Gaining a Common Understanding of Transformation Pathways in Agri-Food: Shared Learning Among Partners of a Horizon Europe Project

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Abstract

Researchers across scientific disciplines widely agree that agri-food systems need transformation, yet they rarely agree on the specific form this transformation should take. This study makes researchers' views of desirable agri-food systems transformation pathways explicit. Using the repertory grid methodology, we elicited personal constructs from researchers with expertise in 101 European initiatives, representing diverse scales, approaches, and objectives of transformation. Embedded in this methodology, personal construct elicitation reveals researchers' tacit knowledge and implicit assumptions. Results from this study reveal high convergence among researchers on the importance of stakeholder inclusion, autonomy, scope of ambitions, and anchoring in farming practices in transformation initiatives. However, researchers diverge in their views on how market orientation relates to transformative potential. Our findings demonstrate that while researchers broadly agree on key dimensions for describing transformation pathways in agri-food systems, they differ in their assessment of what makes initiatives truly transformative. Implications from these findings highlight the need for interdisciplinary research projects to reflect on how, when, and to what extent to engage in stakeholder participation and farmer engagement, as well as on whether transformative actions should be planned or emergent, and adaptive or disruptive, depending on the desired agri-food systems transformation.

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Acknowledgments

We would like to thank the Editor, Prof. Damian Maye, and the two anonymous reviewers for their time invested in reading the manuscript and their constructive feedback. This study was conducted as part of the Horizon Europe Project ENFASYS, which aims to stimulate a just and robust transformation to sustainable, productive, climate-neutral, biodiversity-friendly, and resilient farming systems by improving policies and business strategies that encourage farmers to change their production systems. It does so by developing a theory of change that builds on both system and behavior research and by deriving political and private interventions to promote the transformation. Learnings from the experimentation will be used to reassess the theory of change.

Introduction

The intersecting crises of climate change, biodiversity loss, and environmental degradation pose urgent challenges to agri-food systems worldwide (Turnhout et al., 2021) and threaten food security and agricultural sustainability (Muluneh, 2021). These crises can also be considered humanitarian, as marginalized communities, at both national and international scales, are more likely to experience existential challenges, such as worsening food security (Marshal et al., 2024). As the crisis deepens, large-scale, fundamental changes to our society and way of life are needed to slow and reduce global degradation and facilitate mitigation and adaptation to the worst impacts, particularly in agri-food systems (Muller and Huppenbauer, 2016).

Despite widespread recognition of the need for transforming agri-food systems and a growing body of knowledge about what a transformed agri-food system might look like, visions for a sustainable future are inherently political, involving winners and losers, and the associated aspirations and pathways for transformative change are often contested (Patterson et al., 2017; Hebinck, 2018). It is the task of science to provide evidence for alternative future scenarios, but these are shaped by normative frameworks that are not universally shared and cannot be applied uniformly across different contexts (Horcea-Milcu et al., 2019). Therefore, it is important to understand how questions of justice and their relation to transformative change emerge from, and are influenced by, the histories, needs, and interests of different national and local communities and contexts (Feola, 2015; Rice et al., 2019).

Transforming agri-food systems without sufficient reflection and consideration of context risks imposing frameworks and ideas from a few cultures and countries onto contexts where they may not be appropriate. For example, advocates of degrowth argue that halting the unending pursuit of economic growth can decrease consumption while increasing well-being (Büchs, 2021; Kallis, 2017). However, this concept faces challenges, particularly from poorer countries, which argue that it would deny them the right to grow (though this conclusion is refuted by many—see Hickel and Kallis, 2019). Meanwhile, the concept of "doughnut economics" (Raworth, 2022) examines how economies can meet needs without exceeding social and planetary boundaries. Doughnut economics, with its use of planetary boundary framing, also raises questions about the role of science in democracy and the relationship between science and society (Willis, 2020).

Reconfiguring agri-food systems by promoting and implementing sustainable farming practices requires actions to stimulate change, which in turn demands an understanding of the processes that have led to unsustainable farming practices (Moscatelli et al., 2016).

Questions remain about how to create change in these political economies, political systems, and infrastructures in democratic and just ways, while also recognizing that different countries and cultures may have varying understandings of democracy and may pursue different transformative pathways (Willis, 2020). Furthermore, such questions must acknowledge that transformation cannot occur in a static society, as the environmental context is already changing, and society is evolving both independently and in response to these changes. Transdisciplinary research is a response to these open questions, in which researchers from a wide range of disciplines collaborate with stakeholders and actors from the field to bridge the gap between knowledge production and the demand for solutions to societal problems (Hadorn et al., 2008).

Researchers from various disciplinary backgrounds approach these inherently complex, uncertain, and normative issues related to sustainability transformation while working in specific and diverse contexts and bringing individual professional experiences that shape their worldviews (Ejderyan et al., 2023). The interdisciplinary nature of transformation research means that there are different, and potentially contradictory, understandings of transformation pathways among members of research projects (Stirling, 2015). We recognize this diversity, but for scientists to be coherent in addressing sustainability issues in agri-food systems, there is a need to reach a mutual understanding of what constitutes transformation pathways according to the different

scientists and partners involved in transformation research projects.

The aim of this contribution is to provide insights into the process of making existing understandings explicit and to map and discuss common as well as diverging views held by scholars of agri-food system transformation. To address this aim, we locate primary research within the Horizon Europe project ENFASYS, which is highly inter- and transdisciplinary due to the complex, uncertain, and multifaceted nature of sustainability issues. The project brings together researchers collaborating to explore and enable a just and fair transition toward sustainable, productive, climate-neutral, biodiversity-friendly, and resilient agri-food systems (Ejderyan et al., 2023). We begin by reviewing conceptualizations of transformation pathways, starting from the position that understandings of transformation pathways toward sustainable farming systems are constructed according to individual ontological and epistemological positions. These influence analyses of current agri-food systems (AFS), the properties and desirability of newly configured AFS, and the design of innovative or transformative processes toward AFS. We then collect and collate the different ways in which individual AFS transformation researchers in the ENFASYS project conceptualize the phenomenon in their world and in their own words.

However, while transdisciplinary research is free in direction and methodology, it is bound by the need to agree on what is relevant to the field under study. Thus, a working definition—in this case, of what constitutes an agri-food system—is needed for both framing and interpreting the analysis. We define the agri-food system as the system encompassing all activities and actors related to the implementation of farming practices. This includes activities and actors operating outside farm boundaries that directly or indirectly influence the choice and implementation of farming practices. ENFASYS therefore adopts a perspective that goes beyond the farm level to consider and analyse the entire value chain and overarching governance. The analyses of the systems under consideration include perspectives on social relationships and the interplay of social and ecological components that determine the choice and change of farming practices (Ejderyan et al., 2023). Due to the boundaries of the ENFASYS project, systems are included in the analyses if they relate to farming practices on farms in Europe, though they are unrestricted in terms of scale or associated activities and actors.

Conceptualizations of Transformation Pathways

Although there appears to be a general consensus in the scientific literature that transformation pathways are the routes a society can take to achieve transformation, the terms "sustainability transformation" and "transition to sustainability" are not used consistently. Most scholars define transitions as limited, gradual, and less radical than transformations (Stirling, 2015). Transformation includes, for example, the redistribution of rights and responsibilities, a change in societal development visions (Pelling, 2011), and a strong emphasis on social movements, civil society, agency, and deliberation (Weber, 2020). We follow the common interpretation in the academic debate by using "transition" to refer to more (sectorally) limited and incremental processes in which innovations are introduced and advanced within a dominant system, while "transformation" refers to a more radical and contested process aimed at reshaping the underlying structure of a system.

Klerkx and Begemann (2020) established the analytical approach of mission-oriented agricultural innovation systems to help researchers reflect on the role of agricultural innovations in food system transformation and how they relate to transformative concepts and visions. They differentiate the what, why, who, where, and how of mission-oriented agricultural innovation systems.

The 'what' refers to the concepts on which the mission is built. These include low-input agriculture, optimizing resource use, agroecology, circularity, regenerative agriculture, sufficiency, distribution, commons, etc. Various types of solutions, encompassing both technological and social innovations, are sub-concepts that define more clearly how the mission can be achieved (e.g., precision farming, short supply chains, development of cooperatives). Hebinck (2018) emphasizes that where socio-ecological justice is central to transformative processes, the definition of the 'what' should emerge from a process involving individual and collective agency,

disagreement, and deliberation.

The 'who' relates to the actors driving the innovation. Feola (2015), Hebinck (2018), Weber et al. (2020), Anderson et al. (2021), and De Herde et al. (2022) each highlight the important role of inclusive participation for transformation and the adoption of innovative and sustainable practices in the agri-food sector, including the involvement of actors from different system levels, across industries, policy fields, and disciplines. Advocates of alternative food networks highlight the importance of (re)connecting consumers and producers (Goodman et al., 2012).

According to Feola (2015) and Weber et al. (2020), the consideration of alternative epistemologies, local knowledge, and cultural traditions are prerequisites for endogenous development that arises locally and is based on local knowledge, resources, and technical inputs.

The 'how' and 'where' refer to the number of possible pathways a transformation can take, their direction, speed, and scale. A transformation can arise from changes within the existing system or as the sum of several more radical innovations in niches (Geels, 2002) and can transcend national, sectoral, and technological boundaries. In the context of food system transformation, different authors highlight the need for cross-sectoral governance to achieve better alignment between rules, avoid conflicts, and overcome sectoral constraints to address the systemic nature of food system challenges (De Schutter et al., 2020; Weber et al., 2020; Bergeret and Lavorel, 2022; Edwards et al., 2024).

A transformation can result from a controlled process or a self-organized process without central control mechanisms. Strategies for managing change in agricultural systems include co-creation, support, simply doing, and forced change (Dentoni et al., 2017). Co-creation and support include, for example, knowledge sharing, capacity building, fostering learning networks, and collaboration (De Herde et al., 2022). Morrissey et al. (2014) emphasize the role of multi-stakeholder engagement processes for knowledge sharing and learning in transforming agri-food regimes, which facilitate the co-creation of knowledge, build stakeholder capacity, and enable stakeholders to make informed decisions and contribute to sustainable development. Special emphasis should be placed on close collaboration between research, teaching, and farmers, which Weber et al. (2020) identify as a prerequisite for promoting sustainable agricultural practices. Similarly, El Bilali (2018) and Weber et al. (2020) remind us of the importance of "simply doing", where farmers experiment with agroecology and alternative agricultural practices, thereby generating actionable knowledge and evidence that can contribute to the success of agroecological farming practices.

However, Anderson et al. (2021) emphasise that transformation can be influenced by individual actors or instruments to varying degrees and conclude that transformation can never be fully controlled. In this context, Feola (2015) distinguishes between two types of transformation pathways: deliberate transformation with predetermined outcomes and emergent transformation without predetermined outcomes.

Finally, the 'why' of mission-oriented agricultural innovation systems relates to the sources of innovations, such as reframing ongoing efforts or introducing changes with a truly novel focus. Bottom-up initiatives, for example, often bring a novel focus by redistributing power through the empowerment and self-organization of local communities (Feola, 2015; Patterson et al., 2017). Innovations can arise proactively or as a reaction to external pressures. They can result from supply-push processes related to agri-environmental policies or changing market demand, creating a favorable environment for sustainable food production (Kuokkanen et al., 2017; Linares et al., 2022). They can also result from demand-pull processes, involving changing consumer preferences and demand for sustainable and locally produced food (Klerkx and Begemann, 2020).

As this review demonstrates, the scientific literature on agri-food system transformation reveals both areas of consensus and significant divergence in how transformation pathways are conceptualized. While there is

general agreement about the need for inclusive participation and the consideration of multiple sustainability dimensions, perspectives differ on the roles of market mechanisms, the importance of local versus global approaches, and the balance between incremental and radical change. Klerkx and Begemann's framework of what, why, who, where, and how provides a useful analytical structure, but the literature suggests that researchers' disciplinary backgrounds and experiences may lead to different emphases and priorities within this structure. Our study addresses this gap by systematically examining how transformation researchers themselves conceptualize transformation pathways in agri-food systems, making explicit their convergent and divergent understandings through the elicitation of personal constructs. This approach allows us to move beyond general frameworks to explore the specific ways in which researchers make sense of transformation initiatives in their complexity and context-specificity.

Methodology

Gaining a common understanding within a specific group (in this case, project partners of a Horizon Europe project) of a particular phenomenon (in this case, transformation pathways to sustainable agri-food systems) is not the same as agreeing on an optimal or best-practice pathway. Rather, it involves collating the ways in which individuals think about the given phenomenon in their world. It is therefore important to identify and analyse personal and collective approaches to compare and differentiate these pathways (Bohunovsky et al., 2011). We do so by studying how 11 partners in the Horizon Europe project ENFASYS describe transformation initiatives and which factors are connected to their perception of the transformation potential of these initiatives.

The 11 project partners represent diverse disciplinary backgrounds and institutional contexts, which is important for understanding the range of perspectives on transformation pathways. They work at universities (4), other research institutions (6), and farmer associations (1) based in seven European countries (Belgium, France, Germany, Italy, Norway, Serbia, and Switzerland). Within the ENFASYS project, they hold different positions: work package lead (2), task lead (6), and case study coordination/data collection (10), with some respondents holding multiple roles. The disciplines in which they are trained and/or currently work include agronomy, environmental or agricultural engineering, agricultural economics, sociology, political science, interdisciplinary (including food system) research, and sustainable development. This diversity of backgrounds and roles provides a rich basis for exploring how transformation pathways are conceptualized across different disciplinary and institutional contexts.

We study how these project partners describe transformation initiatives and perceive their transformation potential by identifying the constructs they use to describe and understand 101 real-world case-study transformation initiatives from across Europe. These initiatives were familiar to the researchers, as they had recently completed a review of them as part of the ENFASYS project. In the review, the responding partners collected information about each initiative, including their emergence and goals; past experiences; the involved actors and their relationships; factors that led to or hindered their success; and lessons learned, with the aim of contextualizing the initiatives and providing insights into respective barriers, interventions, and transition pathways. The review methodology was guided by the Light Touch Review (LTR) approach (Fieldsend et al., 2020) applied in the Horizon 2020 project LIAISON.

The 101 transformation initiatives represent a diverse cross-section of efforts to change agri-food systems across Europe. They operate at various scales: local (approximately one-third), regional (one-third), and national (one-third), with 14 initiatives operating at the European multinational level. This multi-scalar approach allows us to examine how transformation is conceptualized across different spatial contexts. In the ENFASYS project, we understand transformation pathways as deliberately initiated pathways to stimulate change toward sustainable, productive, climate-neutral, biodiversity-friendly, and resilient farming systems.

The reviewed initiatives therefore include projects or institutions with activities that lead, or are intended to lead, to innovating or transforming farming practices toward greater sustainability. We consider pathways that involve incremental change within the dominant system and transformative niche-based innovations that might establish and transform the dominant system.

The initiatives vary in their aims and approaches. Approximately 37 initiatives focus on changing existing agricultural systems through, for example, the adoption of organic or biodynamic farming, regenerative agriculture, or circularity principles. A larger group (71 initiatives) aims to change specific agricultural management methods, including soil quality improvement, integrated pest management, water conservation, greenhouse gas reduction, and improving animal welfare. Twelve initiatives focus on changing agricultural products, while 17 work on structural changes such as establishing cooperatives or risk-sharing systems with consumers. Almost 40% (39) of initiatives aim to transform value chains by developing new labels, directly connecting producers and consumers, raising awareness, or engaging citizens.

The initiatives implement their goals through multiple approaches: 72 conduct practical advancement of sustainable farming practices, 33 focus on learning about innovation and transformation, 31 develop markets, 50 advocate for policy changes, and 16 engage citizens. This diversity allows us to examine how researchers conceptualize transformation across a wide range of contexts and approaches, rather than focusing on a single type of transformation pathway.

The initiatives were identified through a multi-stage process in which a long list of initiatives was drawn up for each country and then reduced to a short list of around 8–10 initiatives per country. This process was carried out by the project partners in the various countries in collaboration with the Light Touch Review team. The selection was guided by the following criteria: The initiatives impact farming practices (directly or indirectly) with the ambition to go beyond currently dominant farming practices and standards regarding climate, ecology, and social and/or animal welfare. Moreover, the initiatives are diverse in relation to their initiating actors, aims, functioning to fulfil the aims, geographical scale, age, and degree of success.

The 11 participating project partners were involved in the compilation and selection of the initiatives, conducted the interviews, reported the data, and assessed the initiatives' transformation potential. For this study, we analysed how the responding project partners describe the initiatives and how they perceive their transformation potential by identifying the constructs they use to describe and understand the initiatives. By including a large number of transformative initiatives—and therefore a wide variety of pathways—we could elicit the range of personal constructs used by the participating project partners to describe them. Collation and clustering of these constructs enabled the identification of commonalities and differences in project partners' understanding of the transformation potential of single initiatives and their perceptions of transformation pathways.

Personal Construct Theory

A methodology for eliciting such constructs is Personal Construct Theory (Kelly, 1955), which states that a person's understanding of objects they interact with is built from a collection of related similarity–difference dimensions, referred to as personal constructs. Furthermore, the theory postulates that we, as humans, reduce even complex phenomena, such as nature or justice, to manageable numbers of 'key' constructs: typically, around 10 (Jankowicz, 2004). The theory can be applied in research projects on human constructs (Whyte and Bytheway, 1996) and has been used for conceptual modeling across a very wide range of domains and topics (Gaines and Shaw, 2021). A common method to operationalize Personal Construct Theory is the Repertory Grid Technique (RGT), described by Jankowicz (2004), which systematically elicits and captures the unique, personal ways individuals perceive and differentiate elements within a particular phenomenon to provide thorough and structured insights that are both qualitative and quantifiable (Fransella et al., 2004). The Repertory Grid Technique has been used to identify and understand personal constructs and perceptions

of topics ranging from hotel brand development (Hu and Trivedi, 2020) to urban green spaces (Home et al., 2007) and has been applied in domains ranging from psychotherapy (Winter, 2003) to software engineering (Edwards et al., 2009).

Unlike other qualitative approaches, such as interviews or focus groups, RGT provides a structured yet flexible framework that allows for the systematic elicitation of tacit knowledge and implicit understandings that might not emerge through direct questioning. Compared to alternative techniques, such as laddering, which focus on hierarchical relationships between constructs when operationalising Personal Construct Theory, RGT allows a more holistic mapping of how individuals differentiate between elements (in this case, transformation initiatives). Furthermore, the production of data that can be analysed both qualitatively and quantitatively enables us to identify patterns of convergence and divergence across researchers while preserving the richness of individual perspectives. Based on these considerations, RGT was selected as the optimal method to address the goals of this study by eliciting the diverse personal constructs used by ENFASYS partners to understand and explain transformation pathways toward sustainable farming systems (SFS).

Method

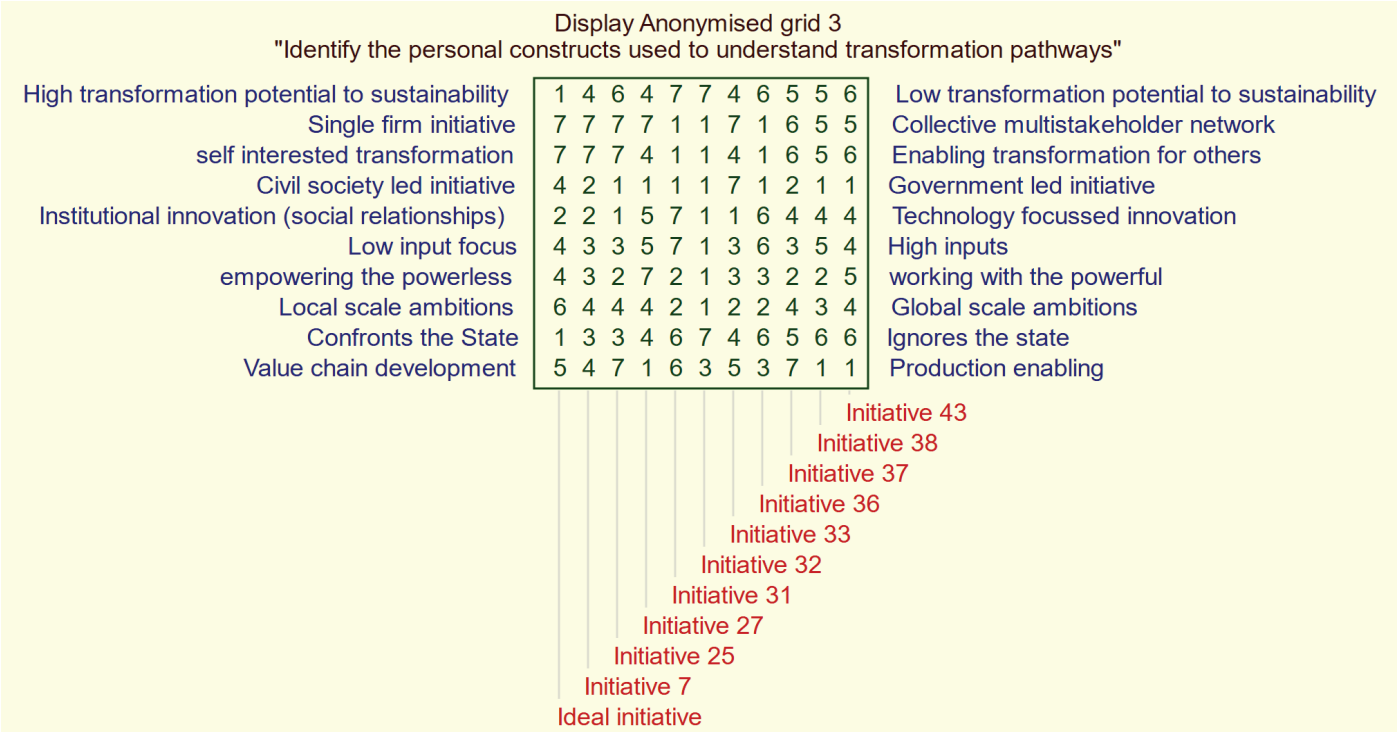
Specifically, 11 ENFASYS project partners were interviewed by FiBL researchers to identify the constructs they use to describe and understand the initiatives they had included in their case study reviews. For this reason, the respondents were the representatives of the ENFASYS partner institutions who had personally conducted the reviews, as they were deemed to have extensive knowledge about the characteristics of the initiatives they had reviewed. Researchers' familiarity with each initiative, particularly the initiatives' objectives, processes, outputs, outcomes, and impacts, enabled them to compare the initiatives by identifying their similarities and differences.

The interviews were conducted using online meeting software and were guided in the application of the RGT by the RepPlus tool (V 2.0), which provides "the capability to elicit, enter, edit, and analyze conceptual grid data, and to reflect back the underlying conceptual representations in graphic form" (Gaines and Shaw, 2021). Specifically, each respondent was asked to:

1. Rate the transformation potential of each of the initiatives for which they had conducted the LTR on a 7-point Likert scale.
2. Follow a triadic elicitation procedure to identify personal constructs, as described by Jankowicz (2004), in which randomly selected sets of three of the interviewed initiatives (elements) were presented in the RepPlus tool. This procedure was repeated until the partner was unable to nominate new constructs to differentiate between initiatives.
3. Rate each of the initiatives by the degree to which they comply with the elicited personal constructs, which had been formulated as a double-pole construct, using a 7-point Likert scale.

The ratings were then formatted into a grid—an anonymised example of which is shown in Figure 1.

Figure 1: Example Repertory Grid



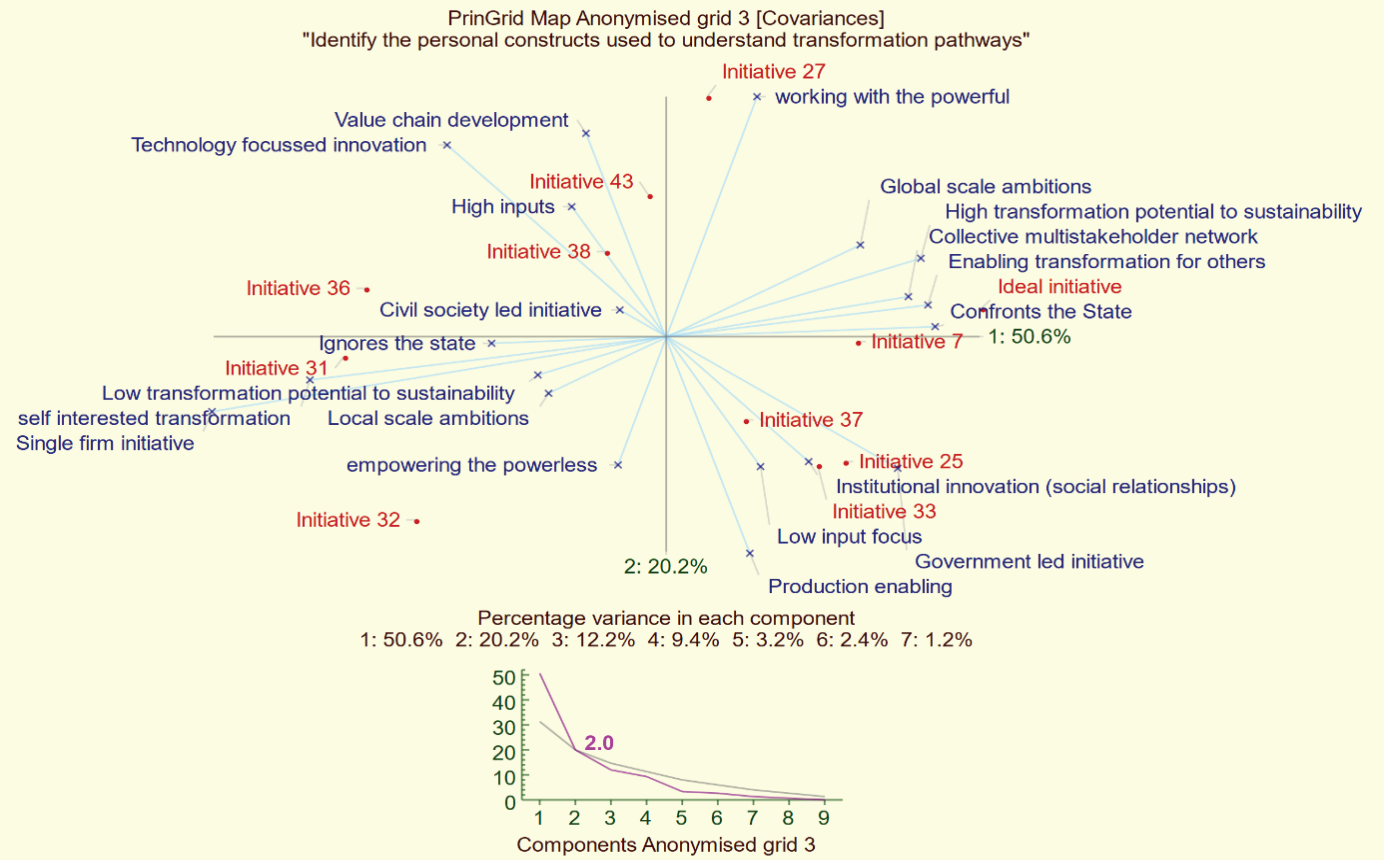
The rows represent the extremes of the constructs identified in the repertory grid procedure. The columns represent the initiatives that are the study elements. The numbers represent the rating of each initiative against each construct, on a scale of 1–7, with the left extreme coded as 1 and the right extreme coded as 7.

Analysis

Jankowicz's (2004) process provided a grid consisting of a comprehensive compilation of all the constructs used by a particular respondent to understand the phenomenon: in this case, transformation toward SFS. This follows the premise that the reviewed initiatives were selected based on maximum variety sampling and thus constitute a holistic perspective on all the distinct pathways toward SFS existing in the respective project areas. The individual grids were analyzed by means of a principal component analysis, which in every case explained more than 70% of the variance on the first two components alone, giving confidence in the comprehensiveness of the compilation of constructs. The principal components analysis results are depicted graphically in a principal component grid map of the first two components, which is also superimposed with the results of a multi-dimensional scaling analysis on the same axes. An example grid map is shown in Figure 2. This graphical depiction indicates the similarity between constructs while also showing the constructs that most closely correspond to the individual initiatives. The graphical depiction of each respondent's results was shown to them immediately following their interview to confirm that the constructs had been correctly understood by the researcher.

Although RGT is a powerful tool for identifying personal constructs for individuals, the outcomes are difficult to collate or analyse at the group level because they are inherently connected to specific examples of the units of study (Jankowicz, 2004): in this case, the case study initiatives. Honey (1979) provides a solution by suggesting the inclusion of a common and broad construct to serve as a reference point, so that distances of the constructs elicited by individuals from this common point can be calculated. The predefined common construct, to which the respondents' personal constructs could be related, was the "transformation potential (high or low)" of each initiative. In a subsequent process, the respondents' personal constructs were analysed in two steps:

Figure 2: Example Grid Map



A correlation coefficient for each construct was calculated using the method described by Honey (1979) to measure the relationship between the individual construct and the transformation potential of the studied initiatives. The correlation coefficient thereby quantifies the extent to which a construct correlates with the transformation potential of the initiative. The strength of correlation was evaluated following Mindrila and Balentyne's (2013) guideline that correlations with coefficient (r) < 0.3 are very weak; $0.3 \leq r < 0.5$ are weak; $0.5 \leq r < 0.7$ are moderate; and $r \geq 0.7$ are strong, although we added a further category of 'very strong' for correlations greater than 0.8.

We used a variation of Jankowicz's (2004) co-recategorization procedure to cluster the personal constructs into thematic groups, which enabled an evaluation of the similarity of each construct with the constructs elicited by the other respondents.

The result of this procedure is a table of the identified constructs, grouped thematically, so that each construct forming the thematic group is correlated with the transformation potential. This provides insight into the relative importance of each cluster in contributing to transformation potential.

Results

The RGT procedure revealed 103 personal constructs, which were grouped according to their content into 11 thematic clusters, shown in Table 1. We present findings focusing on the clusters with the highest convergence among the responding researchers, examining both where respondents agree on describing initiatives and where they diverge in connecting these descriptions to transformation potential.

Table 1: Numbers of Constructs at Different Levels of Correlation with Transformation Potential in Each Thematic Cluster

Thematic cluster	Number of constructs	Level of convergence	Correlation of constructs with transformation potential				
			>0.8	0.65-0.8	0.5-0.65	0.3-0.5	<0.3
Degree of stakeholder inclusion	19	High	16%	11%	5%	26%	42%
Degree of anchoring in farming	16	High	19%	6%	25%	13%	38%
Scope of ambitions	15	High	27%	20%	7%	33%	13%
Orientation to market/supply chain	14	Medium	0%	0%	7%	7%	86%
Degree of autonomy and self-determination	12	Medium	33%	8%	33%	8%	17%
Degree of research integration	7	Low	0%	29%	0%	14%	57%
Input focus	6	Low	0%	17%	17%	33%	33%
Clarity of aims	6	Low	0%	17%	17%	33%	33%
Funding	5	Low	0%	0%	20%	80%	0%
Planned longevity	3	Low	0%	33%	0%	0%	67%

The term 'convergence' refers to the frequency with which the respondents used constructs to describe transformation initiatives in the agri-food sector, as indicated by the number of factors that form the clusters. Clusters with many factors were considered to be highly convergent among the responding researchers in terms of their relevance for explaining transformation pathways. For example, the 'degree of stakeholder involvement' consists of constructs mentioned 19 times by the 11 respondents. In contrast, constructs related to 'planned longevity' were mentioned only three times, suggesting that at least eight of the researchers did not consider them important for explaining transformation pathways. By examining these patterns of convergence and divergence, we achieve our goal of mapping the shared and divergent views of transformation researchers and providing a more nuanced understanding of how transformation pathways are conceptualised in the field of food system transformation research.

However, this provides little insight into transformation potential. To address this, we examine the number of constructs in each cluster that are strongly correlated with transformation potential. The columns in Table 1 indicate groupings of constructs according to the strength of correlation, calculated using Honey's (1979) method, with the fixed term: "Transformation potential to sustainability." The numbers in the table indicate the percentage of constructs for each correlation grouping in each theme. In the case of 'orientation to market/supply chain', 12 constructs (out of 14) correlated very weakly, suggesting that the respondents agree that market/supply chain orientation is important for describing transformation initiatives but that this orientation says little about the transformation potential of the initiatives. Another example is the cluster 'degree of stakeholder inclusion', which contains five constructs that correlated strongly or very strongly with transformation potential but also eight constructs that correlated only very weakly. There is broad agreement among the respondents that the degree of stakeholder involvement is an important concept for describing transformation initiatives. At the same time, however, they disagree on whether strong stakeholder involvement always leads to greater transformation potential. Against this backdrop of understanding convergence and transformation potential, the results are explained in more detail below. We present the

clusters with medium and high convergence (those that include eight or more constructs), which include constructs that most respondents perceived to be important for describing transformation initiatives. We examine the individual constructs within the clusters for possible explanations of disagreement in relation to the clusters' correlation with transformation potential.

The thematic cluster labelled "degree of stakeholder inclusion", which contains 19 personal constructs (see Table 2), relates to the diversity of actors involved in the initiative, the level to which different actors are involved, the diversity of knowledge, and the extent to which deliberation takes place. While researchers consistently used stakeholder inclusion to describe initiatives (high convergence), they showed significant disagreement about whether this factor determines transformation potential. Some respondents perceive 'a high diversity of actors', 'the involvement of people who usually don't work together', and 'not only focusing on involving pioneers and/or open-minded people' to correlate strongly with transformation potential. One aspect of stakeholder involvement is the distribution of responsibility in terms of initiating and implementing the transformation. In this context, 'the distribution of responsibility among many actors in the value chain' correlates with transformation potential according to one respondent. On the other hand, 'the strong involvement of all actors of a regional food system' and/or 'the inclusion of people who are not interested in sustainability' is perceived by others as being correlated rather weakly with transformation potential.

In terms of diversity of knowledge, we see that one respondent perceives 'the inclusion of knowledge from a wide range of sources' to correlate strongly with transformation potential. 'Supporting diversity of knowledge' is also the construct used by another respondent to describe the initiatives' focus on very specialized knowledge correlating weakly with transformation potential. On the other hand, one respondent perceives a 'strong focus on deliberation' to be correlated weakly with transformation potential.

Table 2: Constructs in the Cluster 'Degree of Stakeholder Inclusion' and Their Level of Correlation with Transformation Potential

Correlation with transformation potential	Constructs mentioned by respondents (project partners)
>0.8	- Bringing knowledge from a wide range of sources - Strong focus on targeting a high diversity of actors - More responsibilities across many actors in the supply chain
0.65-0.8	- Collective multi-stakeholder network - Initiative is strong in gathering people who usually don't work together
0.5-0.65	- Actors are included in the process
0.3-0.5	- Strong involvement of all actors of a regional food system - Initiative manages well to gather all the actors that have interest in the issue - Institutional innovation (social relationships) - Inclusive of stakeholders - Very easy to keep up the energy among the participants
<0.3	- More harmonious - Small start-up (vs. Broad alliance) - Includes everyone - Including people who are not interested in sustainability - Strong focus on deliberation between actors within the initiative - Initiative is strongly focusing on involving pioneers, open minded people - Strong focus on peer to peer exchange of very specialized knowledge - Collective with low involvement from producers

The thematic cluster labelled "Scope of ambitions" relates to the extent to which an initiative aims for structural change (vs. adaptation of the current system), the extent to which it considers different aspects

of sustainability, and the geographic ambitions (see Table 3). There is a high level of convergence among respondents, with 16 constructs contained in this cluster, but the correlation with perceived transformation potential varies across the constructs.

The cluster contained seven constructs with strong or very strong correlation with transformation potential, with holistic (i.e., the desired change or transformation takes economic, environmental, and social factors into consideration) and disruptive (i.e., changes taking place at system level, including multiple sectors/products) initiatives being more transformative. Furthermore, constructs related to the scope of reach of the initiatives are perceived by some respondents to be important for transformation, including the aim to scale up or having the ambition to have an impact at a global scale. This is confirmed by constructs related to initiatives being based on pioneer work being perceived to correlate weakly with transformation potential. This perception, however, is not shared by all respondents, as shown by constructs such as 'broad reach' and 'high scope of application (many farms)' being associated with weak transformation potential.

Table 3: Constructs in the Cluster 'Scope of Ambitions' and Their Level of Correlation with Transformation Potential

Correlation with transformation potential	Constructs mentioned by respondents (project partners)
>0.8	- Truly aiming for change - Reconfiguration of current systems - More disruptive - Systematic approach with aim of upscaling
0.65-0.8	- High emphasis on incorporating all aspects of sustainability (combining economic, environmental, social and governmental aspects) - Strong focus on multiple sectors/products - Global scale ambitions
0.5-0.65	- Enabling transformation for others
0.3-0.5	- Highly based on pioneer work - Start-up transformation pathway - Broad reach (national level) - High scope of application (many farms) - Strong focus on the application in an urban agriculture context
<0.3	- Strong focus on implementing multi-functional landscape - Local scope of sales

The thematic cluster labelled "degree of anchoring in farming" contains constructs related to the extent to which the initiatives have strong links to farmers, focus on representing farmers' interests, enable farming, improve farmers' workload, and decrease pressure on farmers (see Table 4). There is a high level of convergence among respondents, with 15 constructs included in this cluster, but similarly to the thematic clusters labelled "degree of stakeholder involvement" and "scope of ambitions", the correlation of single constructs and transformation potential varies. Four constructs correlated strongly with transformation potential: 'emphasis on enabling farming (access to land, funding, knowledge, etc.)'; 'focus on compensating farmers for the risks taken when implementing sustainable farming practices'; 'aims at fairness towards farmers'; and 'initiative reaching a large number of farmers'. Although these constructs underline the importance of inclusion of farmers' voices in agri-food system transformation processes, several constructs only correlated weakly with transformation potential. For example, the two constructs related to the role of farmers in initiating the initiative correlate only weakly with transformation potential. Similarly, initiatives focusing on the agency of farmers and their sphere of influence are also perceived to be correlated weakly with transformation potential.

The responding researchers have varied perceptions of the constructs related to enabling sustainable farming (including aspects related to access to land, funding, compensation of risk, access to markets, knowledge transfer) in terms of their correlation with transformation potential.

Table 4: Constructs in the Cluster 'Degree of Anchoring in Farming' and Their Level of Correlation with Transformation Potential

Correlation with transformation potential	Constructs mentioned by respondents (project partners)
>0.8	- Strong emphasis on enabling farming (access to land, funding, knowledge, etc.) - Strong focus on compensating farmers for the risks taken when implementing sustainable farming practice - Aims at fairness towards farmers
0.65-0.8	- Initiative reaches a large number of farmers
0.5-0.65	- High focus on sharing resources and risks among different actors (related to farm capital/investments) - High emphasis on representing farmers interests towards retail - Strong links to farmers - Action at farm level
0.3-0.5	- Directly interact with farmers - Bottom up generated from a farmer
<0.3	- More farmer participants - Farmers being the most important actor in initiating the initiative - Strong focus on communicating to farmers what other farmers found to be successful farming practices - Farmers played a very important role in initiating the initiative - Strong focus on agency of farmers and their sphere of influence - Strong focus on enabling affordable access to land for sustainable farming practices

The thematic cluster labelled: "orientation to markets and supply chains" refers to the role of markets for the transformation initiatives, the importance of shortening supply chains, the distribution of power among market actors, building relationships with consumers, and establishing new value chains (see Table 5). There are 14 constructs in the thematic cluster, indicating its importance for describing agri-food system transformation initiatives. However, none of the constructs in the "orientation to markets and supply chains" cluster correlated strongly with transformation potential, suggesting that none of the respondents perceived aspects of market and supply chain orientation to be decisive for the transformation potential of agri-food transformation initiatives.

Table 5: Constructs in the Cluster 'Orientation to Markets and Supply Chain' and Their Level of Correlation with Transformation Potential

Correlation with transformation potential	Constructs mentioned by respondents (project partners)
>0.8	
0.65-0.8	
0.5-0.65	- Supply chain orientation
0.3-0.5	- Direct contact with consumers
<0.3	- Whole value chain (vs. Specific products) - Embedded in market that cares about sustainability - Fast reaction to market needs - No marketing aspect - Strong focus on creating of new value chains for short direct selling - Low power of retailers in price making (money that farmers receive) - High power of farmers in price making (money that farmers receive) - Value chain development - Perceive high value in advertising sustainability - Connection with producer community (rural vs. urban) - Set up own marketing channels - Narrow variety of products

The thematic cluster "degree of autonomy and self-determination" relates to the extent to which the initiatives can make a change by referring to autonomy in decision-making and action, and dependency on external conditions, such as legal requirements or governmental support (see Table 6). This cluster contains 12 constructs, so appears to be of medium importance for describing transformation initiatives. The degree of autonomy and self-determination is expressed by constructs about 'confrontation of the state', 'grassroots movements', 'following an overarching (and self-determined) vision', 'ability to make decisions they want', 'few restrictions', 'own funding' and/or 'low level of restrictions by funders'. The degree of autonomy and self-determination is also expressed by constructs related to 'the level of support from laws and regulations', 'government-led initiative', 'working with powerful actors' and/or 'being very institutionalised'. The constructs of this cluster showed the highest correlation with transformation potential, but there is some variation between the individual constructs. Among the constructs correlating strongly with transformation potential, we find mostly aspects related to a high degree of autonomy and self-determination ('no/small lock-ins due to preconditions', 'confronting the state', 'grassroots'). However, one respondent perceives 'legally binding and enforceable processes' to correlate strongly with transformation potential, while another perceives that a 'dependence on external factors' correlates with high transformation potential.

Table 6: Constructs in the Cluster 'Degree of Autonomy and Self-Determination' and Their Level of Correlation with Transformation Potential

Correlation with transformation potential	Constructs mentioned by project partners
>0.8	- No/small lock ins due to preconditions that need to be fulfilled to move forward - Legally binding process/enforceable - Confronts the State - Grass roots
0.65-0.8	- Success of initiative is strongly depending on external factors (e.g. market prices of inputs or consumer demand)
0.5-0.65	- Following an overarching vision (vs. Being heavily influenced by institutional requests) - High ability to make the sustainability decisions they want (e.g. no GMO) - Fully own resources (vs. Fully public funding) - Government led initiative
0.3-0.5	- Working with the powerful
<0.3	- Very institutionalized (controlled by high-level/mainstream institutions) - Low level of restrictions by funders

In addition to the clusters with a medium and high level of convergence among respondents, we also identified clusters that appear to be of less relevance for respondents to describe agri-food system transformation initiatives, including fewer than eight constructs. These are: "the degree of research integration", "the focus on reduction of agricultural inputs", "the clarity of aims", "source of funding", and "the initiatives' planned longevity".

Discussion

Below, we discuss the results by showing how they confirm or contrast findings from existing literature on the transformation of agri-food systems. We seek explanations for contrasts and discuss possible implications for research in this field.

In line with Morrissey et al. (2014), Feola (2015), Hebinck (2018), and De Herde et al. (2022), the respondents indicate a belief that stakeholder involvement is a key element in the transformation of agri-food systems. 'Degree of stakeholder inclusion' is the cluster with the most constructs, and the diversity of actors and knowledge are aspects associated with high transformation potential. However, the results also show that not all respondents necessarily associate aspects of stakeholder inclusion with high transformation potential. One striking finding is that, according to our study, the inclusion of 'everyone', including people who are not

interested in sustainability, does not correlate with transformation potential. This suggests that, according to some respondents, at least a certain common ground must already exist to initiate transformation. Nor is deliberation associated with high transformation potential by all respondents. The experience of food councils and similar direct democratic approaches shows that such deliberation processes are time-consuming and resource intensive. This poses important questions for researchers, managers, and activists seeking to support and accelerate agri-food systems transformation: to what extent, and under which circumstances, should stakeholder inclusion be integrated into processes of agri-food systems transformation? On the other hand, Stirling (2015) might ask how multiple voices and forces of agri-food systems transformation can coalesce toward a common vision without stakeholder inclusion.

There may also be a connection with the difficulty caused by initiatives involving a wide variety of actors having to develop a common vision. In the cluster labelled 'Clarity of aims', we have summarised constructs that also relate to the extent to which initiatives pursue specific objectives, address specific target groups, and/or are adapted to specific contexts. With six constructs, the convergence in this cluster is rather low. Intuitively, one would expect initiatives with clear goals and indicators to be more transformative, but only a few constructs were nominated in this category, and most of them correlated only weakly with transformative potential. Clear goals are important for an initiative to be effective, reach the right people, and adapt to specific contexts, but the results of our study raise the question of whether this expectation of deciding on clear and agreed goals is realistic for initiatives involving different actors with different backgrounds, values, and views.

It is also interesting that the respondents hardly describe the transformation initiatives in terms of the 'what', i.e., the concept or concepts that describe the sustainable agricultural practices to be promoted in more detail. Only six constructs were mentioned in this regard, and these all fall into the 'input focus' cluster, which refers to the efficient use of agricultural inputs. The finding that the concepts are not described in more detail is perhaps because, in terms of participatory transformation, the definition of the 'what' should ideally be the result of a process that involves all the stakeholders concerned (Hebinck et al., 2018). This finding poses the important question of whether transformative actions and interactions need to be planned (i.e., advancing toward predefined aims) or emergent (i.e., developing shared aims with the involved stakeholders). An alternative direction of future investigation could also be to examine under which circumstances transformative actions can be both planned and emergent.

Furthermore, the results show that, despite the important diversity of the actors involved, fairness toward farmers must be ensured. This is also reflected in the large number of constructs relating to the involvement of farmers and the direct link to agricultural reality, which we have summarized in the cluster 'Anchoring in farming'. The general attitude of respondents that farmers or agricultural reality must play a special role in enabling the transformation is in agreement with the results of Weber et al. (2020), but it is less clear exactly what this role might be. For example, we see a low correlation with transformation potential for farmer-initiated initiatives, which contradicts the principle of transdisciplinary processes, which suggests that affected stakeholders should play a central role in (research) projects and that these should be based on, and build upon, their needs (Hadorn, 2008). Constructs that refer to the direct involvement of farmers, their needs, their knowledge, and their cultural traditions, as emphasized by Feola (2015) and Wolfram (2016), do not have a strong correlation with transformation potential according to the respondents who mentioned them (e.g., 'emphasis on representing farmers interests', 'strong links to farmers', 'direct interaction with farmers', 'bottom up generated from farmer', 'focus on agency of farmers', etc.). The possibility of trying out and experimenting with sustainable farming methods, as emphasised, for example, by El Bilali (2018) and Weber et al. (2020) for transformation, was absent from the constructs used to describe the initiatives.

However, constructs were mentioned that relate to enabling sustainable agriculture, although here too there are some that correlate weakly with transformation potential. The constructs that correlate strongly have a focus on access to land, compensation for crop losses, and knowledge transfer. On the other hand, agricultural

policy instruments were absent from the constructs used by the respondents to describe the transformation initiatives, although Klerkx and Begemann (2020) and Linares et al. (2022) particularly emphasise the role of agricultural policy in promoting sustainable agricultural practices. Currently, and in the past, the transformation of food systems has been initiated mainly through agricultural policy instruments, with farmers being the main agents of change (Kuokkanen et al., 2017; Linares et al., 2022). The interviews confirm the focus on compensating farmers for the risks they take when implementing sustainable agricultural practices. Regarding the 'how' of this compensation and enabling sustainable agriculture, the results suggest that proximity to agricultural practice is important, but the degree of involvement of farmers does not positively influence the transformation potential. This point is particularly relevant to the political context: farmers constitute the backbone of European agri-food systems, yet researchers see them as actors with low levels of engagement in agri-food systems transformation. This raises the question of whether farmers have little interest in engaging in a transformation of their own industry or whether researchers are generalizing the example of relatively few 'non-transformative' farmers into a stereotype. An alternative interpretation is that individual farmers may lack agency in driving transformation of agri-food systems. In either case, it will be a challenge of future research to identify the transformative farmers and the visions they are developing, so that lessons can be learned about how to motivate engagement by farmers.

In addition to agricultural policy instruments, focusing on markets and supply chains is another approach to driving agri-food system transformation. The production of sustainable food does not depend solely on factors on the farm but also requires an environment that enables this production, and markets play a central role (Klerkx and Begemann, 2020; Liverpool-Tasie et al., 2020; Saviolidis et al., 2020). This focus was also emphasised by the respondents when describing the transformation initiatives. Interestingly, however, there is clear agreement among the respondents that the focus on markets and supply chains is not associated with high transformation potential. This may be related to a prevailing market logic that is not geared toward the provision of public goods and ecosystem services but rather toward profit maximisation. Respondents nominated constructs to address this deficit, including creating short value chains, direct relationships with consumers, and communicating the sustainability aspects of products, which are aspects that are part of the Alternative Food Networks approach (Goodman et al., 2012). However, few respondents appear to believe that such strategies are sufficient to drive change at the scale that is needed.

The respondents disagreed on how far-reaching the ambitions of individual initiatives should be and whether they should be designed to expand. This points to different transformation paths that exist in certain niches of the system in which the initiatives are located. Initiatives that attempt to change the system from within reach their limits when they are not compatible with the rules of the system. This is shown by constructs in the "autonomy and self-determination" cluster, which correlate strongly with the potential for transformation. The finding that the constructs in the "market and supply chain orientation" cluster do not correlate with high transformation potential suggests the need for political support, such as a change of the rules of the game, to overcome market-related obstacles (Linares et al., 2022). Constructs that relate to resistance to the existing system, on the other hand, are also perceived as very transformative.

These results can be interpreted against the background of the multi-level perspective (Geels, 2002): There are initiatives that seek change within the system (regime change), and there are initiatives that seek a radical break and establish a new niche (which could develop into a new regime of its own). A lack of autonomy and self-determination is primarily a problem for initiatives that seek change from within due to the prevailing rules of the system in which they find themselves. Niche initiatives, such as anti-state and/or grassroots initiatives, have a greater scope for change and a higher degree of autonomy and self-determination, but because they do not play by the rules of the prevailing regime, they have difficulty obtaining funding or generating sufficient market demand for their product.

The finding that both adaptive and disruptive constructs are perceived by the respondents as strongly

correlated with the transformation potential shows that there is no consensus among the respondents on which transition narratives are suitable for the transformation of the agri-food system. Alternatively, this result shows that the transition narratives depend on the local context and the given niche-regime constellation. It is also notable in this context that the respondents do not use any constructs to describe the initiatives that explain the 'why'. However, where transformation initiatives come from and what forces drive them are central to understanding and initiating transformation processes. This points to the need to consider and examine the emergence of transformation of agri-food systems and specific transformation initiatives against the backdrop of the prevailing niche-regime constellation in the local context.

Conclusions

A review of studies on food system transformation suggested that a constructivist approach is appropriate to investigate proposals for transformation pathways (Hebinck, 2018; Feola, 2015; Patterson et al., 2017), and Personal Construct Theory and the Repertory Grid Technique proved to be suitable tools for eliciting the researchers' personal constructs. To our knowledge, there are no studies that have examined the constructs of scientists from interdisciplinary agri-food research projects in relation to the constructs used to describe and make sense of transformation pathways. Using Honey's (1979) method, we were able to bring the individual constructs into a larger picture of constructs that were used to describe transformational pathways. Our findings provide a comprehensive account of the constructs used by transformation researchers to understand and evaluate transformation pathways. However, it is important to remember that the research is not intended to prescribe a distinct ontology and epistemology but rather to stimulate reflection on potentially diverging understandings of transformation pathways. A clear limitation of this study is that it was based on the understandings of 11 researchers in the context of transformation initiatives in European countries, so caution is advised when applying these results in different contexts. Despite these weaknesses, the robustness of the methodology and the selection of respondents produced a rich dataset that allows confidence in the interpretation that may be useful for researchers investigating similar phenomena in other contexts. By identifying areas where researchers' views converge and diverge, we have highlighted the common and contested aspects of transformation pathways, thereby fulfilling the main objective of this study.

According to Stirling (2015) and Scoones et al. (2015), sustainability pathways are influenced by contested values, multiple narratives of change, and the politics of knowledge. The aim of this study was not to create a blueprint for effective transformation pathways but rather to make explicit the constructs that researchers use to understand them. Such an understanding has the dual benefit of directing areas of future research into transformation pathways while also facilitating reflection on the reflexive way our understandings might influence our interpretations and implications of our further research work. In summary, the comprehensive examination of transformation initiatives and project partners' personal constructs delineated crucial elements for the transition toward sustainable agri-food systems.

Constructs strongly correlating with transformation potential were found in the thematic clusters "stakeholder inclusion", "anchoring in farming", "autonomy", and "change ambitions". However, each of these clusters also contained constructs that only correlated weakly. The differences in perceptions of the contribution of the various factors to transformation potential raise important questions about the nature of transformation itself, which warrant further investigation and highlight the complex, multifaceted nature of agri-food system transformation. Key areas for future investigation include:

1. The extent and the circumstances under which stakeholder participation in agri-food system transformation processes can be expanded, and how the diverse voices and forces driving agri-food system transformation can come together to form a shared vision without stakeholder participation.
2. The extent to which transformative actions and interactions need to be planned (i.e., advancing toward predefined aims) and/or emergent (i.e., developing shared aims with the involved stakeholders).

3. The extent to which farmers can actually support agri-food systems transformation, who transformative farmers are, and which transformative visions they are developing.
4. The extent to which the sustainability standards commonly used today provide sufficient information about the transformation potential of initiatives, as they are almost exclusively concerned with the assessment of environmental impacts and, to a lesser extent, economic and social issues. Questions of inclusion and networking, decision-making processes, the distribution of power, and the distribution of responsibility often receive insufficient attention. As a result, interactions in systems that lead to injustice between different population groups are commonly overlooked.

Recognition of the diverse ontological and epistemological backgrounds of these constructs facilitates reflection on potentially contrasting understandings, which has implications for the conclusions and recommendations of research into transformation pathways. By collating these findings through a clustering of constructs and comparison between the different respondents' assessments of transformation potential within each cluster, we have developed a shared understanding of which aspects are considered important to promote transformation.

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