. The criteria contextualise the principles into food systems specific matters. In figure 1, the criteria concentrate upon affluent societies of Global North, who should carry their responsibility in the mitigation of climate change, but the criteria can be reframed and redeveloped for other contexts as well (e.g. Maluf *et al* 2022). The level of principles is more generalizable across the different food systems (e.g. Gonzalez 2015).

To date explicit considerations of justice in transformation pathways are still scarce (Conti *et al* 2025). The same applies for the explicit integration of justice considerations into transdisciplinary research practice. Normative questions are relevant in all phases of co-producing transdisciplinary knowledge, i.e. system, target and transformation knowledge as introduced by Hirsch Hadorn *et al* (2006). For understanding the functioning of the system, better knowledge of the existing in/justices is crucial. Knowledge regarding the future targets needs to be backed by what justice questions need to be resolved for achieving the joint goals. Co-creation of solutions to tackle injustices is critical for transformative knowledge (figure 2). Importantly, no singular discipline or actor can provide solutions to all these questions and matters of justice. The normative compass, hence, can guide different disciplines and actors to tap on salient issues of justice, weave the different types of knowledge together, and to evaluate the gaps in justice understandings accordingly.

In addition to different types of knowledge, it is useful to consider transdisciplinary knowledge production consisting of different phases. This is especially the case in pathway creation, where iterative rounds are needed to find societally robust solutions (Hyysalo *et al* 2019). Following the framework by Lang *et al* (2012) we have structured the deliberation of transformative pathways along three phases that deal with (1) the initial design of pathways; (2) the normative assessment of pathways; and (3) the identification of transformative actions and policy mixes (figure 3). The different phases call for various combinations of system, target and transformation knowledge. Also, the normative compass can play different roles in each iterative round. In the first phase, system knowledge is important for defining and highlighting injustices and inequalities in existing structures and processes. In the second phase, target knowledge assists in deliberating future states of food systems and in weighing alternative viewpoints. In the third phase, transformation knowledge is necessary for re-designing actions and policies to tackle the identified in/justices.

Principles and criteria for just food systems transformation







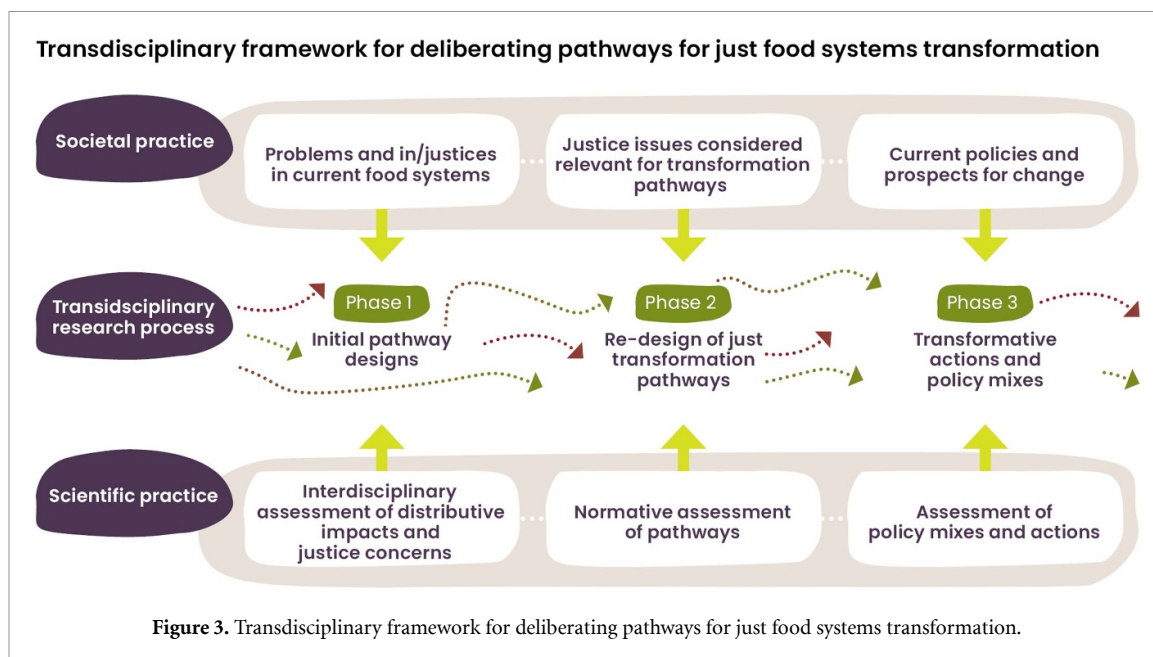
Dimensions of justice	Principles	Criteria
 <p>Distributive justice</p>	Right to vital goods (incl. right to food)	The access of the whole population to sufficient nutritious, adequate, and safe food at all times is protected. The resilience of food supply chains towards shocks is increased.
	Labor justice (incl. farmers and fishers)	The established or supported food jobs have fair payment and working conditions.
	Just food-chain structures	Farmer resilience towards shocks is retained or improved. Established food chain relations are reciprocally agreeable.
	Livelihood opportunities	The viability of farming is retained or improved. The access to suitable farmland is protected.
		Multiple opportunities for livelihoods in rural areas are retained or designing them is supported. Transition demands are designed in a way that different-sized food system actors are able to respond to them.
 <p>Cosmopolitan justice</p>	Global fairness	Decarbonizing activities do not cause food insecurity elsewhere in the world. Decarbonizing activities respect the participatory control over and access to productive resources elsewhere in the world. Decarbonizing activities do not undermine fair livelihood opportunities for distant actors.
	Intergenerational justice	Transitions towards decarbonization do not undermine the opportunities of future generations to achieve well-being.
 <p>Ecology and non-human beings</p>	Ecological integrity	Ecosystem health is improved. Biodiversity is protected or increased. Soil, water, and air health/quality is retained or improved. Natural (biotic and abiotic) resource use stays within planetary boundaries.
	Justice for animals	The inherent value of animals is respected, and they are treated respectfully.
 <p>Procedural justice</p>	Just processes	Decision-making processes are sufficiently transparent, inclusive, and provide a fair opportunity for different voices to be heard. Decision-making does not create or intensify power disparities.
	Access to relevant information	Reliable information about the impacts of food systems and different diets on humans and nature is available to all in decision-making and climate action.
 <p>Recognition justice</p>	Respectful pluralism and esteem recognition	Traditional, indigenous, and local knowledge is respected and given a voice. Diverse visions of producing, preparing, and eating food are respected. Climate actions in different food professions and by all genders are equally recognized and esteemed.
	Non-discrimination	People are not discriminated on ethnic-, gender-, age-related, or other grounds.
 <p>Capacities</p>	Capacity building	Supported innovations are made available to interested actors, especially least-advantaged groups. Developing individuals' skills for transition activities is supported. Capacity building to engage people in collective action for transitions is supported.

Figure 1. Principles and criteria for just food systems transformation. Adapted from Tribaldos and Kortetmäki (2022). CC BY 4.0.

Different knowledge types produced by transdisciplinary research

Knowledge type	Description	Research questions for just food systems transformation
System knowledge	Descriptive or explanatory knowledge of the structure and functioning of the systems	What are the current food system like and how do they function? What are the key in/justices in the current food system? Who are the most vulnerable groups? What we do not know?
Target knowledge	Knowledge regarding future goals	What are the different visions for just and sustainable food systems? How can these visions be reconciled for joint societal targets? What justice questions need to be resolved for achieving the targets?
Transformative knowledge	Knowledge that supports practical solutions and transforms ways of thinking and acting	What are the actions needed to reach the targets? What are the solutions to tackle the injustices? How the actions support transformation in thinking, acting and capacities of people?

Figure 2. Different knowledge types produced by transdisciplinary research. Adapted with permission from Hirsch Hadorn et al (2006), Soini et al (2024).



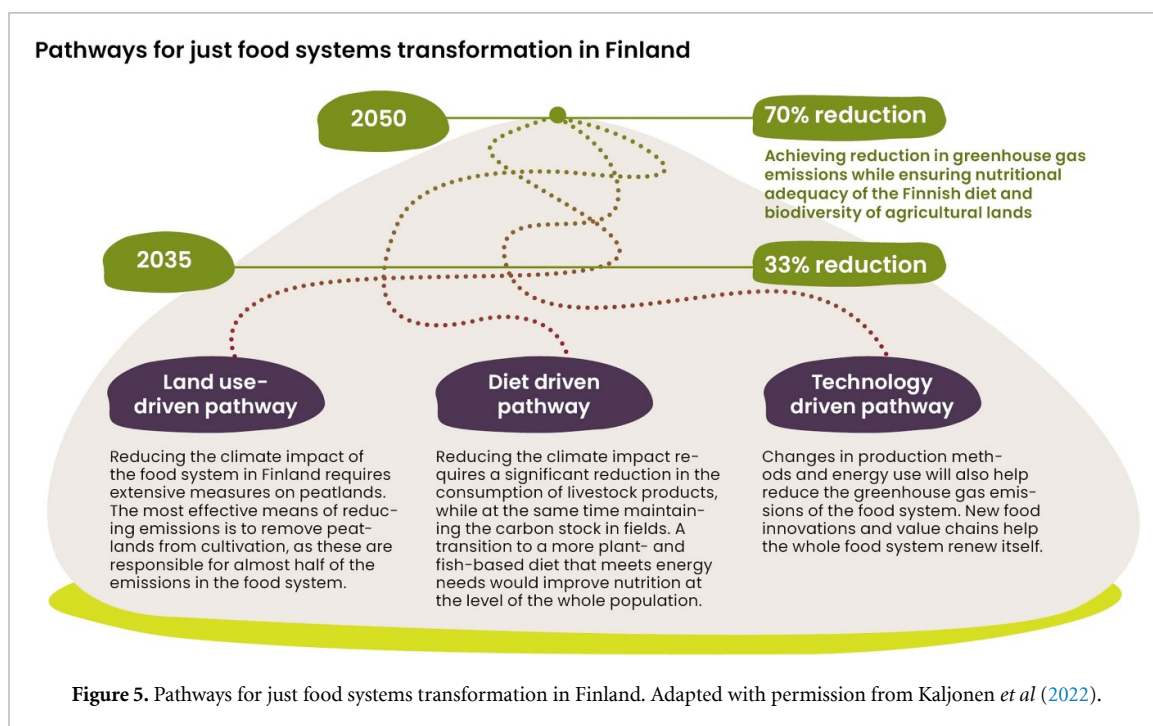
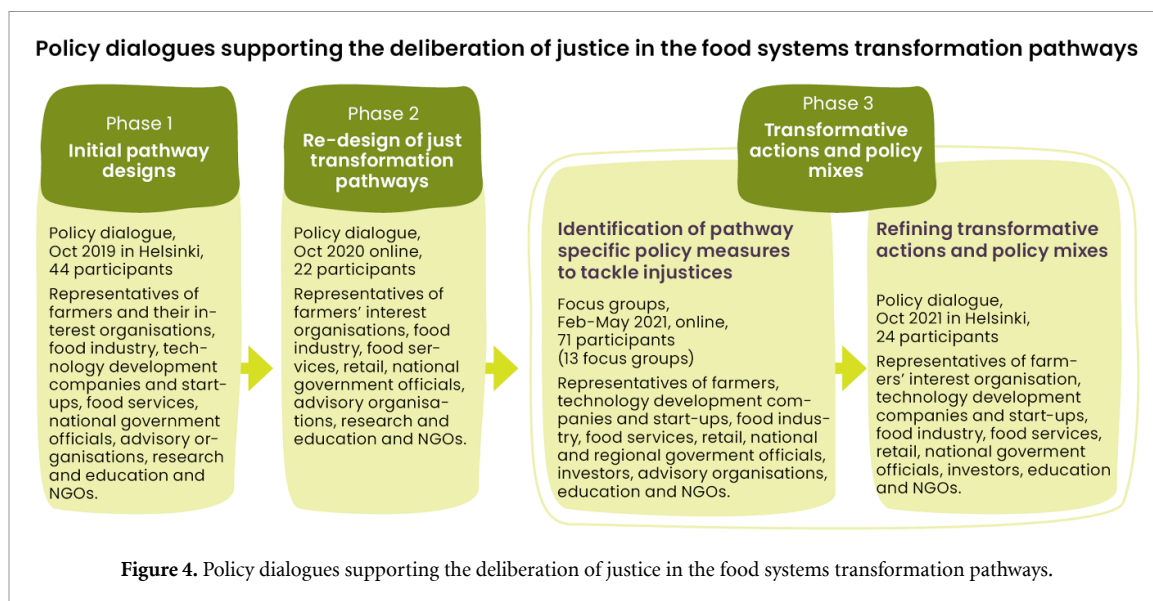
In what follows we demonstrate how the normative compass acted as a boundary object in the deliberation of pathways for just food systems transformation in Finland, and the challenges it raised. The pathways for just food systems transformation were developed during a 6 y transdisciplinary Just food project that explored and developed means for a just transformation to sustainable, healthy and climate-neutral food system in Finland. Just food was funded by the Strategic research council of Finland, which supports research that seek solutions to grand societal challenges together with researchers and societal actors (Korhonen-Kurki *et al* 2022). In this case, the project brought together interdisciplinary expertise from food systems studies, philosophy, social sciences, environmental sciences, agricultural economics and nutrition. It also engaged a wide range of stakeholders in the deliberation of pathways. The Advisory board of the project consisted of representatives from the Ministry of Agriculture and Forestry, Ministry of Environment, Farmers Union, the Finnish Food and Drink Industries Federation, Retail Association, The Martha Association (home economics NGO) and The Finnish National Commission of Sustainability Development. The strong emphasis on stakeholder interaction throughout the project gave legitimacy to the transdisciplinary work and allowed to engage a broad spectrum of actors to the deliberation of the pathways. In the next section, we concentrate upon the iterative deliberation of the pathways. The results of the detailed empirical analysis are published in the articles referenced in the text.

3. Deliberation of pathways for just food systems transformation in Finland

3.1. First phase: Initial pathway designs

In the first phase, the initial pathways were co-designed. This phase aimed to better understand food system in/justices, while considering potential partners for their resolution. The preliminary pathways were co-designed through interdisciplinary discussions among researchers, and by involving a wide spectrum of food systems actors.

In Finland, we organised a policy dialogue process to support the deliberation of pathways (figure 4). The aim of the policy dialogue was to engage food system actors in a step-wise discussion on just transformation pathways, provide them with an opportunity to bring their knowledge and expertise to the process, and ensure the breadth and applicability of the results. The participants were recruited with an open invitation sent to the most relevant organisations representing different food system activities in Finland. The participants included a wide range of actors from farmers, food industry, start-ups, public food services, public officials, and advisors to NGOs concentrating on environmental, animal or food issues, as well as research and education. The scope of participants was intentionally wide to support holistic discussion on justice. However, we did not manage to recruit participants representing particular marginalised groups such as immigrants, disabled or the elderly, rather the justice issues were considered from the perspective of core food system actors (Huttunen *et al* 2024).



In Phase 1, the task of the policy dialogue was to assist in mapping the problems and in/justices as perceived in society. This discussion fed directly into the development of the just food systems transformation principles and criteria (figure 1) and to the initial design of pathways. Together with the interdisciplinary group of researchers, the initial pathways were co-designed. The land-use, dietary, and technology driven pathways were to reduce greenhouse gas emissions 33% by 2035, and 70% by 2050, whilst securing good nutrition for all and biodiversity of agricultural lands (figure 5). Modelling approaches were designed to study the distributive impacts of the pathways to agricultural and food production in different regions in Finland (Lehtonen *et al* 2022, Niemi *et al* 2025), nutrition of different sociodemographic groups (Valsta 2022a, Irz *et al* 2024b, Valsta *et al* 2025) and the costs of the diets (Irz *et al* 2024a). The assessment of distributive impacts were designed to be used in the re-design of just transformation pathways in the later phases of the iteration. In practice a combination of modelling approaches were utilised (see refs. above and Kaljonen *et al* 2022). The impacts of technological innovations and novel foods were evaluated qualitatively (Paloviita 2022). This phase combined system and target knowledge, setting the ground for the upcoming phases.

3.2. Second phase: Re-design of just transformation pathways

In the second phase, justice issues relevant for each of the pathways were further deliberated and clarified. This was carried out by utilising the just transformation principles and criteria as a normative compass. The normative compass was introduced to the policy dialogue participants in the second series of meetings (figure 4, Phase 2), helping them to identify the specific justice concerns related to each of the pathways. The normative compass assisted also the interpretation of the modelling results.

In the Finnish case, the normative assessment assisted to refine the regional economic and livelihood impacts of land-use and dietary pathways. It showed how the impacts caused by climate measures on peatlands require better attention in the land-use driven pathway both from the perspective of distributive (Lehtonen *et al* 2022) and recognition (Puupponen *et al* 2022) justice. According to the economic assessment, however, large reductions in GHG emissions could be possible, if proper incentives were in place (Lehtonen *et al* 2022). Likewise in the diet driven pathway the potential distributive impacts vary greatly according to geographic location and production possibilities of farms (Lehtonen *et al* 2022), as well as the structure of food industry and services (Niemi *et al* 2025). The impacts on agriculture being greater in Northern and Eastern Finland, with fewer feasible crops and lower yields. The same applies to the technology driven pathway, where the distribution of benefits gained from the novel innovations across the value chain requires more attention, as well as the recognition of the farmers' position (Paloviita 2022).

The dietary driven pathway was, importantly, estimated to improve the nutrition of the whole population (Valsta 2022a, Valsta *et al* 2025). The distributive impacts, however, vary greatly between gender, education and the place of residence (Valsta *et al* 2022b, Sares-Jäske *et al* 2025). In addition to recognition of these intersectional impacts, the capacities of different socio-economic groups call for better support (Irz *et al* 2024a, Sares-Jäske *et al* 2024). With respect to the latter, the normative compass clearly showed the need for more targeted transformative knowledge.

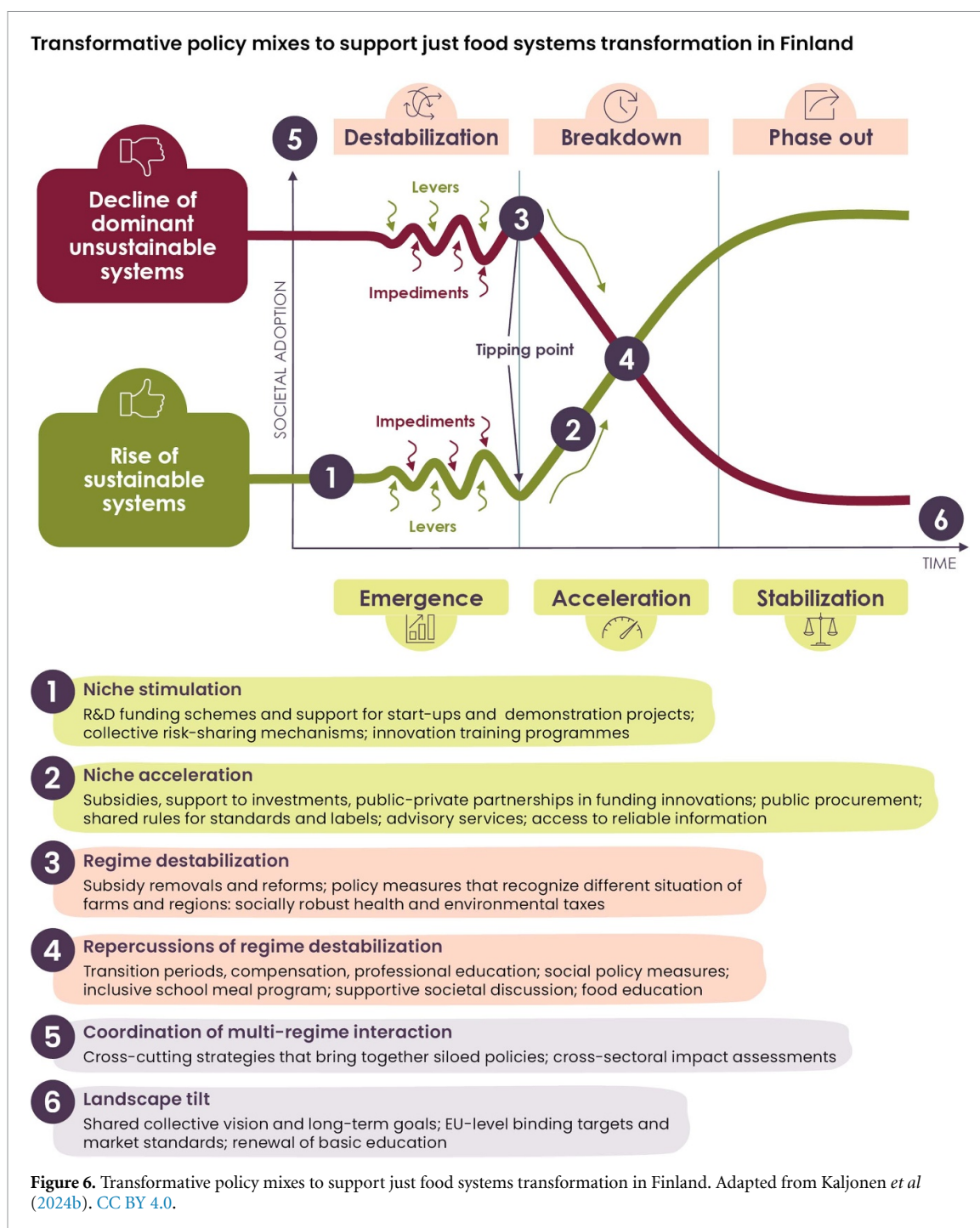
In this way the normative compass assisted in combining the system and target knowledge for the re-design of just transformation pathways, and point towards the justice concerns deserving attention. In this phase, the normative compass also showed its strength in the support of policy dialogue, and its critical assessment. According to our results, the ways different actors understand justice in food system transformation differ significantly (Huttunen *et al* 2024). Here the principles and criteria assisted in bringing structure to the discussion and identifying the most important matters of justice. They also revealed gaps in justice understanding. In the Finnish case, the justice frames tended to focus on the immediate impacts, e.g. on peatland farmers (Puupponen *et al* 2022) or male meat-eaters (Sares-Jäske *et al* 2022) prioritising social justice claims at the cost of environmental ambition and largely ignoring global fairness and intergenerational justice (Huttunen *et al* 2024).

3.3. Third phase: Identification of transformative actions and policy mixes

In the third phase transformative actions and policies were identified. Just food systems transformation, by definition, calls for multiple policy measures to support environmental sustainability and social justice in equal weight (Asquith *et al* 2022). Intervention points for triggering the twin dynamics of transformation, i.e. the emergence and acceleration of niche innovations, whilst simultaneously destabilizing the existing regimes, phasing out unsustainable practices, and mitigating repercussions are helpful in identifying policy mixes enabling just transformations (Kanger *et al* 2020).

In the Finnish case, we gathered again the food system actors to the third set of policy dialogues to deliberate the transformative actions and policy mixes (figure 4, Phase 3). The policy mixes were identified first for each of the pathways, after which they were iterated and analysed together. According to the results, justice considerations are important for each of the intervention points (figure 6) (Kaljonen *et al* 2024b). Attention to distributive justice in niche stimulation and acceleration allows ensuring that innovations do not strengthen the existing economic injustices but open avenues also for novel actors and structural renewal. Likewise, in the destabilization phase, the mitigation of repercussions with transition periods, compensation measures and capacity development are important. In the Finnish case, targeted compensation measures are emphasised for cultivated peatlands, whereas targeted capacity development measures are required to support the dietary changes of various socio-economic groups. Binding targets and cross-sectoral cooperation are needed for renewing food policy and strengthening policy coherence.

The results gained from the Finnish policy dialogues stress that current policy measures are largely concentrating on reactive, compensatory measures, whilst the active and emancipatory measures are largely missing from the policy discussion (Kaljonen *et al* 2024b; see also Lonkila *et al* 2024). The active approach would embrace more prominently phase-out measures and capacity development, whereas the emancipatory approach would focus on strengthening procedural justice and seeking alternative development pathways for challenging the existing injustices and structural forms of power (Turnheim 2022).



In the Finnish case, this would be important especially for regions which are hit most strongly with dietary and land-use changes (Lehtonen *et al* 2022, Niemi *et al* 2025, Huan-Niemi *et al* 2023). Diversification of production structure and value chains for plant-based production would require major shifts in both national and regional innovation and development policies (Paloviita 2022). Such major changes cannot be solved by singular agricultural policy measures.

In the third phase, the normative compass allowed to show gaps in the current mix of policies and to support the widening of imaginaries for more transformative policy mixes in the future. In this manner, the normative compass also supported the co-creation of transformative knowledge.

4. Discussion

Deliberating just food systems transformation pathways is not a straightforward process. The experiences gained from deliberating just transformation pathways for the Finnish food system showcase this

clearly. An iterative transdisciplinary approach that allows coming back to assessing justice implications is needed for co-designing societally fair pathways. In the approach presented here, the normative compass performed different functions in the various phases of transdisciplinary knowledge co-production. In the first phase, it assisted in targeting the pathway designs to societally meaningful questions of justice, and in producing system knowledge. In the second phase, the normative compass supported the co-production of target knowledge on how to refine the pathways to address the relevant justice issues. In the third phase, the compass provided means to show the gaps in the current policy mixes and to widen the imagination for policy mixes that would enable moving from reactive to active and more emancipatory policies.

The results gained from the Finnish context show how the normative compass can provide a robust, but flexible enough boundary object to connect diverging viewpoints, knowledges and disciplines in the deliberation of pathways. The justice principles and criteria were useful for researchers from different disciplines to investigate multiple dimensions of justice, and for societal actors to develop their arguments on what can be considered as just in their transformation strategies. The principles and criteria succeeded in identifying gaps in societal discussions and current policy mixes.

Our experiences also reveal difficulties for both researchers and food system actors in prioritizing multiple justice dimensions and adopting holistic perspectives that extend beyond immediate stakeholder concerns or individual disciplines. Furthermore, normative discussions continuously revealed additional matters of concern, which creates a risk of paralysing the transformation. This phenomenon is at the core of complex problem solving: new perspectives tend to emerge indefinitely, with various levels of dissent, requiring constant attention and negotiations. (Dedeurwaerdere 2014, Patterson *et al* 2024). Moreover, as shown by the Finnish case, even participatory approaches may dismiss the broader spectrum of justice concerns or focus on concerns that risk watering down the transformation (Fischer *et al* 2023, Huttunen *et al* 2024).

Future research should reflect on how to create spaces for societal discussions that address these concerns (Ciplet and Harrison 2020). One such option would be to include transformation boundaries into the pathway designs keeping the negotiations concentrated on securing social needs without exceeding the planetary boundaries (Kallis *et al* 2025, Kortetmäki *et al* 2025, Mazac *et al* 2025). Short- and long-term actions should also be differentiated better in the just transformation pathways. This would assist in filtering actions that address difficult systemic and structural problems and those that can be carried out immediately (Lonkila *et al* 2024, Conti *et al* 2025). This is essential for moving from reactive to more active and emancipatory actions. Maintaining the breadth and timeliness of the pathways is critically important in turbulent times, when many climate targets are being questioned or watered down by immediate geopolitical concerns (Rosenbloom *et al* 2025).

In the co-design of pathways, the system boundaries require careful attention. This is directly linked to the breadth of the pathways. In Finland, the deliberation of transformation pathways was mainly carried out by researchers and actors closely aligned with food system activities and policies. Wider and more thorough perspectives on e.g. regional economic development and progressive transformative capacities is needed to find truly transformative actions. This requires deliberation and visioning across the different socio-technical systems, and whole-system policies (Abram *et al* 2022). The systemic linkages between energy and food production are one prime example (Valve *et al* 2021), but for transforming regional economies and diversifying the opportunities for primary production, the breadth is even wider (Woodhill *et al* 2022).

Balancing between the different types of knowledge in the co-creation of pathways is a continuous struggle (Chambers *et al* 2022). In the Finnish case the pathways were co-designed with the interdisciplinary group of researchers deliberated together with the societal actors. This alone is not enough for the creation of transformative knowledge. In future, researchers need to be attentive on their position in the knowledge co-creation and choose the methods accordingly (Kaljonen *et al* 2024a). This requires contextual understanding. In the Finnish case, the system knowledge on the distributive impacts of climate actions showed a need for more genuine transformative knowledge, which gives recognition to the diverse visions and capacities of different socio-economic groups, economic sectors and regions. In future, it is hence important to extend the group of actors to all who have knowledge, agency, and stakes in the transformation, and reflect on what benefits the various societal actors in transformations (Bracken *et al* 2015, Coulson and Milbourne 2021). This will deepen system knowledge on vulnerabilities, but also requires novel procedural approaches to co-create transformative actions and capacities (Sanz-Hernández *et al* 2020, Huttunen *et al* 2022, Schmid *et al* 2024). Extending the group of engaged actors must pay careful attention to power imbalances in participation (Kok *et al* 2021). Likewise, the consideration of global fairness, as well as justice to non-humans, requires tailored approaches and

development of assessment methodologies to make these concerns a material part of the discussion (Celermajer *et al* 2021, Kytä *et al* 2023).

Critical ethical reflection on just transformation is needed from all involved actors in transdisciplinary research. In addition to being critical and reflexive about their own disciplinary premises and boundaries (Benton 2023, Kaljonen *et al* 2024a), researchers need to work on how to best support societal discussions to stay focussed also on inconvenient, empirically based facts and how to pose the right questions at the right time. Actors engaged in policy planning and making are often restricted by political realities when it comes to being creative about novel approaches to just food systems transformation. Researchers and practitioners are therefore better placed to co-develop innovative ideas and work on proof-of-concept methodologies, and to build bottom-up pressure for change. Further developing participatory approaches in transdisciplinary research around justice considerations is therefore a critical avenue for enabling more profound changes in food systems. In this regard, ethical reflection on how the co-created actions support transformation in thinking, acting and capacities of people is of vital importance.

5. Conclusions

In this article we have shown how the deliberation of just transformation pathways can benefit from a normative compass that is robust, but flexible enough for bringing different disciplines and societal actors together to deliberate on future prospects of food systems change. Such explicit evaluation and articulation of justice concerns is urgently needed in transformative food systems research. This is however not an easy, straight forward exercise, as the experiences from the Finnish context underline. Further applications and methodological development of the compass in the support of just transformation pathways are needed. While different disciplinary methods are important to investigate system knowledge, participatory transdisciplinary methods are necessary to engage in complex justice debates during transformation processes and to approach possible solutions for them. In the Finnish case, which represents an affluent welfare society of the Global North, we utilised policy dialogues for engaging a wide scope of food system actors in the deliberation. Further investigations are needed to find effective applications in other contexts. In societies with deep existing inequalities and injustices, other approaches might be more applicable to address the structural problems.

A greater understanding between the different transformation pathways, across various contexts, is needed to build capacities for understanding the different justice issues at hand, and to develop transformative actions to resolve the persistent lock-ins. The normative compass introduced here offers one route for introducing ethical reflection to the deliberation of just transformation pathways. Further research and creative transdisciplinary imagination is needed to widen the methodologies for its application, and take the next step towards transformative research.

Data availability statement

The data used in the article is accessible via the published articles referenced in the text.

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Conflict of interest

There is no competing interest.

Ethics statement

We follow the ethical guidelines of the Finnish National Board on Research Integrity. No additional research ethics statement is required for the conducted research. See the privacy notice: www.syke.fi/en/projects/just-food.

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