



# The anticipatory governance of sustainability transformations: Hybrid approaches and dominant perspectives

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## ABSTRACT

Anticipation methods and tools are increasingly used to try to imagine and govern transformations towards more sustainable futures across different policy domains and sectors. But there is a lack of research into the steering effects of anticipation on present-day governance choices, especially in the face of urgently needed sustainability transformations. This paper seeks to understand how different perspectives on anticipatory governance connect to attempts to guide policy and action toward transformative change. We analyze perspectives on anticipatory governance in a global network of food system foresight practitioners (Foresight4Food) – using a workshop, interviews, and a survey as our sources of data. We connect frameworks on anticipatory governance and on transformation to analyse different perspectives on the future and their implications for actions in the present to transform food systems and offer new insights for theory and practice. In the global Foresight4Food network, we find that most foresight practitioners use hybrid approaches to anticipatory governance that combine fundamentally different assumptions about the future. We also find that despite these diverse food futures, anticipation processes predominantly produce recommendations that follow more prediction-oriented forms of strategic planning in order to mitigate future risks. We further demonstrate that much anticipation for transformation uses the language on deep uncertainty and deliberative action without fully taking its consequences on board. Thus, opportunities for transforming future food systems are missed due to these implicit assumptions that dominate the anticipatory governance of food systems. Our combined framework helps researchers and practitioners to be more reflexive of how assumptions about key human systems such as food system futures shape what is prioritized/marginalized and included/excluded in actions to transform such systems.

## 1. Introduction

Diverse anticipation methods and tools have been used for decades across different domains - increasingly to support strategy and action toward sustainability transformations (Henrichs et al., 2010; Wiek et al., 2012; Pereira et al., 2019). *Anticipation* can be understood as a general term for formal or informal processes that attempt to make sense of uncertain futures (Vervoort & Gupta, 2018). Foresight methods and tools are most commonly associated with anticipation processes, including, amongst others, scenario planning, visioning and back-casting, horizon scanning, and gaming (Swart, Raskin and Robinson, 2004; Jordan and Turnpenny, 2015; Wiebe et al., 2018). Other methods

and tools not commonly labelled foresight can nonetheless be anticipatory in character, since they explore futures in order to inform policy processes in the present. These include, among others, risk assessment, environmental impact assessment and real-time monitoring of changing sustainability conditions with an explicit future-orientation (Rogers, 2011; Fazey et al., 2015). *Anticipatory governance* as a concept refers to governance processes in the present that seek to use anticipation to engage with uncertain futures in order to guide action in the present (Vervoort and Gupta, 2018; Burch et al., 2019; see also Boyd et al., 2015; Fuerth, 2009; Guston, 2014). A research agenda on anticipatory governance has emerged from across critical social sciences research traditions, including science and technology studies, responsible

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research and innovation, and environmental policy and governance (Muiderman et al. 2020). Salient questions brought up include: whose visions are articulated in anticipation processes, what kind of futures they point to and how these visions have implications for actions in the present (Vervoort and Gupta, 2018)?

Sustainability transformations take place through interconnected and often messy (non-linear) dynamics between environmental, societal, technological and economic systems (Patterson et al., 2017). One key sustainability challenge is transforming the food system to a more sustainable system - both in terms of human and planetary health (Herrero et al., 2020). The framing of 'transformation' is inherently anticipatory as it shifts the focus of practitioners and policy makers to envisioning more sustainable futures and identifying pathways for actions in the present to achieve transformational change (Feola, 2015; Patterson et al., 2017; Burch et al., 2019). In this context, structured, deliberate anticipation processes are considered particularly useful for engaging with the non-linearity and boundary-spanning structure of complex system change through their exploration of relationships between a wide range of drivers of change and the broadening of perceptions of what is possible (Habegger, 2010; Pérez-Soba and Maas, 2015). Just like other key sustainability domains, the food systems domain has seen a strong proliferation of anticipation approaches, from global assessments to local participatory foresight processes (Vervoort et al., 2014; Hebinck et al., 2018; Ingram and Zurek, 2018; Mangnus et al., 2019).

However, futures are not neutral spaces (Selin, 2011). Anticipation processes are sites of political negotiation, where these messy future dynamics are made sense of and processes of prioritization and inclusion are shaped (Anderson, 2010; Granjou, Walker and Salazar, 2017; Vervoort and Gupta, 2018). Despite the seeming consensus that transformation of food systems is needed and anticipation can support these processes (Hebinck et al., 2018; Ingram and Zurek, 2018; Mangnus et al., 2019; Klerkx, 2020), anticipation practitioners often do not specify explicitly or fully what their assumptions about the future are (Vervoort and Gupta, 2018) nor how they hope to intervene in policy and governance contexts (Garb et al., 2008; Henrichs et al., 2010). There is a need to critically investigate how assumptions about the future in anticipation processes impact on present-day actions that seek to contribute to sustainability transformations.

In this article, we connect and mobilize theory on anticipatory governance and transformations to understand how, in practice, assumptions about futures and their impacts on present action shape the anticipatory governance of sustainability transformations in the food systems domain. Our case is one of the foremost global anticipation initiatives focused on food systems change: Foresight4Food. Foresight4Food is a global network of international foresight practitioners working on the future of food security and food systems. To this end, we apply a new analytical framework on anticipatory governance that identifies four distinct approaches to anticipation which have not been empirically tested before. Guided by the framework, we examine the Foresight4Food initiative in terms of (a) how diverse processes of anticipation contain different conceptions of the future, (b) how these conceptions inform policy and governance choices in the present to transform food systems and (c) what ultimate aims are intended to be realized. We then connect this framework with an analytical framework on transformations (Feola, 2015) to further examine how these implicit assumptions about the future steer different approaches to transformations. Through this analysis, we identify which approaches might be dominant, and what they imply for sustainability transformations. By doing so, this article brings to light, for the first time, fundamental assumptions about the knowability and manageability of the future, and how such assumptions are embedded in anticipation work that seeks to guide sustainability transformations more generally, and food system transformations in particular.

The next sections are structured as follows. Section 2 reviews scholarly debates on anticipation and transformations and their

relevance for governing food systems. In section 3, we explain our methodological approach. In section 4, we apply the analytical framework on anticipatory governance by Muiderman et al. (2020) to examine the diversity of perspectives in the Foresight4Food initiative regarding their conceptions of the future, implications for the present and ultimate aims for engaging with anticipation. In discussing our findings in section 5, we connect this framework to the analytical framework on transformations by Feola (2015) to analyze what these perspectives imply for governing sustainability transformations in the food systems domain and beyond.

## 2. Anticipation for food system transformations

There is a growing role for anticipation to guide future sustainability transformations (Burch et al., 2019) amongst others in global norm setting institutions such as the Intergovernmental Panel on Climate Change (IPCC), its Shared Socio-Economic Pathways (Riahi et al., 2017), the UNFCCC, integrated assessment models (O'Neill et al., 2014), UNEP's Global Environmental Outlook, the Millennium Ecosystems Assessment and other assessments (van Vuuren et al., 2012). A recently developed framework on anticipatory governance provides a new lens to analyze fundamental assumptions made in these ongoing practices of anticipatory governance (Muiderman et al., 2020). The framework identifies four approaches to anticipatory governance within social and interdisciplinary sustainability sciences and focuses on three often implicit and under-analyzed elements, namely: (a) diverse conceptions of the future; (b) the implications for actions to be taken in the present; and (c) the ultimate end to be realized through anticipatory governance (see Table 1 below).

Scholarly debates on anticipation and transformation are closely related (Burch et al., 2019) - sustainability transformations are often seen as relying on the envisioning of future pathways (Späth and Rohrer, 2010; Wyborn, 2015; Hebinck et al., 2018). There are, however, different perspectives in transformations literature - on how change happens, and on the role of science in guiding transformations (Feola, 2015; Patterson et al., 2017). We argue that this also leads to different roles for anticipation. Feola (2015) reviewed various literatures to identify different conceptions of, and research approaches to, transformation. Fig. 1 below illustrates these different perspectives on transformations mapped onto two axes: how change happens (from deliberate and actor-driven, to emergent out of wider structural system change), and how the aim of research is framed (from prescriptive to descriptive). Feola characterizes research perspectives as either analytic-descriptive (the below left box) or solution-oriented (the top right box).

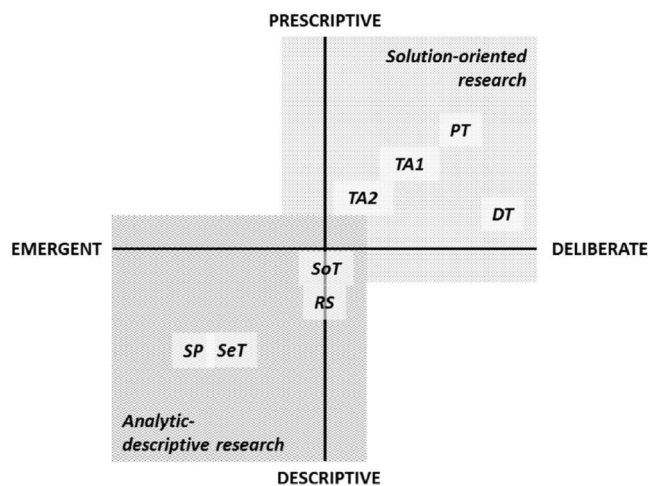
Debates on anticipation and transformation are also connected in the food systems domain. Food systems are generally considered to be in need of drastic transformations, including in terms of climate change mitigation and adaptation (Dinesh et al., 2021). More sustainable food system futures focus on, amongst others, meeting global food and nutritional demands, reducing inequalities in access to healthy food, and addressing its role in environmental degradation and emissions (Ingram, 2011). The concept of 'food system' puts the focus on the interconnected relationships between all activities in the commodity chain, the interactions across scales and socio-economic, environmental, political constraints and impacts (Ingram, 2011; Termeer et al., 2018). Governing future food systems therefore entails spanning the boundaries between the diverse sectors, scales, spheres, and between policy and science (Pereira and Drimie, 2016).

Various anticipation processes are used to anticipatory govern sustainability transformations of food systems. Anticipation processes are generally considered useful for engaging with system-oriented principles such as those of food systems (on synergies and trade-offs, dynamics and reflexivity). More formal and systematic foresight are considered particularly useful to explore the multitude of dimensions, scales and temporal dimensions of complexities and uncertainties of global

**Table 1**

Table 1 shows the four approaches by Muiderman et al. (2020) mapped onto a spectrum of views on the conception of the future (horizontal row) and the implications for the present (vertical row). The narratives delineate the four approaches, including the conception of the future (in blue), the implications for the present (in purple) and the ultimate aim for engaging with anticipatory governance (in black).

WITH WHAT IMPLICATIONS FOR THE PRESENT?	HOW IS THE FUTURE CONCEPTUALIZED?			
	Probable and improbable	Plausible	Pluralistic	Performative
	Planning Assessing probable and improbable futures in order to inform strategic policy planning to reduce future risks			
	Building capacities	Exploring plausible futures in order to build adaptive capacities and preparedness to reflexibly navigate (uncertain) futures		
	Mobilizing		Imagining pluralistic futures in order to mobilize diverse societal actors to co-create new futures	
	Interrogating			Scrutinizing the performative power of future imaginaries in order to interrogate and shed light on their political implications in the present



**Fig. 1.** Analytical framework on transformations (Feola, 2015). The vertical axis represents the spectrum of research approaches that relate to how change is seen to happen, ranging from seeing transformation as a deliberate and actor-driven to an emergent process. The horizontal axis presents the spectrum of research approaches that relate to how transformations research is framed, ranging from more prescriptive to descriptive outcomes. The boxes illustrate where different research communities engaged in transformations research are situated, including deliberate transformation (DT), Progressive transformation (PT), Regime shift (RS), Societal transition (SoT), Social practice (SP), Transformational adaptation 1 (TA1), Transformational adaptation 2 (TA2) and Socioecological transition (SeT).

environmental change to which food systems must adapt (Wiebe et al., 2018). Others have used anticipation processes to help new groups of actors collectively explore options for the radical transformation of food systems, focusing on bottom-up initiatives and including marginalized perspectives (Bennett et al., 2016; Pereira et al., 2021). Anticipation processes in the food systems domain thus take on a variety of methodological approaches in a diversity of methods and tools. They range from global modelling (Mason-D'Croz et al., 2016) and global environmental assessments (van Vuuren et al., 2012) to participatory processes (Hebinck et al., 2018), cost-effectiveness analysis (Landert et al., 2017) and seed initiatives (Bennett et al., 2016) - or combinations of the above (Palazzo et al., 2017) each having their specific foci and limitations regarding what and whose futures can be imagined.

These processes also contribute to different forms of guiding actions in the present. Some discussions are about making food systems more adaptive to global environmental and societal change (Ingram and

Zurek, 2018) and investments have been allocated to contribute to incremental change rather than accelerating transformations (Dinesh et al., 2021). Others have used anticipation processes to help new groups of actors collectively explore options for the radical transformation of future food systems through bottom-up initiatives (Bennett et al., 2016; Koretskaya and Feola, 2020). There are thus diverse conceptions of the future embedded in these processes of anticipation as well as different ideas on how anticipation can guide sustainability transformations in the present. These assumptions give shape to decisions regarding who gets to decide (and how and when) what food system-related innovations are desirable, what change is feasible, and whether the focus should be on incremental or radical change and what parts of food systems (and their political, economic, social and environmental contexts) are included (Duncan et al., 2019). The framework on anticipatory governance (Muiderman et al., 2020) can bring these assumptions about the future to light and their implications for actions in the present. Connecting these findings to the framework on transformations (Feola, 2015) can help understand what these approaches mean for steering sustainability transformations in the food system domain and beyond.

### 3. Methodology

This section describes the methodological approach used for our empirical analysis. We first describe the case study. Then we delineate how we collected the data, through use of multiple methods and explain our comparative approach to the data analysis.

#### 3.1. Case study: the Foresight4Food initiative

We utilize a qualitative case study approach in applying the analytical framework described above to analyze anticipatory governance processes within the Foresight4Food initiative. The Foresight4Food initiative was set up in 2017 at the University of Oxford to function as a global platform for foresight practitioners and researchers working on food system, with support provided by the Open Society Foundation, the Australian Centre for International Agricultural Research (ACIAR), The Global Forum for Agricultural Research (GFAR), French Agricultural Research Centre for International Development (CIRAD)/University of Montpellier, and the University of Oxford. The Foresight4Food initiative provides a connecting platform for diverse independent projects that aim to strengthen food systems foresight analysis through quantitative and qualitative methods and tools and improve the linkages between scientific analysis and policy dialogue with stakeholders (Foresight4Food, n.d.). Conversations within the initiative have particularly focused on transforming global food systems to a more sustainable and resilient path (Foresight4Food, n.d.), for which

some projects use foresight as a way to understand future complexities that allow for adapting current food systems to the impacts of climate change, while other projects have a more normative outlook and focus on alternative food systems futures to challenge and transform the status quo.

For our analysis, we draw on a representative cross-section of these projects, taking into account geographic spread and use of qualitative versus quantitative anticipation methods.

Our analysis documents the viewpoints and experiences of participants in the Foresight4Food initiative during the period January–June 2020. We sent out a survey in January to a selected group of people in the initiative, followed by the organization of a workshop in February and interviews in the period January – June. The Secretariat of the Foresight4Food Initiative (of which two members are co-authoring this paper) selected participants based on (a) practical experience with anticipation processes (the initiative also involves members that are predominantly scholars or policymakers), and (b) engagement with a broad range of decision-makers (including in private and non-governmental organizations). A total of 24 participants, who worked for 19 different projects across the globe, took part in our research. In 3 cases (Sentinel, AgMip and CCAFS), 2 or 3 participants joined, but they were working on different geographical locations or scales, and/or using different methods.

Table 2 below gives overview of the 19 projects that the 24 participants worked for, and a synthesis of the anticipation methods and tools they identified as part of their project.

In terms of geographical spread, survey participants worked across the globe while workshop participants were mostly based in Europe and North America. The Foresight4Food initiative funded accommodation, but participants paid for travel costs, which meant that people working or living close to the workshop location or with a travel budget were able to come. Participants represented projects that are led by a consortium of research institutes and international organizations located in the Global North and/or NGOs located in the Global South, with financial support of donor organizations (such as GIZ and USAID), research councils (such as the UK Research Council and the Swiss National Science Foundation), international agencies (such as IFAD, the World Bank and FAO) and philanthropy (such as the Open Philanthropy Project and the Wellcome Trust). However, the projects mostly work on food systems in developing countries.

In terms of methods and tools of anticipation covered in the studied projects, the two dominant methods were participatory scenario building (17) and quantitative simulation modelling (18). A variety of other quantitative and qualitative methods are employed in conjunction with these anticipation processes, such as financial analysis in the LEAP project, and visioning and back casting and fuzzy cognitive maps in the Sense project. Some projects primarily focus on modeling, such as Poseidon and LEAP, while most combine quantitative and qualitative phases. A qualitative phase can inform a quantitative phase. In the CCAFS Scenarios project qualitative scenario narratives of plausible socio-economic futures with public and private sector stakeholders, which were then quantified using the IMPACT and GLOBIOM models in order to estimate climate impacts and food security changes under these scenarios. Quantitative and qualitative processes can also occur in parallel. For example, IMPRESSIONS, an integrated assessment platform examining what a future above 2 degrees Celsius could look like, used in parallel participatory scenario analysis and simulation modeling to iteratively create scenarios generated by stakeholders. Then, shorter-term policy choices were extracted from visioning and back casting. Also in SUPat, a urban planning project, the quantitative and qualitative phases occurred in parallel. Its agent-based model is a collaborative effort combining the expertise and methods (including simulation tools) of designers, planners, scientists to create scenarios for more sustainable city environments (SUPat, no date).

A few projects combined qualitative methods or used qualitative interpretations of existing sources of quantitative information. An

**Table 2**

Overview of projects and their anticipatory methods, according to participants.

	Project	Anticipatory methods used by participants
1	Agrimonde-Terra	Trend analysis, scenario building with five expert groups using morphological analysis, simulation of scenario impacts on land use, agricultural production and trade through biomass balance model GlobAgri-AgT
2	Poseidon Project	Agent-based model of fisheries
3	Farmers of the Future	Horizon scanning, megatrend analysis
4	Impressions	Participatory scenario analysis and simulation model development, visioning and back casting
5	Senses	Story and simulation, fuzzy cognitive maps, visioning and back casting
6	Social and Environmental Trade-Offs in African Agriculture (Sentinel): 2 participant representing participatory scenarios analysis and quantitative scenario analysis)	Participant 1: Participatory scenario analysis, back casting Participant 2: Simulation land use and land cover, story and simulation, maps of land use change
7	Livestock, Environment and People (LEAP)	Financial analysis of land use optimization, linear mathematical programming of 3 scenarios, cost-engineering framework
8	Sustainable Urban Patterns (SUPat)	Agent-based model, qualitative and quantitative scenarios
9	Agricultural Model Intercomparison and Improvement Project (AgMip): (3 participants representing the Global Economics Model, Regional Economics Model and Regional Integrated Assessments)	Participant 1: Global economic modelling of future food systems scenarios Participant 2: Participatory scenario analysis Participant 3: Scenario used for climate impact assessment for agriculture
10	Food and Agriculture Organization (FAO) The Future of Food and Agriculture	Trends and challenges; Alternative pathways to 2050; Scenario design (narratives) based on identified challenges: stocktaking exercise of internal (FAO) views about emerging challenges for sustainable food & Agriculture, consultative process; Quantification of scenarios models with FAO-GAPS (global partial equilibrium model) and ENVISAGE (Global General equilibrium model, Purdue University)
11	Impact of faster productivity growth	Equilibrium economic simulation model, megatrend analysis, Impact assessment
12	Modular Applied General Equilibrium Tool (MAGNET)	General equilibrium model simulating impacts of agricultural, trade, land and bioenergy policies on the global economy
13	The Food, Agriculture, Biodiversity, Land, and Energy (FABLE) Consortium	Various modeling approaches (crop model, climate model, biodiversity model), impact assessments model, participatory scenario development, simulation gaming, expert consultation, decision analysis under risk and game theory, and artificial intelligence
14	The Food and Landuse Coalition (FOLU)	Simulation of better futures scenario with current trends scenarios and today's situation 2020–2050 through GLOBIOM Model
15	The role of livestock in food system resilience in remote, upland regions (ResULTS)	Semi-structured interview following back casting logic, participatory scenario development, and Delphi studies
16	Rural Affairs Monitoring and Modelling Project (ERRAMP)	Integrated assessment model based on story and simulation
17		

(continued on next page)



Table 2 (continued)

	Project	Anticipatory methods used by participants
	Climate Change Agriculture and Food Security (CCAFS) Program's Futures Scenarios Project: 3 participants representing the work in Africa, Central America, Bangladesh)	Participant 1: Participatory scenario analysis Participant 2: Participatory scenario analysis Participant 3: Participatory scenario analysis, storyline and simulation, quantified in IMPACT and GLOBIOM models
18	Zero Hunger Zero Emissions (ZHZE)	Participatory scenario analysis, storyline and simulation, quantified in MAGNET Model
19	The Brazilian Agricultural Research Corporation (EMBRAPA) Strategic Intelligence System Agropensa	Participatory scenario analysis, megatrend analysis, expert panels

example is the Brazilian Agricultural Research Corporation EMBRAPA, which identifies megatrends that impact Brazilian agriculture through a combination of participatory scenario development and qualitative megatrend analysis based on existing quantitative analyses (Embrapa, 2018). As another example, the Farmers of the Future Project of the European Commission combines horizon scanning with megatrend analysis based on external sources.

### 3.2. Data collection methods

Using the analytical framework on anticipatory governance as a template for our empirical enquiry, we designed a tool to ask questions, which we called a Data Generation Tool (see Annex 1). The tool includes descriptive questions related to the design of the anticipation processes, which we called the 'anticipation space', as well as questions about the three component elements in the analytical framework (Table 1), which we called the anticipatory governance space. Questions in the anticipation space were: (a) What methods and tools were used to engage with the future? (b) Why were these methods and tools chosen? and (c) Who designed, funded and participated? Question in the anticipatory governance space were: (a) How was the future conceptualized? (b) What were the implications for policy action in the present? and (c) To realize what ultimate ends? We used the Data Generation Tool to collect data through several methods, these are discussed below.

#### 3.2.1. Survey

As a first data collection method, we sent out an online survey in Google Forms (see Annex 2) to a targeted group of Foresight4Food community members to which 12 participants responded. The responses to the survey were used to generate a first dataset, but also to test the usefulness of the framework and feasibility of this study's research aims. Each multiple-choice question had an 'other option' based on which we could assess if our categorizations could be related to the experiences of the participants. No changes to the categorizations were needed based on this feedback. The survey also included broader questions about geographical scale in order to get to know the projects better.

#### 3.2.2. Workshop

As a second data collection method, we organized a two-day workshop. A total of 22 Foresight4Food members participated in the workshop, and this group partially overlapped with the survey respondents as eight of the 12 survey respondents were at the workshop. The theory-informed workshop was structured according to each of the six questions in the Data Generation Tool, complemented by a few community building sessions in support of the Foresight4Food initiative. Each session started with a presentation of the literature review and analytical framework based on Muiderman et al. (2020). We then asked participants whether they could relate to each component element in the analytical framework, as well as the literature underpinning it, or if they

would want to add totally different categories (for instance, to complement the existing categories of futures), or change the setup of the workshop program. This did not lead to changes to the framework, since none were seen as needed by participants. Then, for each session, participants filled in responses per question on the blank Data Generation Tool. Participants worked in pairs to stimulate exchange and debate while examining the other's perspective.

#### 3.2.3. Interviews and online communication

As a third data collection method, seven interviews were held during the second workshop day to discuss responses in more detail. The rest were contacted post-workshop. In the following three months, five additional interviews were held, communication with the other 10 participants happened via email. All survey and interview responses were typed into a digital version of the data generation tool (Annex 1) and shared with the participants for their verification and adjustment of responses, and also to encourage them to add new insights that may have emerged after the workshop. These interviews and online communications provided more richness on viewpoints regarding the component elements, and on the relationships between elements.

### 3.3. Approach to the data analysis

We analyzed the perspectives within Foresight4Food initiative using a qualitative case study method. This is a well-established method for looking at complex phenomena in their context (Baxter and Jack, 2008) with sensitivity to the empirical complexity (Flyvbjerg, 2006; Hopkin, 2010) and the diversity of viewpoints (Yin, 2003; Baxter and Jack, 2008). As such, it most suited to analyze diverse perspectives on how explicit and implicit assumptions steer decision making and actions in the present.

We proceeded as follows. As earlier stated, the analytical framework by Muiderman et al. (2020) served as the template for the deductive enquiry (Yin, 2003). During the workshop, we presented the four approaches to anticipatory governance as laid out in the analytical framework after which participants self-identified their position within the diversity of perspectives using the Data Generation Tool, and added new viewpoints. Their spoken accounts were then typed into a digital version of the tool, one tool filled in for each participant, and complemented with responses from the other methods (survey, interviews and online communication). The final tool was shared with participants for verification and adjustment. We analyzed and compared responses to the analytical framework on anticipatory governance, using its four ideal-type approaches as heuristic tools for identifying diverse approaches to anticipatory governance within the community. We finally analyzed how these approaches to anticipatory governance relate to different conceptions of transformations by combining the analytical framework on anticipatory governance with the analytical framework on transformations.

Using several research techniques in subsequent order helped establish an iterative process of exploring and refining research findings synchronously (Baxter and Jack, 2008). This replication logic, in which findings can be confirmed, rejected and adapted, is considered to create more in-depth knowledge and robust findings, as well as the generalizability and validity of data (Verschuren and Doorewaard, 2010).

We also complemented this deductive inquiry with an inductive inquiry by probing participants to reflect on the usefulness of the analytical framework as a whole, its diverse relationships between component elements, and add other possible categorizations. This heuristic process, in which exploration and discovery of new findings are in dialogue, has been considered a key contribution in qualitative case research (Kleining and Witt, 2000).

## 4. Results: anticipatory governance of food systems in practice

This section presents the findings from applying the 'four

approaches' analytical framework (Muiderman et al. 2020) to the case study. It analyzes diverse perspectives on anticipatory governance within the Foresight4Food community, relating to the conception of the future, the ultimate aim and the policy implications. We present the findings regarding ultimate aims before the policy implications, as this order is reflective of how the discussion developed.

#### 4.1. Diverse conceptions of the future

As we explained above, the analytical framework on anticipatory governance that we are applying here identifies four diverse conceptions of the future: probable (and improbable), plausible, plural and performative futures. Any single project the participants worked on embeds multiple conceptions of the future according to participants - approximately two per project. Within this multiplicity, plausible futures are predominantly imagined: 'probable futures' was mentioned 7 times, 'plausible futures' 21 times, 'plural futures' 10 times, and 'performative futures' only 2 times. Participants regarded the fourth conception, 'performative futures' as least applicable to their work. These conceptions of the future give shape to a variety of anticipation processes.

Futures framed by probability/likelihood (approach 1) were most often executed through modeling exercises by incorporating data uncertainties related to the spread of future trajectories. Some examples started with the present and then explored a range of probable futures (e.g. AgMip). Others examples were more normative, and aimed to identify a most desired future within the spread of probabilities.

Importantly, the distinction between approach 1 – futures framed by likelihood/probability and approach 2 – futures framed by plausibility and deep uncertainty was the focus of in-depth conceptual debates, and in some instances, a source of confusion. A large group of participants positioned themselves within the probabilistic futures domain, yet there were different understandings of what probable futures can entail and how one can go about assessing such futures. For example, a few participants critiqued the usage of probabilities in futures studies, stating that probability is merely a statistical application assigned to the data assumptions underpinning any single scenario, not of the scenarios as a whole. These participants emphasized that probabilistic scenario analysis cannot identify a most probable future but only probable occurrences under certain conditions and scenario assumptions. This means that probability assessments can be made for a set of scenarios that are not ranked, but instead all considered plausible. On the other hand, a number of participants commented on incorporating fundamental uncertainty (approach 2) in their analyses, while still sticking to approach 1 framings of prediction and probability. All in all, probabilistic futures work seems on the one hand a well-established category of futures work, yet on the other hand part of ongoing debate, especially in terms of its boundaries with approach 2.

Plausible futures (approach 2) were referred to as 'what-if' scenarios to illustrate their exploratory character. The Sentinel project used uncertainty matrices to develop four plausible scenarios with stakeholders (Zurek and Hebinck, 2018). Stakeholders identified drivers and driver complexity across multiple systems (socioecological, sociotechnical, economic, political, geopolitical etc.), as well as commonalities between them. These matrices served as the backbone for scenario development. What-if scenarios were also used to arrive at a most desired future. In Agrimonde-Terra, a desirable future scenario was introduced for land-use and food security in 2050 and contrasted with the drawbacks of the other four plausible scenarios (Mora et al., 2020). Also, several modelling exercises took plausibility as a starting point, by identifying key drivers underpinning the simulation of scenarios in a participatory process focused on multiple plausible scenarios (e.g. Impressions). Participants explained that global modeling exercises rarely result in normative scenarios, but often in explorative scenarios (of global change patterns), whereas national and sub-national modeling exercises allow for identifying preferred future trajectories. To summarize, most of the work within the Foresight4Food initiative is plausibility focused, but

this plausibility orientation is used to shape how the future is engaged with, often with a strong focus on identifying desirable futures.

Participants who positioned their work as focused on pluralistic, normative scenarios (approach 3) were fewer, yet these participants provided thought-provoking viewpoints. Some participants preferred normative plurality over plausibility, even when they identified plausibility as the focal conception within the project. To these participants, normative plurality is more reflective of reality as scenarios depend on interpretation of the world and are therefore inherently socially constructed (see also Ramírez and Selin, 2014). However, as one participant noted, when projects combine qualitative and quantitative scenario building, plurality gets morphed into consensus in models and can therefore not be maintained: "Models are consensus. They are about probable futures, maybe about plausible futures, but not pluralistic. So, if I say, my model needs data, I implicitly say that pluralism needs to be morphed into something that's no longer there. So, I do workshops, bring people together, start very broad but make one story, a plausible future in which I sweep pluralism under the carpet." (Interview with one of the participants, 7 April 2020).

Models integrate datasets that present data consent rather than plural viewpoints, and as such may represent diverse plausible trajectories but not a plurality of worldviews or worlds. For example, when quantifying narratives, a diversity of information about a wide range of futures with very different accounts and assumptions is translated into something quantifiable and plannable, such as impacts of demographic growth and migration on food availability. Another process of translation is spurred by the widespread use of the global Shared Socioeconomic Pathways developed by the IPCC community as a reference framework for scenario development. These scenarios are five narratives of "plausible major global developments that together would lead in the future to different challenges for mitigation and adaptation to climate change" (Riahi et al., 2017, p. 153). Consolidating scenarios work with the SSPs is considered to increase the robustness of scenarios, but also means that SSP assumptions about global trends can clash with assumptions made by stakeholders at local or national levels. The plurality of futures is thus challenging to maintain throughout the various stages of the anticipatory process.

Only two participants identified performative futures, seen through a critical lens (approach 4), as a conception of the future embedded in their project. Of these projects, one was understood to have combined probable, plausible and performative futures in order to reduce future uncertainties, and was described as thereby using an approach 4 conception of the future to meet an approach 1 ultimate end (SUPat). The second example (The Future of Food and Agriculture) combined plausible futures, and an understanding of futures as performative, by collectively sharing and scrutinizing values and interests as a step towards arriving at a desirable future based on shared values, thereby integrating elements of approach 4 within approach 2 (FAO, 2017, 2018). Apart from these examples, there was least attention for and interest in the performative power that imaginations of the future have over action in the present in the F4F network.

Summarizing the conceptions of the future across the Foresight4Food participants, they predominantly worked with plausible futures, and also with probable and plural futures, including in a number of hybrid forms. A critical lens viewing futures as performative in a societal context was rarely applied.

#### 4.2. Ultimate aims

The framework identifies four diverse ultimate aims: reducing future risks, navigating diverse futures more reflexively, co-creating more (radically) transformative futures and shed light on the political implications of futures. Just like with the first dimension (conceptions of the future), most projects in our case study were reported to pursue multiple ultimate aims for engaging with the future. More than half of the participants (13 out of 24) identified three or more ultimate aims. The

versatile projects consolidate aims spanning the entire continuum of perspectives identified in the framework (Table 1); ranging from risk reduction (approach 1) to shedding light on political implications of future claims (approach 4). In contrast to conceptions of the future, viewpoints regarding ultimate aims were quite evenly distributed: 'reducing future risks' was mentioned 12 times, 'navigating diverse futures' also 12 times, 'co-creating new futures' 10 times and 'shedding light on political implications' 9 times.

Reducing risk involved in future food systems is a core aim for many projects, and almost always mentioned in conjunction with the aim of reflexively navigating diverse futures (approach 2, e.g. Poseidon project), and the aim of co-creating new (and more transformative) futures (approach 3, e.g. ERRAMP), and/or by the aim of shedding light on political implications (approach 4, e.g. Sentinel). Only two participants identified futures risks reduction (e.g. of food insecurities and natural resource depletion) as the sole aim (LEAP and MAGNET).

Reflexively navigating diverse futures is another core aim. It was seen as, amongst others, part of a process in which policy makers can be cautioned of plausible future changes, and also have a deliberative and reflexive process that introduces citizens to innovative new approaches, technologies and practices that are not yet so well-known and attains their buy-in for new policy measures (e.g. Farmers of the Future). Only one project identified the reflexive navigation of diverse futures as the sole aim. This project, IMPRESSIONS, explored the effects of extreme high-end scenarios (+4 degrees global warming and tipping points) in order to stimulate reflexivity in policy instruments and plans by taking such extremes into account.

Many projects in the initiative have the ambition to transform the food system, and consequently quite a few participants positioned themselves within the third approach, without necessarily aiming to radically transform towards new futures. Approach 3 was often mentioned in tandem with approach 1. For example, one project assessed probable futures to pursue, as part of a wider set of aims, the transformation towards a risk reduced future (e.g. Senses). This hybrid points to the consolidation of present futures instead of a radical transformation. Other projects aim, also as part of a wider set of aims, to co-create transformative futures through plausibility thinking in interrogative spaces; thereby they intersect approaches 2, 3 and 4 (e.g. Sentinel). Two projects identified co-creation of new futures as the sole aim, meaning to realize more desired outcomes in terms of sustainability (The Future of Food and Agriculture and Impact of Faster Productivity Growth).

Shedding light on political implications of food systems change was often pursued through probability and plausibility-focused projects (e.g. AgMip at the regional level and CCAFS in Bangladesh). In these cases, such an aim was pursued by scrutinizing scenario assumptions and distributional effects with a group of stakeholders. Such aims were not explicitly related to a belief that future claims have performative power over the present. Apart from these hybrids, no project exclusively pursued an ultimate aim that seemed similar to approach 4.

Summarizing the ultimate aims thus demonstrates that the community works towards an interplay of (on average three) ultimate aims which span the entire analytical framework, based on a smaller set of (on average two) futures conceptions that range from probable, plausible and plural, but not performative futures. While all four aims are equally presented, they are part of interesting combinations in which approaches 1, 2 and 3 are most strongly present. Noticeably projects do not resemble clear connections between the three component elements in ideal-type approaches, but rather merge, blend and omit component elements.

#### 4.3. Implications for policy action in the present

Finally, the framework identifies four implications for policy and governance choices in the present: strategic planning, capacity building, mobilizing stakeholders and interrogating assumptions. As with the

other dimensions of the analytical framework, participants argued that multiple forms of policy action are typically aimed for in a single project. However, informing policy planning stands out. Of the 24 participants, 16 identified informing strategic policy planning as the core policy action in the present; 14 to build capacity and preparedness; only 4 to mobilize stakeholders; and another 4 to scrutinize the political and contested character of futures.

The majority of the participants identified strategic planning as the core type of policy action to be taken in the present. Some of these assertions follow the logic of the narrative associated with approach 1, namely that a future can be made partially knowable based on analytically informed insights, often generated through simulation modeling, in order to recommend policy action that reduces risks associated with a most likely future. It was said that numbers give guidance, and many policy makers seem to appreciate future visions in terms of likelihood and quantifications. Many pursue policy action in an approach 1 mode, but based on futures that relate to the other three approaches. For example, a project might focus on imagining plural futures, but use them in order to provide recommendations and critiques to support the prioritization of policy measures. In such a case, the plurality of worldviews is regarded pivotal to the anticipatory process, but not necessarily seen to be maintained when formulating implications for the present.

Another key form of policy action in the present that participants identified was associated with approach 2: building capacities of decision-makers (as a broad category, including societal organizations such as farmer organizations). Such capacities are seen to be built through, amongst others, the provision of anticipatory tools to better understand and prepare for future changes. Most frequently, participants argued that a mix of approach 1 and 2 is key – for instance, informing strategic planning in ways that also enhances the capacities for preparedness (for instance, in A common Journey).

The present action associated with approach 3: mobilizing societal stakeholders, was mentioned much less often. It was mentioned only by 4 participants, which contrasts starkly with the relative importance of the other two component elements of approach 3 (plural futures and co-creating transformative futures).

The Senses project explicitly identified the mobilization of a diverse group of stakeholders as the implication for policy action in the present, but saw this as part of building their anticipatory capacities for preparedness. The ResULTS and Senses projects also saw mobilizing stakeholders toward new futures as part of strategic planning and interrogating assumptions (merging approaches 1 and 4, Sentinel and ResULTS). The Food, Agriculture, Biodiversity, Land-Use, and Energy (FABLE), combines approaches 1, 3 and 4 in their experimentation with using algorithmic support to identify a country's potential for making steps towards reaching the sustainable development goals and encourage policy makers to be more ambitious. Others used language that can be loosely associated with approach 3 but here used in service of approaches 1 and 2, e.g. democratic stakeholder deliberation to yield a more strategic policy trajectory and building of anticipatory capacities (e.g. Agrimonde-Terra and Farmers of the Future). The key result here seems to be that the fundamental principles regarding plurality and political action underlying approach 3 are abandoned when formulating policy action in the present.

Participants rarely mentioned that the interrogation of political assumptions embedded in future claims (approach 4) was aspired as action in the present, and if so it played a smaller part within anticipatory governance processes more strongly representing approaches 1 or 2. Examples were seeing trade-offs between future choices as contributing to an informed strategic planning process (e.g. ResULTS and Agrimonde-Terra) which participants classified as being related to approach 4. One project integrated two elements of approach 4: it identified performative futures as one of its conceptions of the future, and also aspired to shed light on their political implications in the present, yet for an ultimate aim pointed most strongly in the direction of approach 1 (SUPat). This means that in the few relevant examples in our analysis, the principles



underlying approach 4 were not upheld when it came to guiding action in the present.

Summarizing, while perspectives on the ultimate aims vary, approaches 1 and 2 strongly dominate in terms of the how present action based on anticipation is understood. Although examples were found of policy action associated with approaches 3 and 4, these were much rarer.

Fig. 2 illustrates our findings, based on a few randomly selected example projects, which are presented in the figure with numbers 1–7. One can see there that, in terms of conceptions of the future, many viewpoints align with approach 1 (see projects 1, 2, 5 and 7); most with approach 2 (see projects 2, 3, 4, 5, 6, 7); fewer with approach 3 (see projects 2, 4); and rarely with approach 4 (see project 5). Also, for the policy implications in the present, many viewpoints align with approach 1 (projects 1, 3, 6): most with approach 2 (projects 2, 3, 5, 6, 7); one with approach 3 (project 2); and none with approach 4. While randomly selected, these offer a sense of how participants positioned themselves within the Foresight4Food initiative, their hybrid approaches and dominant perspectives. The ultimate aims are not visualized, but their diversity is explained in the narratives on the right side of the figure.

## 5. Discussion and conclusions

In this article, we examined anticipation processes in the food systems domain - a domain where sustainability transformations are urgently needed. We analyzed a global case study on food systems foresight through an analytical framework on anticipatory governance that identifies four different approaches (Muiderman et al., 2020). The study represents the first global, empirical analysis of different assumptions about the future and their connections to the steering of sustainability transformations across a network of anticipation projects.

Two key insights emerge from the analysis. In this section, we discuss these insights and connect our findings to the analytical framework on transformations (Feola, 2015) to link the four approaches framework to different conceptualizations of transformation.

### 5.1. Hybrid approaches and dominant perspectives: privileging prediction and uncertainty over pluralistic transformation and fundamental critique

The first insight from our empirical analysis is that participants described the anticipatory approaches in their foresight projects and processes to be of a hybrid character, in relation to the four ideal-type approaches presented in the analytical framework. Thus a given foresight initiative appeared to borrow elements from one or more of the four approaches. Understanding such hybridity and its implications is important, because the four approaches represent different fundamental assumptions about the future. For example, notions of probability and plausibility (which underpin approaches 1 and 2, respectively) were interpreted and used in diverse ways. Furthermore, anticipation processes working from a risk/prediction/probability approach to the future (associated with approach 1) also professed to incorporate deep uncertainty into their engagement with the future (associated with approach 2). However, these processes were still fundamentally concerned with prediction. It could be argued that they do not take approach 2's insights on unknowability and uncertainty fully on board (Ramírez and Selin, 2014).

The second insight emerging from our empirical analysis is the dominance of approaches 1 and 2 over approaches 3 and 4, especially in terms of formulating actions in the present. Most anticipation processes in our case study provide recommendations for guiding strategic policy planning (approach 1) and developing participant capacities (approach 2), rather than mobilizing new groups of stakeholders (approach 3) or

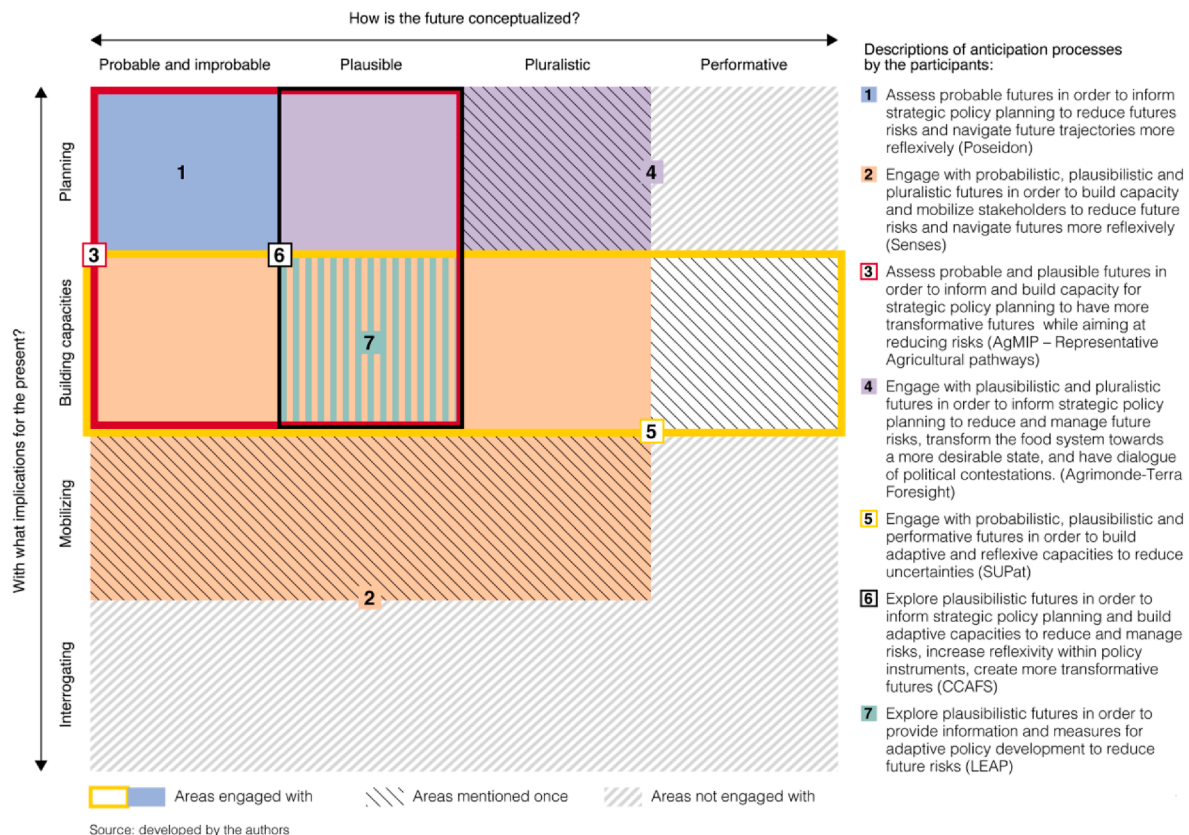


Fig. 2. Examples of hybrid approaches to anticipatory governance in the Foresight4Food initiative. The blocks represent a selection of anticipation processes mapped onto the framework based on how participants described the conception(s) of the future (horizontal axis) and implications for the present (vertical axis). The numbers and colors correspond with the narratives to the right. The striped sections illustrate future conceptions and implications that were not mentioned or only once.



critically interrogating the assumptions underpinning future-related claims (approach 4). Approaches 3 and 4 are (sometimes) seen valuable for the design of the anticipation process itself – e.g. co-creating plural, aspirational futures and the investigation of key assumptions – but not as guidelines for actions in the present.

The first insight above about the hybrid character of foresight processes is connected to the second insight about the dominance of probability and plausibility in the foresight design. Often, imagined futures, created to greater or lesser extent using pluralistic and critically deliberative forms (approaches 3 and 4), are translated into more technical and value-neutral outcomes in policy documents. This implies that the openings that are created for plural and critical dialogue in the design of the process are closed down during the formulation of policy and action (Stirling, 2008; see also Bellamy et al., 2013) and that the epistemologies of approaches 3 and 4 that focus on the constructed and political nature of future visions are abandoned.

On the whole, Foresight4Food participants predominantly argued that more technical and probability-informed actions associated with approach 1 are most comfortable for policy makers and resonated better with the logic of policy environments. The dominance of approach 1 is therefore motivated by the aim to produce policy relevant outcomes rather than what is fundamentally needed to transform food systems. In the ‘present action’ element, the pluralistic and critical tendencies of approaches 3 and 4 that focus on the politics of anticipation are subsumed by approach 1 to fit outcomes into the more value-free and technocratic planning preferences of incumbent actors (such as governments). Decision-makers can then take the lead in making political choices and legitimize their actions based on what they perceive as objective expert-based input.

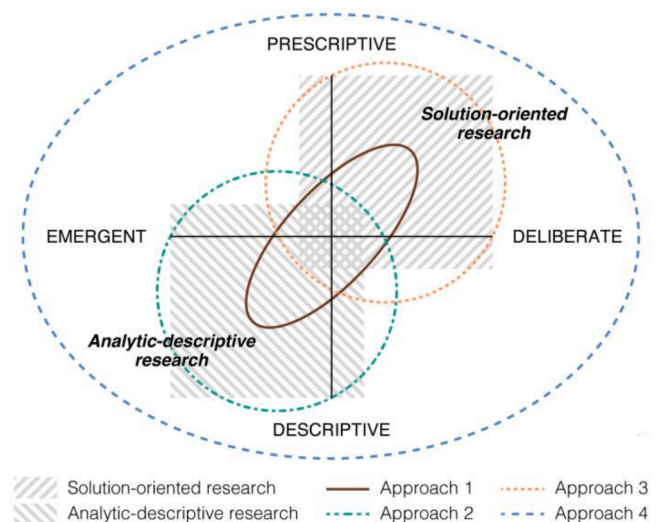
This dominance of approach 1 in the ‘present action’ element contradicts the diversity of stated ultimate aims underpinning Foresight4Food projects, which, according to the participants, cover all four approaches. An important consequence is that several aims might not be achieved or are not fully pursued. While approach 1 action may be strategically effective in some cases, it is also problematic because it risks neglecting the inherently normative and political nature of futures work (Granjou, Walker and Salazar, 2017; Patterson et al., 2017; Esguerra, 2019).

## 5.2. Different approaches to anticipation connect to different conceptions of transformation

We argued above that assumptions about the future have implications for actions in the present to transform food systems. These assumptions about the knowability and manageability of the future are thus ultimately also about how sustainability transformations take place. If so, how do current approaches and practices of anticipation in the food system domain relate to diverse implications for sustainability transformations?

In Fig. 3, we map the Muiderman et al. (2020) anticipatory governance framework onto Feola’s framing of different conceptions of transformation, and the role of transformation research. This exercise reveals that approach 1 can be understood to correspond with emergent and deliberate understandings of transformation, but in a very particular way. This approach sees the future as partly emergent from larger societal processes, but since these processes can be predicted to some degree, the future is also controllable, and therefore, transformations are seen as deliberate in some sense. Approach 1 analyses are intended to be analytical-descriptive, offering analyses of future trends and contextual developments; but they can also be prescriptive, aiming to ‘win the future’ (see e.g. Fuerth and Faber, 2013) based on (partially) knowable future developments.

Approach 2 is largely analytical-descriptive, focusing on complexities and uncertainties to be navigated as they emerge – though this also includes some aspects of deliberate action (actors navigating uncertainty) and of prescription (guidance on the navigation). By contrast,



**Fig. 3.** Figure 3 illustrates the four approaches to anticipatory governance mapped onto Feola’s (2015) framework on concepts of transformations. The vertical axis represents the spectrum of research approaches that relate to how change is seen to happen, ranging from seeing transformation as a deliberate and actor-driven to an emergent process. The horizontal axis presents the spectrum of research approaches that relate to how transformations research is framed, ranging from more prescriptive to descriptive outcomes. These axes identify research approaches as either analytic-descriptive (the below left box) to include perspectives from e.g. social practice and socioecological transition literatures, or solution-oriented to include perspectives from e.g. transformational adaptation and deliberative transformation literatures. The four circles represent the four different approaches from Muiderman et al., 2020 (see Table 1).

approach 3 is mostly solution-oriented and prescriptive, seeing transformations as deliberate action by societal actors and groups based on images of the future in which various stakeholders have agency. However, like its counterpart in approach 2, it also includes some insights on the emergent nature of transformations, and some analytical-descriptive work to support its more prescriptive, deliberate focus. Approach 4 offers a meta-perspective, seeking to understand and open up the assumptions behind various engagements with the future and its concepts of transformation.

Mapping Muiderman et al.’s four approaches onto Feola’s framework offers some key insights for understanding and contextualizing the results in this article, as well as for understanding different approaches to the future more generally. It shows that those working from the perspective of approach 1 overlap to some degree with both approaches 2 and 3. Elements of these approaches are mobilized by approach 1-dominated foresight – in case of approach 2, because of an increasing appreciation of complexity and uncertainty; and in case of approach 3, because of an increasing appreciation for the political nature of deliberate change. In the end, however, approach 1 is based on assumptions about a consensus reality and prediction. This means that neither the full consequences of ‘emergent’ nor ‘deliberate’ drivers of transformation are adopted, even if language and tools from approaches 2 or 3 are used. Emergence, accepted fully, would imply deep, irreducible uncertainty (approach 2); while deliberate change, accepted fully, would imply that many actors are attempting to shape the future, and that futures are plural and political (approach 3). Both perspectives ultimately contradict consensus and prediction.

This helps us understand why approach 1-dominated hybrids cannot fully engage with what is needed for the anticipatory governance of sustainability transformations – and taking the meta-perspective of approach 4 can help make these hidden assumptions visible.

### 5.3. Consequences for anticipatory governance for food systems transformations

The dominance of approach 1 in terms of actions in the present has several important consequences for governing food systems. In general, scholars point to the radical shifts that are needed to deal with the many interconnected sets of food system pressures such as climate change (Maye and Duncan, 2017) in reflexive, democratic and radically transformative food system governance arrangements (Duncan, 2015; Termeer et al., 2015; Pereira and Drimie, 2016; Ingram and Zurek, 2018). Radical food systems change can happen through innovation in more grassroots and alternative movements (e.g. agroecology, vertical farming, etc.) as well within more conventional systems (Maye and Duncan, 2017; Herrero et al., 2020; Dinesh et al., 2021). However, it is considered key to shift perceptions and meaning in order to overcome path dependency and bring about structural change (Termeer et al., 2015). Furthermore, sustainability transformations of food systems require alternative visions in politicized policy processes (Duncan and Claeys, 2018).

These needs clash with the current dominance of approach 1 in food systems anticipation, which appears to result in propositions to transform food systems that are more about incremental adjustments to existing (neoliberal) modes of food systems governance than providing structural adjustments to its weaknesses and system failings (Maye and Duncan, 2017). Anticipation processes in line with approaches 3 and 4 can help include diverse perspectives, mobilize different groups, explore alternative futures and criticize assumptions. Without such pluralistic and critical approaches, voices are lost, perspectives are excluded, action become undesirably top-down and capacities for transforming unsustainable systems are wasted (Hajer et al., 2015; Bennett et al., 2016). Using elements of approach 3 or 4 from a fundamentally approach 1 framing closes down such future possibilities in the guise of opening them up (Stirling, 2008).

### 5.4. Ways forward for anticipation in support of sustainability transformations

Engaging with the politics of anticipation means to embrace that sustainability futures are complex and normative, and this should not be minimized or structured to avoid the relations of power and contestations in them (Duncan and Claeys, 2018). Several interesting (combinations of) methods and tools of anticipation offer key avenues for engaging with ‘who wants what?’. They also make the question of ‘what is possible?’ explicitly political (Escobar, 2020). In terms of approach 3, complementing quantitative and qualitative scenario processes with experiential and creative methods might more effectively mobilize the plurality of views in policy action in the present, by building infrastructures for ‘worldmaking’ or ‘future making’ beyond established pathways (Vervoort et al., 2015; Esguerra, 2019). Approach 3, with its focus on pluralistic, politically aware visioning and the mobilization of actors is currently opening up in a number of different, fruitful directions. Experimenting with experiential futures (Candy and Dunagan, 2017), game design (Vervoort, 2019), and role playing can help support processes of imaginative engagement with the future in ways that empower diverse societal actors to take part in reshaping their futures (Vervoort et al., 2015). Anticipation processes could also be informed by approach 4 thinking by, for example, imagining futures with the specific goal to test and challenge how imagination defines the boundaries of understanding what the future may look like (Esguerra, 2019; Low and Schäfer, 2019). Moreover, approach 4 can be crucial to building critical futures literacy as a skill among anticipation practitioners (Goode and Godhe, 2017; Mangnus et al., 2021). And thirdly, on-going work on the discourses and performativity of futures can be expanded and developed (Späth and Rohrer, 2010; see e.g. Altamirano-Allende and Selin, 2016; Hajer and Versteeg, 2019), including questioning who has agency

to determine future problems and action in the present (Groves, 2017). These approaches can contribute to making futures work more reflexive in terms of assumptions and their implications for action.

Examining the Foresight4Food initiative through the lens of the novel analytical framework on anticipatory governance recently advanced by Muiderman et al. (2020), and connecting it to the framework on transformations by Feola (2015), allowed us to typologize and systematize implicit assumptions and their implications for sustainability transformations within an influential global foresight community on food systems. In the empirical work, the anticipatory governance framework helped to bring to light often-implicit conceptions of the future in the design of anticipatory processes. Participants expressed that applying the four approaches to their work was an ‘eye opener’, which helped to elucidate steering effects of diverse approaches on actions in the present. Secondly, it allowed us to demonstrate that anticipation practitioners use hybrid approaches and that certain perspectives dominate within these hybrids. Connecting the analytical framework on anticipatory governance with the analytical framework on transformations further illustrated how fundamentally different assumptions about the future relate to approaches to transformations.

In conclusion, we believe that the insights of this paper have value for 1) those involved in setting more effective and inclusive research and practice agendas for the future of foresight and anticipatory governance of sustainability transformations; 2) practitioners who want to become more reflexive about the consequences of their visions of, and approaches to, the future and the assumptions behind them; and 3) those working on sustainability transformations and interested in using anticipatory processes for more democratic and radically transformative actions. Furthermore, it also highlights the need for reflexivity about the link between anticipatory practices and the nature, depth and direction of food systems and sustainability transformations.

#### CRedit authorship contribution statement

**Karlijn Muiderman:** Conceptualization, Methodology, Investigation, Validation, Formal analysis, Visualization, Writing – original draft. **Monika Zurek:** Conceptualization, Methodology, Validation, Resources, Investigation, Writing – review & editing. **Joost Vervoort:** Conceptualization, Visualization, Writing – review & editing, Supervision. **Aarti Gupta:** Conceptualization, Writing – review & editing, Supervision. **Saher Hasnain:** Investigation, Project administration, Writing – review & editing. **Peter Driessen:** Conceptualization, Writing – review & editing, Supervision.

#### Declaration of Competing Interest

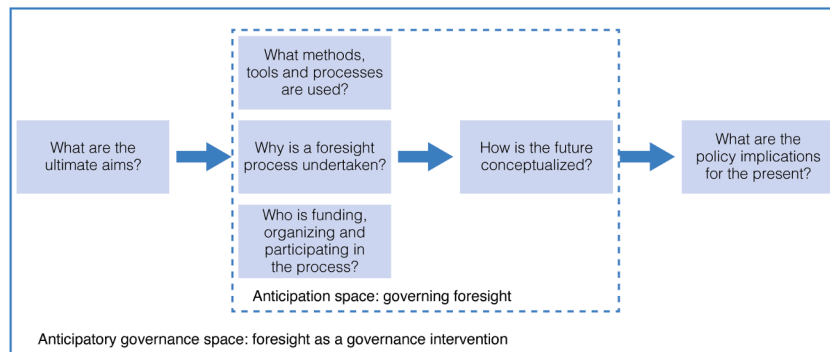
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Annex 1.

**Data generation tool**



Source: developed by the authors

## Annex 2. Survey questions

- Which of the following methods did you use to develop forward looking information to explore the future of food systems? Please describe your most recent process (In case you want to describe another process, please use the option at the end of this form):
  - Simulation model
  - Participatory scenario development
  - Horizon scanning
  - Visioning and back casting
  - Story-and-simulation
  - Megatrends analysis
  - Delphi survey
  - Simulation gaming \* e.g. to experiment with future food systems, governance systems, etc.
  - Role play \* e.g. to explore future interests and negotiations
  - Citizen jury \* e.g. to critically reflect on assumptions embedded in frames of the future
  - Vulnerability pathway mapping \* e.g. to explore factors contributing to future vulnerabilities
  - Prefer not to say
  - Other:
- Did you combine the above method with another method? (e.g. risk-, vulnerability- or impact assessments, scenario narratives). Please note which one(s):
- Can you let us know the name of the process/exercise/project/process? Please also use this space to share any relevant weblinks. If you would like to share an informative document on this, please email
- Which organizations, institutes, companies etc funded the process?
- Could you briefly describe the process, what steps you followed and how in a few sentences? Please also use this space to share any relevant weblinks. If you would like to share an informative document on this, please email us
- Which organizations, companies, etc. were involved in designing the practice?
- Can you briefly describe what interaction you had with your clients? (The people in the governance space that ask you to do the foresight process)
- Were the stakeholders (e.g. policymakers) consulted in the design and/or the content of the process?
  - Yes
  - No
- Please describe how they were involved or co-designed the process (e.g. help with formulating or framing the issue, or identifying, developing or implementing policy measures, or assessing its impact)
- Who were the stakeholders that participated in the foresight process? Were these participants from:
  - Research institutes/Universities
  - National government
  - Research & Development institutes
  - Local government
  - International governmental organizations
  - Civil society
  - Large enterprises
  - Small and medium-sized enterprises
  - Community representatives
  - Farmers groups



- Prefer not to say
  - Other:
11. As a designer/co-designer of the process can you describe how the future was/futures were seen and engaged with in your process? For example: \*
- A most probable future can be approximated
  - Multiple futures are plausible as the future holds fundamental uncertainties
  - Futures are plural - shaped and co-created by those who imagine them
  - Future are performative - assumptions embedded in frames of the future exert power over the present
  - Prefer not to say
  - Other:
12. Did this conception of the future influence any of the following steps in the design of the foresight process?
- Which method was chosen
  - Which stakeholders participated
  - How engagement with policymakers was undertaken
  - How engagement with other clients took place
  - The outcomes of the foresight process
  - The (policy)recommendations
  - Prefer not to say
  - Other:
13. What time horizon was set? \*
- 0-5 years
  - 5-10
  - 10-20
  - 20-50
  - >50
  - 20
14. Why was this time horizon chosen?
15. What was the geographic scale of the process? \*
- International
  - National
  - Local
  - Other:
16. Why was this scale chosen?
17. What were the key issues addressed in the exercise?
- Land use change
  - Food system development
  - Agricultural development
  - Diet and nutrition outcomes
  - Climate change or environmental changes
  - Livelihood Issues (related to agriculture and food)
  - Other:
18. According to you, what was the purpose of the foresight process? Why was this foresight process undertaken? For example:
- To scientifically explore future uncertainty
  - To educate and raise awareness for future risks and opportunities
  - To support decision making
  - To deliberate and mediate conflict
  - To analyse future trade-offs
  - Prefer not to say
  - Other:
19. If you supported decision making processes, please briefly state why and how:
20. What do you think was the ultimate societal aim of the foresight process in whichever governance or decision-making process you supported? For example, the foresight processes was undertaken to aim to:
- Reduce and manage future risks involved in food systems
  - Increase reflexivity within food policy instruments, plans, trajectories, institutions
  - Transform food system towards a more sustainable or desirable state
  - Have dialogue about the direction of food system change and political contestation involved in such change processes, e.g. discussing who benefits, who's excluded
  - Prefer not to say
  - Other:
21. Did you aim to influence any of the following steps in the policy process? \*
- Identify the issue/problem with stakeholders/decision-makers
  - Frame the issue/problem with stakeholders/decision-makers
  - Identify which policy measures are needed and ex-ante impact assessment
  - Developing or adopting certain policy measures
  - Implementing certain policy measures
  - Supporting the effectiveness of certain policy measures and ex-post impact assessment

- Prefer not to say
- None of the above
- Other:

22. Do you know if and how the foresight exercise indeed influenced any of these steps of the policy process? Please describe this impact:

23. Can we approach you for a further discussion of your answers? If yes, please enter your email address below: \*

End of Survey. Many thanks for your input.

Do you want to describe another process? Please click 'Submit Another Response' on the page once you select Submit below

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