31.08.2023

Milestone 2.2

Analytical Framework

Work Package 2 Task 2.2

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1. Executive summary

Milestone (M2.2) provides the Analytical Framework (AF) that will steer the empirical research of the VISIONARY project, with regards to policy interventions (WP3), to novel value chain initiatives and business models (WP4), and to leverage points in the agri-food systems (WP5). AF adopts a novel approach combining two substantially different approaches: quantitative, experimental and behavioural economics on the one hand, and qualitative, comprehensive systems thinking approaches on the other. AF is a key document for the project research flow, aligning the logic behind the research questions and methods chosen. Moreover, the AF draws a connection to the underlying narrative of the Visionary conceptual framework (CF).

The AF aims to strengthen the approach of looking at the whole agri-food system. This will be ensured by using this systemic approach as the frame of reference for all empirical work. Therefore, the development of the AF was used to encourage all researchers with responsibility for a task to disclose their understanding of the system and to consciously reflect on how the research in Visionary can be located in the agri-food system. To this end, 11 qualitative interviews (based on mental model interviews) were conducted internally with responsible research partners. The AF thus supported an internal examination of the project's own understanding of the agri-food-system and allowed the various empirical work to be located within this system. The AF also provides a structured framework for the research questions addressed and the relevant methodological approaches. The AF presents how the research questions of WP3-WP5 address the research gaps identified in the systematic literature review (D2.1). Last but not least, the AF provides an overview of the case studies in which the research questions are addressed and gives in this way a comprehensive overview on our methodological approach.

2. Introduction

This Analytical Framework (AF) operationalize the Initial Conceptual Framework (CF) (M2.1) for our empirical work. The CF emphasis the ambitious to approach the whole agri-food-system within the Visionary project. This system thinking is seen as key element of research on transition of the agri-food system. The CF assembles the project's "theoretical foundations by adopting an interdisciplinary approach bringing together the expertise of the consortium, by integrating in a consistent manner a number of concepts, explaining the systemic character of the food system and its transitions towards sustainability, the role of food actors' behavioural factors in conditioning such transition and the interaction between research and policy-making to accelerate" (CF VISIONARY). One of the key aspects of the underlying narrative of the Visionary CF is that in order to create a research process that corroborates for social transition, transdisciplinary is a key aspect (Conti et al. 2021).

Box 1. The CF underlying narrative (source: M2.1)

Food system transition - which expands beyond mere technological change to include social transformation (Conti et al. 2021) - requires transformative research that aims to deliver on a normative mission promoting change processes (Reisch, 2021). This is our action-oriented focus. For this to be done, particularly in the field of behavioural analysis, Reisch suggests adopting a transdisciplinary research perspective. This would allow a better collective and shared understanding of the behavioural foundations of actors' decisions making in food systems. Moreover, pushing changes in a concrete direction requires feedback mechanisms as allowed precisely by transdisciplinary approaches (Conti et al., 2021).

There is an underlying Theory of Change approach in relation to behavioural-related interventions (Olejniczack et al., (2020), i.e. a specific causal chain about how and why planned activities and interventions – those addressing the cognitive mechanisms of individual actors and their choice architecture – will bring about change for the better. In this regard, VISIONARY focuses on activities and interventions in two interwoven domains: policy-making and business models.

VISIONARY integrates these elements, by combining (i) a system thinking approach, (ii) the findings of behavioural insights - i.e. pieces of knowledge based on empirical findings about behaviour (Troussard and van Bavel, 2018) - stemming from the case studies, and (iii) the multi-actor platforms of Science-Policy Interfaces.

Finally, VISIONARY will explore the way the concept of sustainable business models can become a meeting point of the different streams of knowledge about farmers', consumers' and other food actors' sustainable behaviour, as well as an approach to explore and promote farmers' adoption of sustainable practices.

The CF define key elements of the agri-food-system we want to consider in our VISIONARY project. In the centre are the actors of the whole value chain with multiple interactions. The actors` behaviour have to change for the sustainable transition of the system. The CF define two main domains with high relevance for the change process: policies and the business models characterized by rules and interactions of the business actors (Figure 1). These domains can send behavioural interventions and influence behavioural factors. Behavioural interventions, are understood as policies or initiatives that utilise nudges, education or function as incentives for actors to change their behaviour. In addition, a large range of behavioural factors (dispositional, social and cognitive) will influence actors´ behaviour and ultimately determine sustainability outcomes, i.e. the transitions to more sustainable agriculture and food systems (Figure 2).

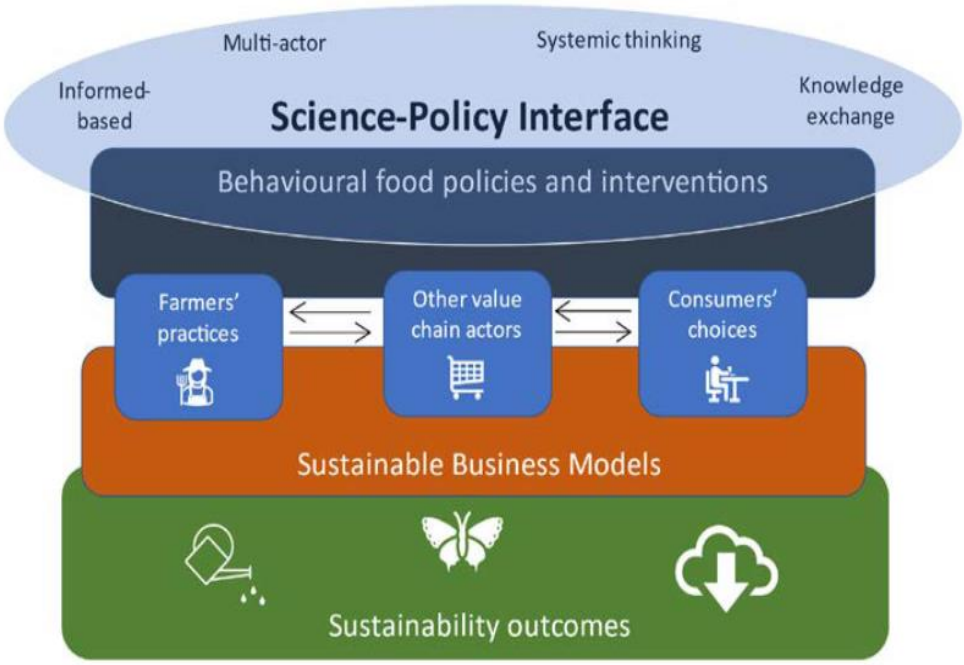


Figure 1 Scheme of VISIONARY Conceptual Framework

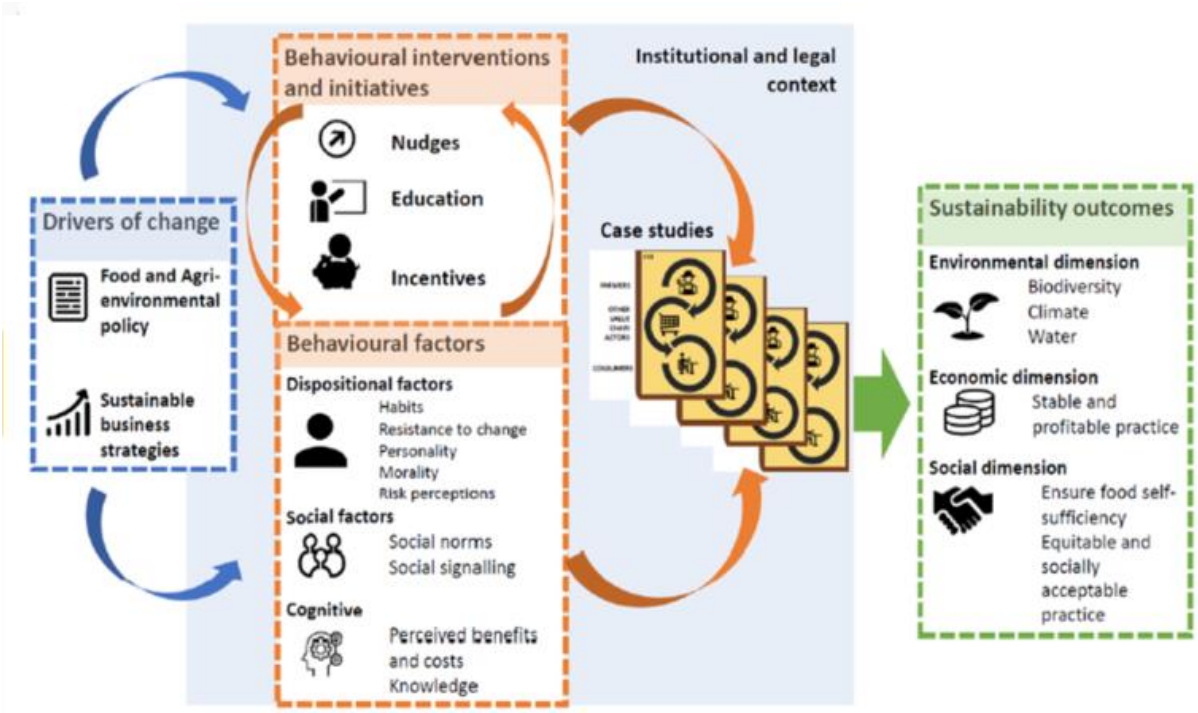


Figure 2 Visionary Theory of Change (TOC) Framework

Based on the CF, we can summarise three challenges for our research to contribute to the transformation of the agri-food system.

1.) We have to focus on the whole agri-food-system.
2.) We have to develop knowledge to understand and influence the behaviour of agri-food actors.
3.) We have to work in an inter- and transdisciplinary mode.

The AF describes how we intend to achieve this ambitious goal.

The AF takes up the key elements of the CF and develops a guiding structure to contextualise the empirical research, including case studies and methods, within the whole food system, and to make the research process coherent. This makes transparent the sub-issues of the agri-food system to which we contribute and how the individual contributions are interlinked. The AF provides an operational roadmap for Visionary. The consistent reference and consultation of the AF by each case study in the project enables a transparent and replicable research process and supports the synthesis of results.

2. Handling the challenges

2.1 Challenges overview

Before we describe the analytical approach to guide and structure our empirical work we want to explain how we deal with the three challenges of the research design derived from our CF.

2.1.1 How do we implement a system thinking?

Figure 3 gives an overview of our approach to integrating systems thinking into our project.

A) **Developing Conceptual Framework and proving structural review of literature**
The conceptual framework provide the underlying theories and put the emphasis on the system thinking approach. The literature review (D2.2) provide a mapping of drivers for behaviour change of the whole food system and connects different strands of literature. The identified potential research agenda strength the system approach. Both task help to develop our common understanding of the agri-food system and the interdependence of the individual components, including the behaviour of the various actors.

B) **Analysing stakeholders and researchers understanding of the agri-food-system**
As part of the development of our analytical framework (Task2.3) we established a reflexing process for leading researchers on their underlying agri-food models using an adapted mental model approach. By doing so we make our own understanding explicit. The results of the process are shown in subchapter 2.2. Task 5.3 discovers the mental models of stakeholders in a broad variety of agri-food contexts. This will help the whole project to develop a common understanding of the agri-food system.

C) **Analysing the whole agri-food-system at case study levels**
Visionary conducts the empirical work in two different types of case studies. One type of case studies tries to understand the whole governance model including actors´ beliefs and viewpoints. Mapping of behavioural and economic experiments within the whole agri-food system.
Another type of case studies focusses on a better understanding of behaviour and the behavioural change of single actor groups (e.g. consumers). In order to follow Visionary's systemic approach, the last case studies are explicitly placed in the overall agricultural and food system by the responsible researchers (see Appendix File Mental Model Interview of Visionary Researchers). This allows a critical assessment of the contribution to the transformative research.

D) **Bringing together different disciplinary expertise and applying qualitative and quantitative methods**
Given the complexity of the agri-food system, a single disciplinary perspective is insufficient to explain what changes are needed in which part of the systems and how to design appropriate

interventions and frameworks. We therefore draw on interdisciplinary expertise from agricultural and environmental economics, behavioural economics, sociology, political science and institutional economics represented in the consortium. VISIONARY will pursue a novel methodological approach to create synergies from combining two substantially different approaches: quantitative, experimental and behavioural economics on the one hand, and qualitative, comprehensive systems thinking approaches on the other. Experiments are increasingly being advocated for evaluation of policy options and payment designs (i.e. incentives), and are credited with producing results quicker and at lower cost than trial and error in real life settings (Lefebvre et al. 2021). However, to become effective, experimental insights need to be integrated with policy cycles, and contextualised with in-depth insights generated from qualitative methods and systems approaches. Only these can reveal the underlying structural challenges such as dominant property rights regimes that hinder the emergence of sustainable food systems (Calo et al. 2021) and entrench lock-ins in value chains.

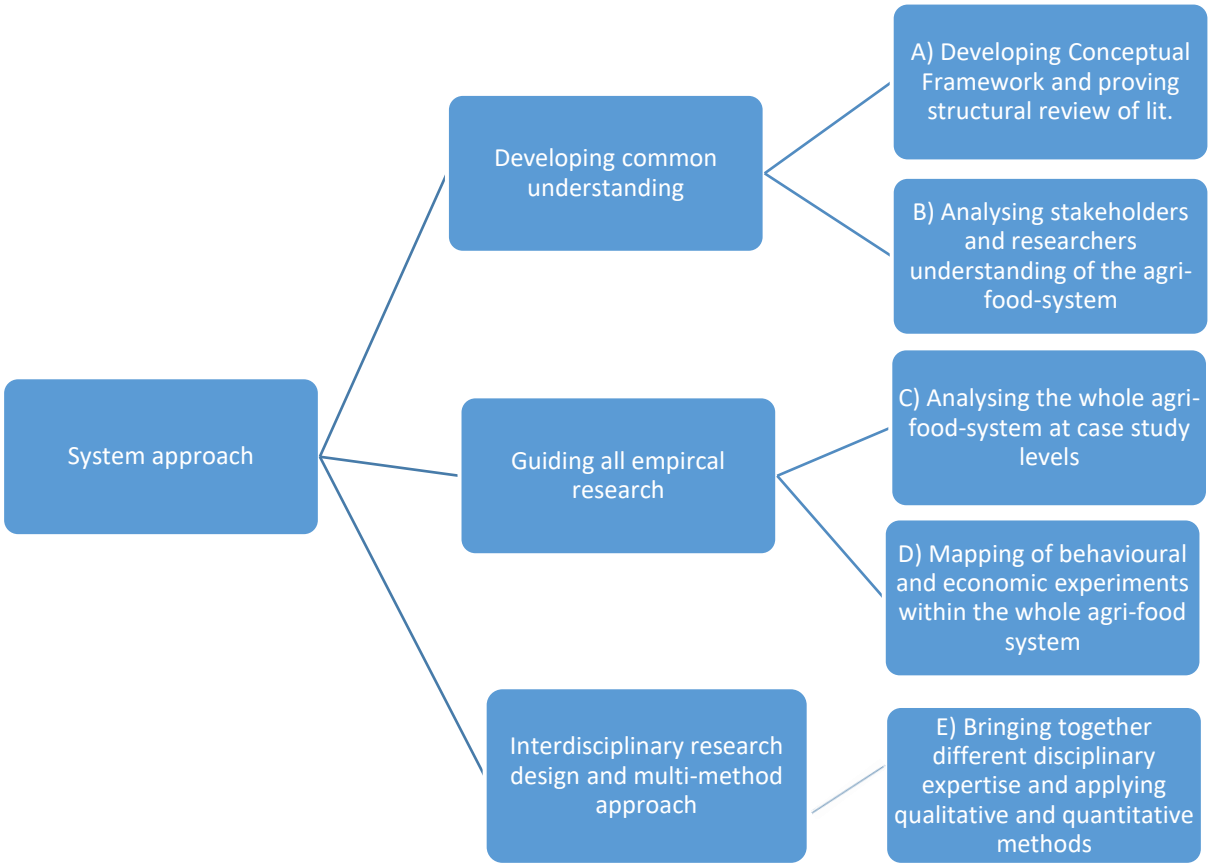


Figure 3 System thinking within the VISIONARY project

2.1.2 How do we focus and design our research to better understand and influence the behaviour of agri-food actors?

Reflecting our CF we use two domains of transition (drivers) towards sustainability to concretize our empirical work: Behavioural Agri-Food Policy and Behavioural understanding of sustainable business models. We choose for agri-food policy three most relevant environmental issues we have to approach by policy: climate, biodiversity and water related agri-food policy. We look at case study level how different policy interventions (would) influence behaviour of farmers. Within the business models we identified three aspects we want to focus to improve our behavioural understanding: better understanding i) of promising sustainable value chain cases and the interaction of diver's actors, ii) of preferences of consumers for sustainable food products and iii) of behavioural change of consumers based on label und nudging interventions. In addition, we look at two agricultural production systems that are currently very relevant to society: plant protein production and organic farming. We want to better understand how we can significantly improve the implementation of these systems by better understanding the barriers and leverage points throughout the value chain.

Addressing the behavioural dimension of the transition towards sustainability inevitably requires focusing on the specific actor groups. From the diversity of actors who make up the food system scientific behavioural literature has focused -almost exclusively- on farmers and consumers, paying much less attention to other relevant actors operating in between (D2.1). We try to address this research gap by using a broader range of methods to analyse behavioural aspects and viewpoints of different actors of the value chain.

Finally, the potential research agenda for food system-related sustainability research identified in D2.1 - Literature-based mapping of drivers for behaviour change in the food system will guide the developing of the concrete research design for our case studies (see Figure 4).

In the next step we will work on the concrete research design of each case study. We can use for this important step results of the first SPI workshops as well as the very helpful overview on the potential research agenda identified in D2.2 (Literature review).

2.1.3 How do we approach a transdisciplinary research mode?

VISIONARY is built on the premise that a change in the agri-food system cannot happen without involving the relevant actors in the identification of problems, and development and testing solutions. Any intervention or recommendation that is only developed by researchers, however theoretically sound, will not generate the impact needed to make substantial shifts in the food system. VISIONARY therefore also takes a transdisciplinary approach, involving multiple actors both in the consortium (academic, NGO, SME), and in its methodological design (empirical scientific work and Science-Policy Interfaces for knowledge exchange with food chain actors). Such a multi-actor approach requires that needs and constraints of stakeholder are incorporated early on, therefore VISIONARY involves stakeholders in the development and fine-tuning of experimental designs and research questions. Analysing stakeholder needs and previous successes or failures is part of the project. These activities, as well as involving diverse participants as data providers, will follow ethical standards and accepted codes of conduct for minimising risk, avoiding harm and maximising benefit for participants. They will also take into account the gender dimension, both in its research design and recruitment of participants, as well as in the organization of stakeholder activities (e.g. timing, and infrastructure provided). This will reduce biases and increase inclusivity.

Figure 4 show our actor-oriented analysis of the agri-food system and the linkages between the empirical work (WP2-WP5) and the other WPs.

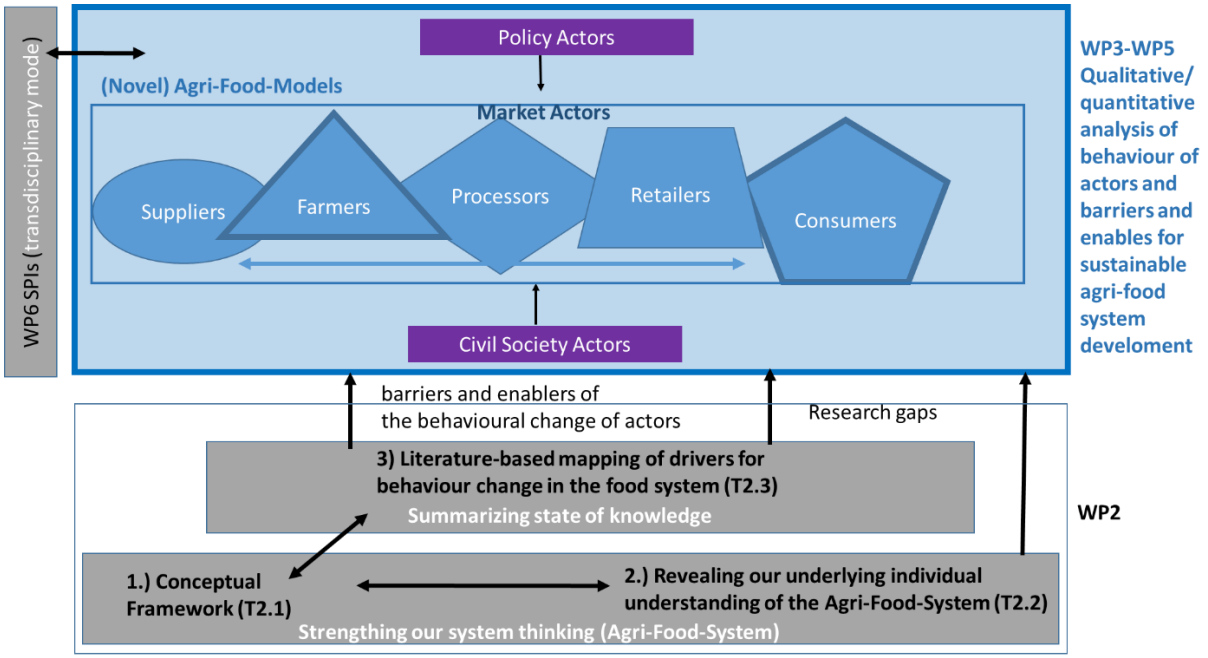


Figure 4 Actor oriented analysis approach of VISIONARY

2.2 Researchers´ understanding of the agri-food system and their own research

Method for revealing our system understanding

We conduct 11 interviews with our leading researchers. The interview structure was inspired by the mental model's approach. In order to set the interview, the basic interview guidelines were inspired in the book by Young (2018). The goals of the interviews are to understand the mental model for the food system transition (and identify what are the common understandings among the scientists), spot where in the mental model the specific method is located, understand the link between the food system representation and the concepts visionary aims at exploring (see Figure 4).

Moreover, the interviews explored the justification for the application of the method and the functioning of the methods with diagrammatic representation. As a result, the interviews shine a light on the lens of the different disciplines and contribute to integrating and delivering clarity not only regarding the focus and scope of the methods but also in terms of interdisciplinarity, exploring the different heuristics –mental models for each of the areas of research and standing points of view. The results of the common understandings (general findings) summing up all the interviewers are presented in the next chapter and the specific mental models in regard to the method allocation and their logic are presented in Chapter 5 following the description of the methods.

Interview Questionnaire
1a. What is necessary to change the current agri-food system? draw a diagram.
1b. What kind of link do you focus on in the food agri-food system?
1c. You may now include concepts from the project theory of change diagram - as many as you judge necessary.
2. Why did you choose to apply your specific method (s) to the food system?

-Think in terms of the mental model you build

3. How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

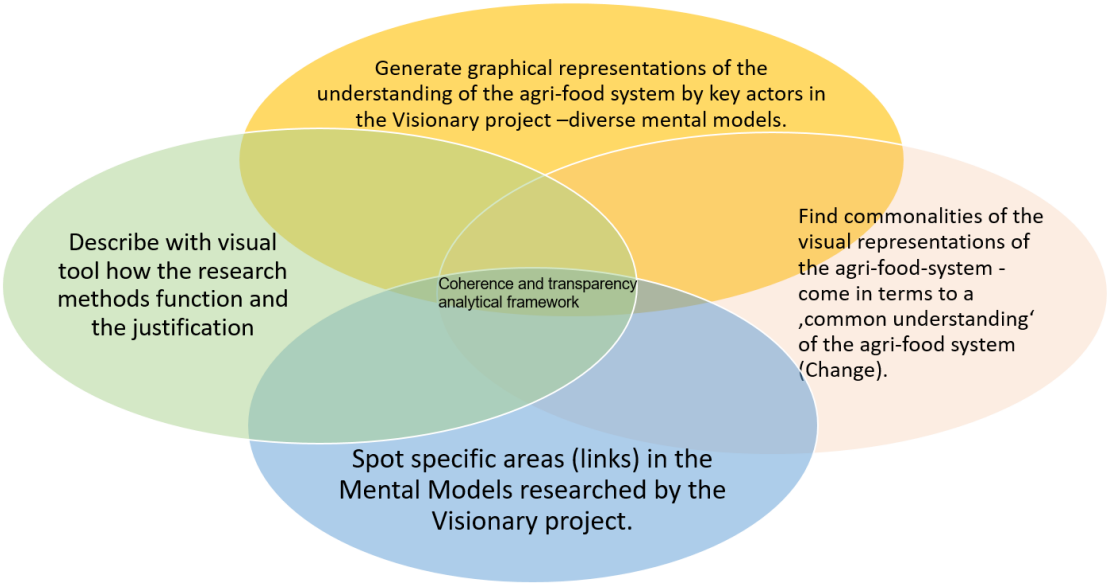


Figure 5 Justification and goal for conducting mental model interviews

Conducting mental-model interviews with our researchers reveals not only our system understanding but it is a process of reflection for each of the interviewees. The results of the interviews will also inform the empirically grounded conceptual framework to be published in month 46.

General Findings

Box 2 presents the general findings of the interviews conducted with 11 project partners from all work packages (with higher participation of partners from WP3, 4 and 5.). For detailed results of the interviews and analysis see Appendix File Mental Interview of Visionary Researchers.

Box 2.

General findings of the Interviews: The common ground of understanding the food system transition towards sustainability

The Problem

Shared Problem Statement: Consensus exists that the current long-chain agri-food system is unsustainable, with variations in the understanding of why and how it is unsustainable among project partners. A key concern is the considerable distances involved in the process, resulting in adverse socio-environmental impacts and consumer alienation.

Homogenization of the Food System: Ongoing concerns about the homogenization of the food system extend beyond differing viewpoints among value chain actors to include oversimplification in agricultural practices, landscape planning, market dynamics, and land use changes. Notably,

powerful retailers and processors are seen as agents contributing to homogenization due to economies of scale (power imbalances). Presented as one of the key points of the unsustainable aspect of the food system: the over-simplification in terms of the agrobiodiversity (fewer crops, decreasing number of small-scale farms in the EU), and processing of food (verticalization of the value chain, decrease of diverse food environments).

Initiating Change: The question of where to commence and direct efforts for the envisioned sustainable transformation of the food supply chain engenders a profound and extensive debate. A substantial subset of project collaborators advocates for two distinct strategic paradigms: either instigating change from the demand side or the supply side, contingent upon their methodological orientations. The intricate and multifaceted nature of this issue has rendered it a "wicked problem," characterized by the absence of a singular, definitive solution. Furthermore, regarding the contribution from the scientific production: certain methodologies, such as the utilization of mental models, demonstrate a cross-cutting applicability across the spectrum of actors involved within the value chain. Similarly, the Q Methodology is positioned as an inclusive approach, designed to engage with diverse stakeholders spanning the entire value chain. A recurrent perspective is that the catalyst for change lies in the cultivation of a shared comprehension of the fundamental challenges inherent to the food system.

The Solution: Food system transition towards sustainability

Anticipated Positive Transformation: The anticipated positive outcomes resulting from interventions within the current agri-food system predominantly center around the aspiration for a healthier environmental impact. However, it is worth noting that many project partners also underscored the compelling importance of social and equity considerations, emphasizing their intrinsic interconnection with favorable environmental consequences. Furthermore, a prevalent argument posits the necessity for a more profound cultural shift, particularly in terms of generational changes in understanding and reevaluating the value system pertaining to the food system. Consonant with this perspective, the integration of various instruments, including incentives, policies, and educational initiatives, is deemed imperative to realize enduring progress. A parallel line of reasoning directs attention towards ethical concerns, identifying them as pivotal focal points in the discourse surrounding transformative change.

Ethical Considerations: Ethical concerns are intricately woven into the expectations regarding the nature and outcomes of positive changes within the agri-food system through interventions. Additionally, ethical considerations invariably intersect with consumer choices and behaviors. As an initial step, it is acknowledged that there is a need to comprehend prevailing choices and behaviors, which would then serve as a foundation for delving into the underlying ethical principles guiding them. It is important to note that, while this understanding is recognized as valuable, it lies outside the purview of the project's scope. Nevertheless, project partners have highlighted the potential for social and transformative learning to engender enduring shifts in mindsets. This transformation can be facilitated through the integration of knowledge, including Science Policy Interfaces (SPIs), among other elements.

Communication and Knowledge Integration: The project places significant emphasis on fostering a shared vision, facilitating constructive dialogues, and promoting the effective dissemination and integration of knowledge within society. Notably, project partners spearheading the implementation of SPIs identify a crucial impediment to achieving positive change: the deficiency in communication channels. They argue that gaining insights into challenges from the vantage point of

diverse stakeholders, such as consumers gaining a comprehensive understanding of the trials faced by farmers and the factors influencing product pricing, holds the potential to elucidate the broader context—a progression towards embracing holistic systems thinking. In this context, incentives emerge as a vital component, with both scientific inquiry and policy formulation recognized as instrumental in fostering effective communication. Furthermore, for a subset of project collaborators, the issue of labels and consumer information presents intricate challenges that warrant dedicated attention and resolution efforts. The exploration of optimal practices for disseminating information is viewed as a means to address the diverse array of consumer preferences and behaviours, thereby engendering positive change.

Consumers as Catalysts for Change or Passive Recipients of Power Imbalances in the Agri-Food System: Regarding this assertion, a spectrum of perspectives emerged among the project partners. Some contend that consumers assume the role of change agents through deliberate choices such as purchasing environmentally friendly products or actively participating in associations or engaging in personal production efforts. Conversely, others posit that consumers are ensnared in a rather challenging predicament where they possess the liberty to select products from retailers but lack the influence to compel the introduction of novel, more sustainable products into the market. In this context, optimism is directed toward the larger market players, with the hope that they will opt to invest in the development of new, ecologically sustainable products.

Transitioning from a Large-Scale, Homogeneous Model to a Smaller, More Diverse, and Locally-Oriented Approach: Several project partners endorse a dualistic framework for conceptualizing change—one that encompasses the present state and the envisioned future state of the agri-food system. Within this alternative paradigm, various approaches are delineated by the partners. One prevailing perspective revolves around the distinction between long value chains and short value chains as alternative models. In the context of long value chains, smaller enterprises, such as local gastronomic establishments, and consumers who engage in practices like self-sufficiency through local gardens, collaborate more closely within their respective locales. This viewpoint finds resonance among other partners who advocate for self-organized or small-scale projects and businesses as an alternative, emphasizing their capacity to facilitate nutrient cycling and mitigate transportation costs. Nonetheless, a small subset of project partners introduced the notion that the impact of these localized approaches extends beyond the local sphere and exerts a global influence and the trade-offs of how the transition is implemented should take into consideration to avoid global socio-economic backlashes. For example, enhancing self-sustainability within Europe may have repercussions on the countries where the economy depends on the production of food commodities and exports mainly to the EU.

Absence of Prescriptive Recommendations for Action: It is noteworthy that most of the interviewees did not articulated definitive directives regarding the course of action to be pursued. Instead, they proffered methodical approaches to address particular issues, often within their specialized domains of knowledge. While this observation may seem self-evident, it emphasizes the complexity inherent in the problem under consideration, emphasizing the necessity for a holistic systems thinking approach. Furthermore, all interviewees underscored the significance of intersectoral interactions within society and the imperative for meaningful discourse on the subject, thereby reaffirming the rationale underpinning the project.

The VISIONARY research approach to support a sustainable transition

Empirical Validation: A compelling argument advanced by many project participants centers on the notion that the Visionary initiative will yield empirical data for substantiating constructive alterations within the agri-food system. This perspective further rationalizes the significance of scientific production as an influential tool for enabling the transition. The term "ground proofing" is occasionally intertwined with discussions related to the verification and validation of Social Practice Indicators (SPIs) and experiments. This convergence occurs as semi-contextualized experiments, including those conducted in supermarket settings, approximate real-world conditions—aligning with everyday life and policymaking contexts. Consequently, the Visionary project is positioned to generate scientific outcomes that are more closely attuned to actuality. The combination of SPIs and experimentation serves as the foundation and the pivotal distinguishing factor of Visionary relative to other scientific undertakings, as underscored by numerous interviewed project collaborators.

Holistic Perspective: The mental models employed uniformly emphasize the intrinsic entanglement within a larger system, encompassing political, social, environmental, economic, and cultural dimensions. Furthermore, the interactions among various actors were depicted as intricate, and, notably, during the course of the interviews, most participants progressively recognized the interplay between all actors and processes—a manifestation of comprehensive, holistic thinking. In summary, within the Visionary project, collaborators perceive the agri-food system as a multifaceted, dynamic, and holistic predicament confronting European and global society.

Challenges Associated with Solely Emphasizing Economic Incentives: Analogous to the discourse on oversimplification, the application of a singular, uniform economic incentive or policy is deemed inadequate. Instead, a comprehensive policy framework, encompassing a spectrum of diverse incentives and interventions, including educational endeavours, should be explored. Economic incentives, while acknowledged as valuable tools, are regarded with a degree of scepticism due to the complexity of gauging their capacity to induce enduring, sustainable behavioural changes. This scepticism, however, should not be construed as undermining the utility of economic incentives; rather, it accentuates the desirability of supplementing them with complementary methods, consistent with the principles of systems thinking. In the context of farmers, economic incentives are particularly pivotal, especially if tailored to address the diverse needs within this demographic. Farmers, viewed as a group confronted with formidable barriers to change, benefit significantly from economic incentives. An intriguing line of argumentation posits that pricing constitutes a fundamental predicament across the entire value chain. The proposition of instituting comprehensive pricing accounting, akin to a total life cycle analysis, is raised. Such an approach would inherently favour the affordability of the most sustainable agricultural products, with their prices reflecting the internalization of various costs, including those associated with chemical additives, transportation, health concerns, ethical considerations, and more.

The Market as a Nexus of Social Interactions: Within the agri-food system, all participants engage in transactions as both buyers and sellers, given that every individual partakes in the consumption of agricultural products in some form or another. It is imperative to consider this interaction not solely within the confines of customer surveys but also within the broader social and economic context that envelops these actors. In this context, the issue of power imbalances assumes paramount significance, particularly in the context of lengthy value chains. It is noteworthy that producers, in general, occupy a relatively marginalized position within the overarching system, and their narratives often diverge significantly from those of other actors within the value chain. Additionally, the influence and interference exerted by intermediaries in the value chain should not

be underestimated, extending beyond retailers to encompass lobbying activities, the food marketing industry, transportation, and other spheres.

3. The implementation of the analytical framework

VISIONARY wants to make a difference in food system transitions, contributing to radical rather than incremental change (Runhaar 2021), by identifying what factors underlie the path dependencies and 'lock-ins' in current unsustainable food systems, and showing how these can be overcome. The project will learn from existing initiatives that are still niche and small-scale and investigate the barriers to scaling up and out. By means of experiments, VISIONARY will generate data on the same sustainability transition in different contexts (countries and value chains). For selected and promising transitions, VISIONARY will tackle both policy and business shifts that are necessary to make a change.

VISIONARY utilises a range of methodological approaches from behavioural and experimental economics, empirical social sciences and systems thinking in order to improve understanding of lock-ins and levers, opportunities for developing more sustainable farming systems, and factors driving the decisions of consumers, value chain actors, policy makers and farmers. The two-pronged approach of a) a behavioural economics approach to farmers and consumers decision making (incorporating nudges and other behavioural instruments), and b) a system thinking approach using a wider systems governance lens in case studies will allow for cross-checking, embedding, and validating the findings of the other, and for highlighting divergence (which is equally important).

To operationalise the agri-food system in the methodological approach, VISIONARY adopts a food system typology centred on its fundamental components: the links between food value chain - food environment - consumer behaviour (HLPE, 2017). European food systems are dominated by long value chains, but place-based food systems are also important to include in the methodological approach as they have the potential to link consumers' preferences for sustainable produce more directly to sustainable farming practices and improve mechanisms to recognise local environmental constraints and opportunities to support local economies. VISIONARY case studies therefore focus on both, long value chain systems and place-based food systems. In the latter type, a diversity of food value chain actors interacts in a regional geographic space and are coordinated by territorial governance, so that consumers are connected to the environments and people producing food (Klassen & Wittman, 2017). A simple form is an intermediary organising an online platform for selling produce of several farmers. Farmers keep having relevant decisions-making power in place-based food systems. In long value chain systems, downstream actors (processors, retailers) play a central role in deciding the terms of production and the portfolio of produce.

In its case studies, VISIONARY studies a range of behavioural interventions that can be applied in the food system ranging from pure public measures to private initiatives by companies, NGOs and trusts along the food value chain. These interventions fall under different types including nudges (an intervention which leads to a predictable change in behaviour by reinforcing the intentions to act in a sustainable way or by indirectly suggesting adoption of new practices that are easy to implement and do not fundamentally change the incentives of individuals or groups of individuals); educational interventions (providing information and facilitating access to information with the purpose to change the knowledge of decision-makers to enable them to take more sustainable actions, including farm extension services, information campaigns, knowledge brokers and facilitation); and alignment of incentives with sustainability outcomes (includes both economic incentives via public or private

schemes, and the role that social norms, attitudes and moral justification have in economic decision making).

Importantly, this typology has been used to guide the selection of experiments in WP3-5 (see figure5 for type of intervention in the experiment), but a whole governance approach has been used for selecting the case examples of initiatives that will be studied more qualitatively (see Figure 4 or table 1). These cases are not about studying a particular intervention introduced by the project, but investigating promising examples that currently exist and have the potential for upscaling and out scaling (see figure 5). In real life systems, transitions may include a mix of behavioural drivers, and understanding their interaction is important for developing more effective policy and successful business models. We also acknowledge and utilise synergies from the overlap in factors that will be studied in each case (e.g., incentives, education to increase knowledge, social norms) which will form the basis of a comparative framework.

VISIONARY conducts ex-ante valuation of the effectiveness of proposed policy interventions (using experiments) as well as ex-post valuation. The latter is conducted after the intervention is implemented and can inform decision makers regarding the degree of successfulness of the intervention in achieving the desired behavioural change. The latter can only provide a limited amount of information about factors that have facilitated or prevented the success of the intervention and about the effectiveness of alternative policy designs since it is often not possible to run a counterfactual analysis. In contrast, ex-ante valuation is conducted before the policy intervention has been implemented and can help policy makers in identifying the most cost-effective policy design to achieve the desired outcome. This type of analysis allows the study of lock-ins and levers of behavioural change, and it is best suited to provide a counterfactual type of investigation.

The range of methods used to understand the behavioural response to intervention ex-ante is wide but can be categorized into three main branches: Discrete choice experiments (DCE), economic experiments (EE) and randomized controlled trials (RCT), all of which are applied in VISIONARY as appropriate.

Based on our CF we use two domains of transition (drivers) towards sustainability to organize our empirical work: Behavioural Agri-Food Policy (WP3) and Behavioural understanding of sustainable business models (WP4). Beside this we explicitly focus in one WP on a system change approach and look at a systemic change on the production side (WP5). The empirical work is framed from our Science-policy Interfaces in WP6.

For a more comprehensive exploration of the work packages including scope, methodologies, strategy and overarching research questions refer to Appendix 1.

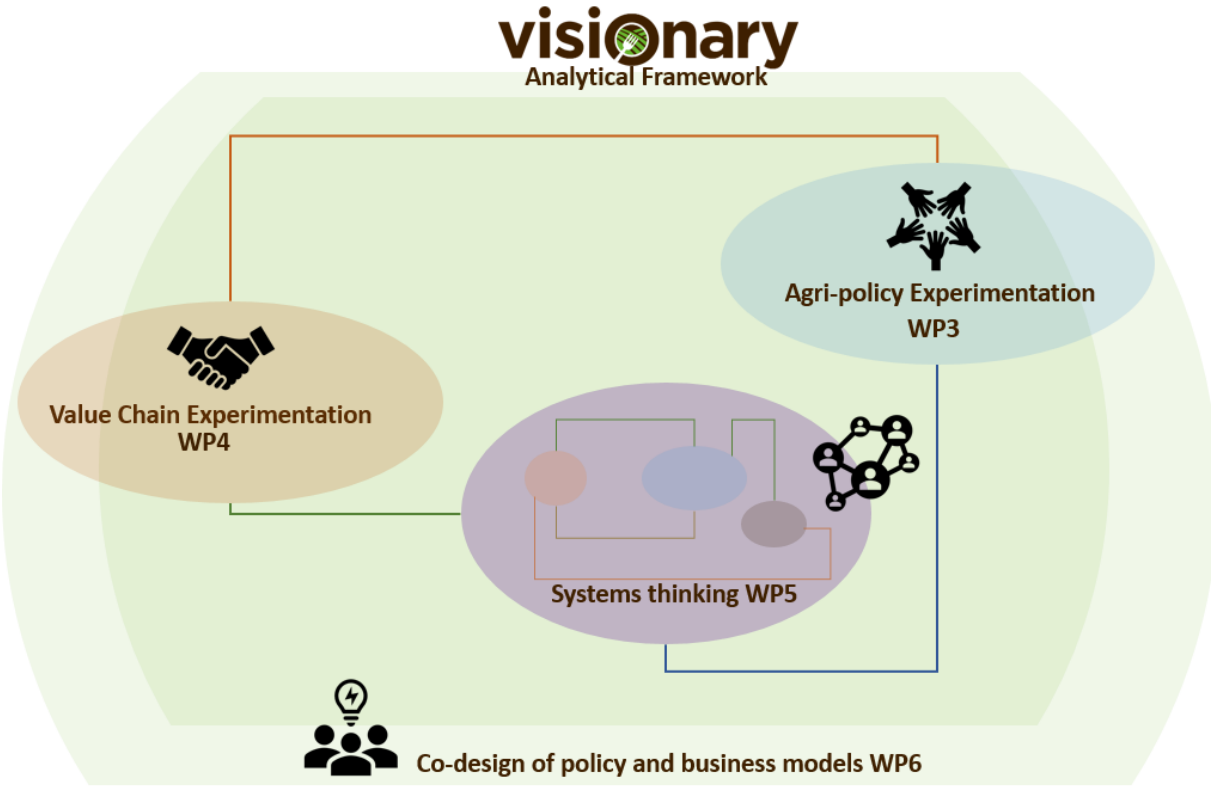


Figure 6 VISIONARY Analytical framework regarding work packages.

(Dark green concerns the research-focused work packages, and light green represents the underlying transdisciplinary approach).

Moreover, Table 1 gives an overview on our case studies and applied methods in the different WPs. All this case studies and methods are mapped within the agri-food system based on our mental model interviews with our researchers (see Appendix File Mental Model Interview of Visionary Researchers). The different case studies are described in more detail below and visualized in Figures 7-14.

Chapter 4 explains key methods used for VISIONARY in more detail and give some justification for using the specific method.

Table 1: Overview of VISIONARY case studies

Cluster of Transition	(No of case studies) Location	Methods	Object of analysis	Case study comparison	WP/ Task
Policy transition pathways (WP3)					
Climate/ carbon Behavioural intervention: incentives	(2) Italy, Denmark	Contextualised Economic Experiment, Focus Groups	Behavioural change of farmers	Yes (different contexts)	T3.2
Biodiversity Behavioural intervention:	(4) Germany, Spain, UK, Poland	Choice Experiment, Focus groups, Key informant interviews	Behavioural change of farmers (preference	Yes (different contexts)	T3.3

incentives/ nudges			based) and of policy makers/ administrators (qualitative assessment)		
Water Behavioural intervention: incentives	(3) Hungary*, Spain, Denmark	Comparison of behavioural approaches to study collective action: Contextualised Economic Experiment, Focus Groups, Ex-post policy evaluation, Choice Experiment, key informant interviews, Agent-based modelling	Behavioural change of farmers	Yes (different approaches)	T3.4
Sustainable business model pathways (WP4)					
Value chain	(7) Romania*, Hungary, Denmark, Germany, UK*, Poland*, Spain*	Mixed qualitative (focus) and quantitative methods and comparative analysis	Drivers and barriers of the governance model	Yes (different approaches)	T4.2
Consumers	(6) Denmark, Italy, Germany, Poland, UK, Spain	Experimental preference elicitation methods (consumer experiments embedded in online surveys)	Behavioural change of consumers (preference based)	Yes (different contexts)	T4.3
Retailers Behavioural intervention: alignment of incentives/nudges	(?) Denmark, Italy, Germany, Poland, UK, Spain, Hungary and/or Romania	Field experiments testing consumer nudges in real retail stores	Behavioural change of consumers	No?	T4.3
Production system pathways (WP5)					
Plant-based protein	(4) Denmark*, Germany*, Spain, Poland	Q study, Key informant interviews	Drivers and barriers in the production system - Leverage points within the governance model	Yes (different contexts)	T5.1

Organic farming	(4) UK*, Germany*+, Poland*, Hungary*	Factorial Survey Experiments, Focus groups, Key informant interviews	Drivers and barriers in the production system - Leverage points within the governance model	Yes (different contexts)	T5.2

*input for the research design from SPI (T6.3) – strengthening the transdisciplinary approach; + input for the research design from mental models of food systems of stakeholders (T5.3) – strengthening the system thinking approach

3.1 Case studies on policy transition pathways (WP3)

3.1.1 Case studies on climate/ carbon neutral

Do financial policy instruments work in the farming sector? Carbon markets and taxes have been used by many EU member states to reduce greenhouse gases emission in some sectors of the economy, but never in agriculture. Two case studies conducted in Italy and Denmark explore farmers' response to the introduction of these market-based instruments in agriculture and examine behavioural mechanisms that mediate such response. The case studies also test the potential ability of such instruments to reduce greenhouse gas emissions from agriculture via the adoption of innovative technologies and more sustainable production practices by farmers. Experimental economic approaches are used to study farmers' behavioural change and attitudes.

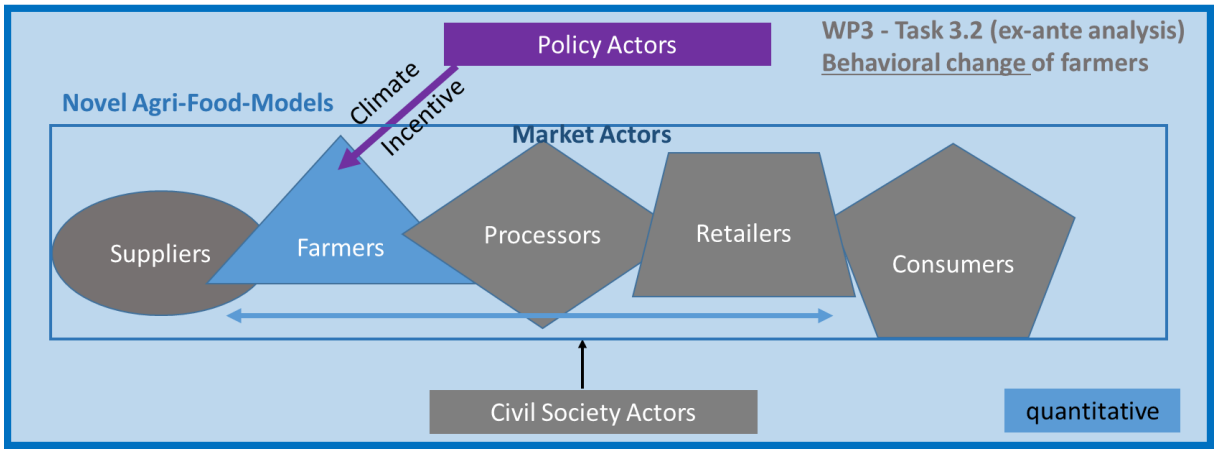


Figure 7 Empirical approach in Task 3.2

3.1.2 Case studies on biodiversity

Food production plays a vital role in protecting our planet's biodiversity. But how can we make agri-environmental climate measures more appealing to farmers? The cluster on biodiversity-friendly food systems analyses targeted (also often called "dark green") agri-environmental climate measures such as buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls, or ponds. In four case studies, we investigate whether the attractiveness of dark green measures for farmers´ increases if the performance of farmers is made visible via a label approach, and/or market advantages can be realised via higher prices or better purchase conditions. A Discrete Choice Experiment (DCE) is conducted in Germany, Poland, Spain, and the UK to investigate farmers' preferences for such governmental label.

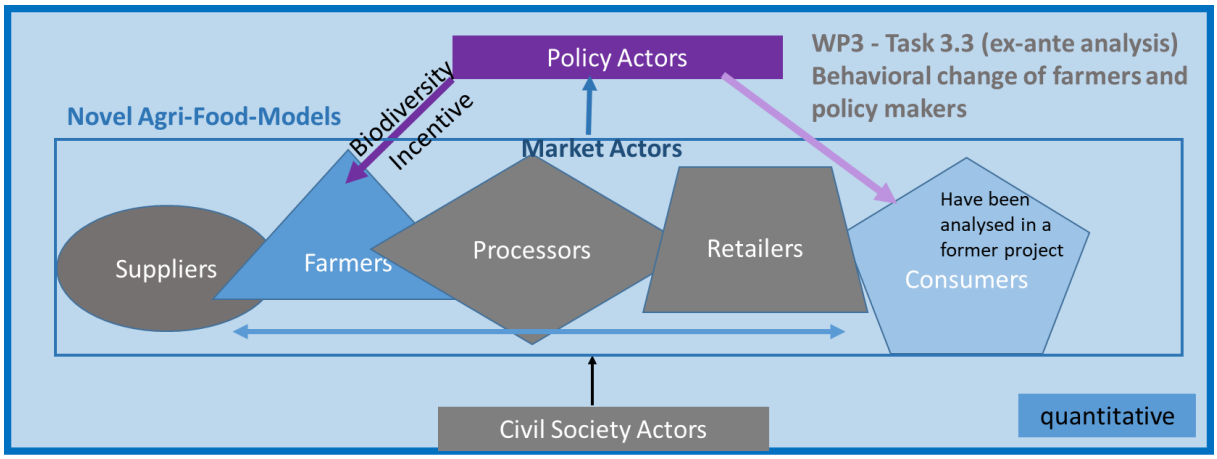


Figure 8 Empirical approach in Task 3.3

3.1.3 Case studies on water

A large proportion of EU water is still below Good Ecological Status, with nutrient runoff from agriculture being a big contributing factor and there is inefficient utilisation and governance of water resources in some countries. The water cluster identifies and evaluates existing and potential agri-environmental policy interventions for sustainable water resource management and closely explores behavioural motivations and barriers for coordination among farmers in water quality protection and water utilisation. We use three case studies across Europe (Spain, Hungary, and Denmark) to capture varying contexts and traditions in collaborative management practices. The case study in Spain focuses on analysing the problems that organic farming encounters in Mediterranean irrigation systems, while the case study in Hungary focuses on assessing policy options for an integrated and efficient utilization of irrigation. The case study in Denmark explores policy interventions that enhance water quality. Methodologically, we use quantitative and qualitative methods: focus group discussions, interviews, ex-post policy evaluation, choice experiment surveys, and economic experiments. The water cluster provides important policy inputs into addressing nutrient runoff from agriculture and for efficient utilisation of water.

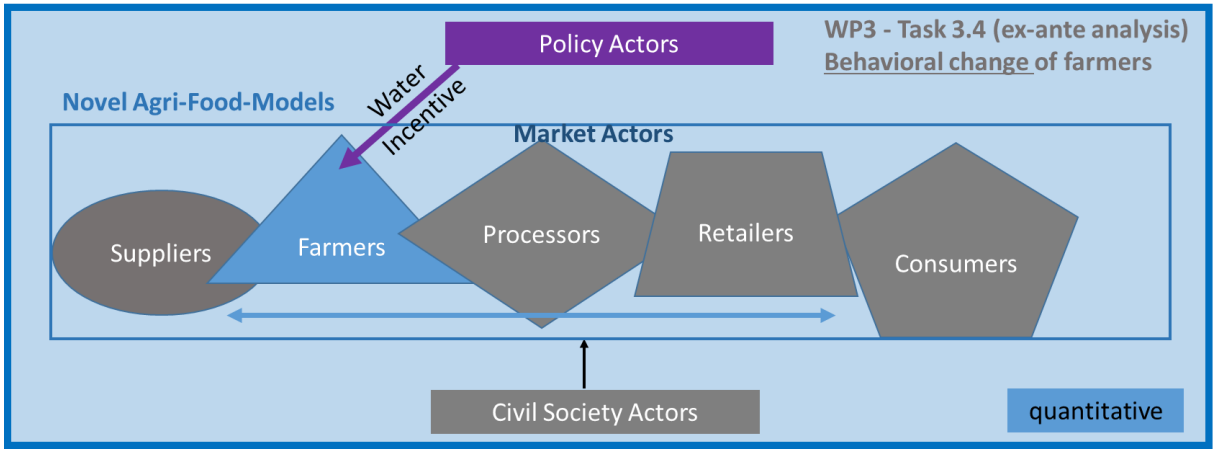


Figure 9 Empirical approach in Task 3.4

3.2 Case studies on sustainable business models (WP4)

3.2.1 Case studies on value chain

How can we successfully create markets for sustainably produced food? The Value chain cluster investigates private initiatives among operators in agri-food value chains and identifies successful business strategies and models. In the process, we are aiming to find out how relevant actors make their decisions – their motivations and barriers –, what problem(s) and barriers the initiative had to remove, and the kind of support available (finance, policy, networks).

The analysis takes a systems perspective and covers all actors: Farmers, upstream and downstream operators, and consumers, but also agricultural and non-agricultural experts in the advisory systems (e.g. farm advice, marketing, logistics). The case studies span all three environmental transitions (climate, biodiversity, water, multiple benefits), different farm sizes, and different products with their associated value chains and are conducted in the UK, Romania, Poland, Spain, Germany, Hungary, and Denmark.

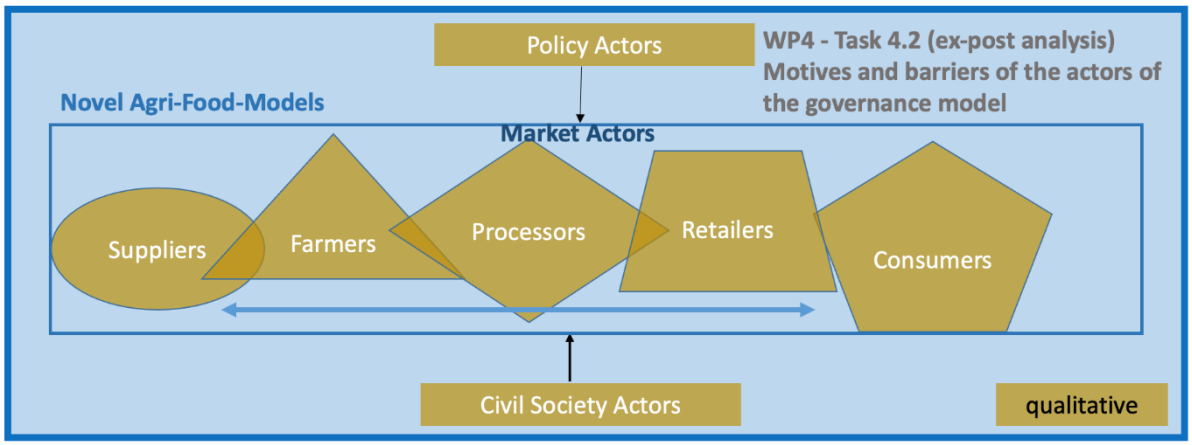


Figure 10 Empirical approach in Task 4.2

3.2.2 Case studies on consumers

The food consumption patterns of the average European can be considered unsustainable, causing high adverse impacts on climate, biodiversity, the environment, and personal health. The central question is how to initiate and sustain large-scale behaviour change toward sustainable food consumption. This cluster conducts consumer research in six European countries looking at the following questions: How can the consumption of sustainable, climate-neutral, and biodiversity-friendly food be fostered among consumers? What can private value chain actors do to increase consumer demand for their sustainable products? How effective are different promotion measures for sustainable food in raising consumer trust and perceived quality? Data is collected with consumer experiments embedded in online surveys. These insights complement the field experiments carried out in retail stores.

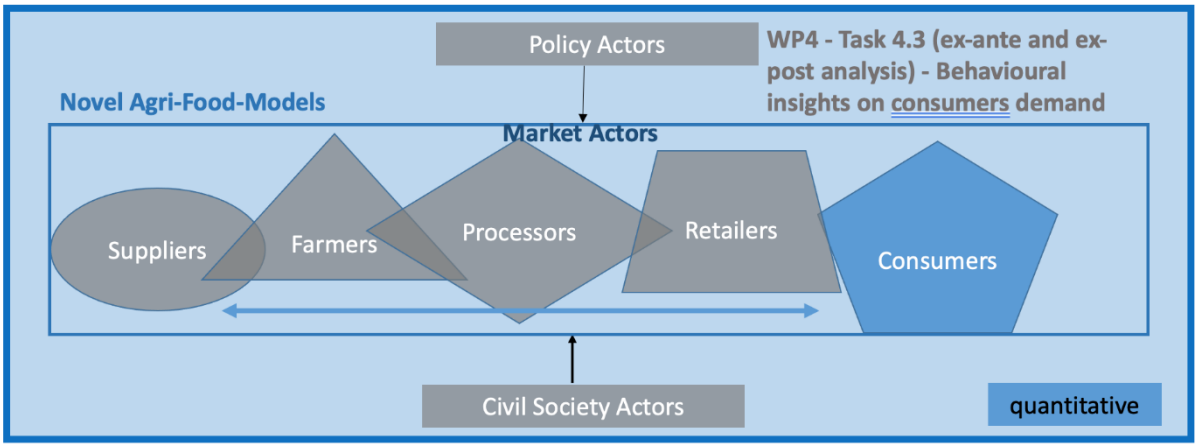


Figure 11 Empirical approach in Task 4.3

3.2.3 Case studies with retailers

Can we promote the sales of sustainable food by nudging the consumer in the right direction? Conducting field experiments in retail stores (e.g. supermarkets, farm shops), this cluster generates unique new insights into nudging interventions for sustainable food in the context of consumers' real purchase behaviour and tests the effectiveness of different nudges and promotion measures for increasing the sales of sustainable food. The insights from the retail store experiments complement the consumer insights from survey research (see 'consumer insights').

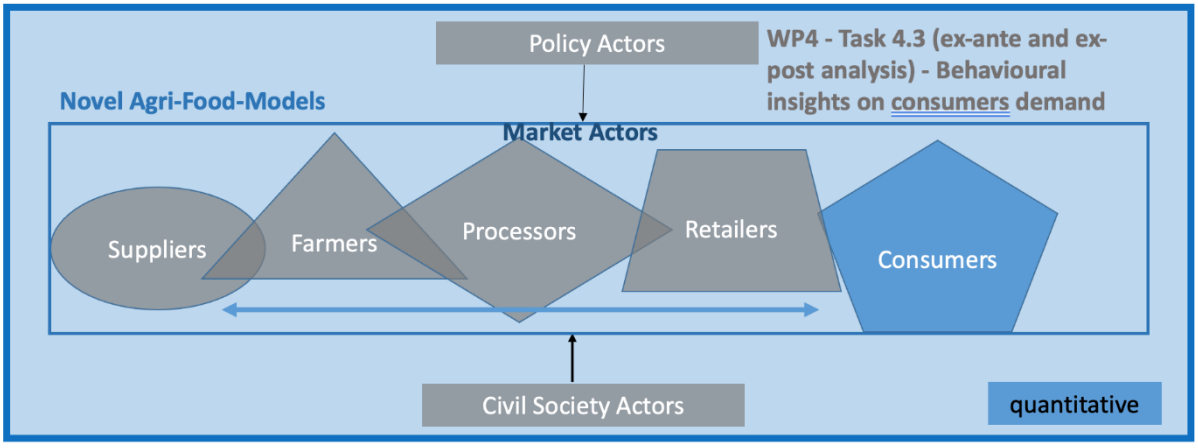


Figure 12 Empirical approach in Task 4.3

3.3 Case studies on transition of a production system (WP4)

3.3.1 Plant-based proteins

What are the drivers and barriers to the uptake of plant-based protein products? There are many actors involved in the value chains that are responsible for the successful establishment of plant-based protein alternatives – such as producers, processors, retailers, inspectors, and end consumers. In four case studies conducted in Germany, Denmark, Poland, and Spain, we investigate the personal perceptions of different food system actors of plant-based protein products using Q-methodology. This method allows us to combine qualitative and quantitative data to express viewpoints in a meaningful way.

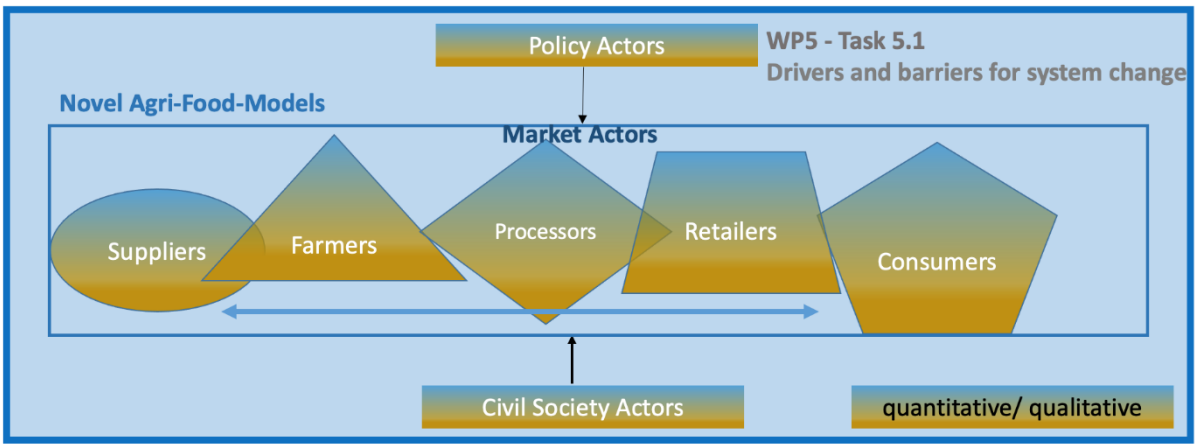


Figure 13 Empirical approach in Task 5.1

3.3.2 Organic farming

This cluster aims to promote the Green Deal's "Farm to Fork" target of at least 25% of agricultural land in the EU being managed organically by 2030 by advancing the available evidence about conditions (barriers and drivers) and potential support programmes to encourage balanced and equitable growth of organic agriculture in the EU. Case studies in Germany, Hungary, Poland, and the UK identify the required compensation that conventional farmers' demand for switching to certified organic production and other leverage points. It exposes fundamental determinants (farm level, value chain and policy) of cross-country differences in uptake of organic farming, and experiments with most relevant design features of an organic farming scheme. The research will analyse data from interviews and discrete choice experiments (DCE) techniques administered to different types of stakeholders.

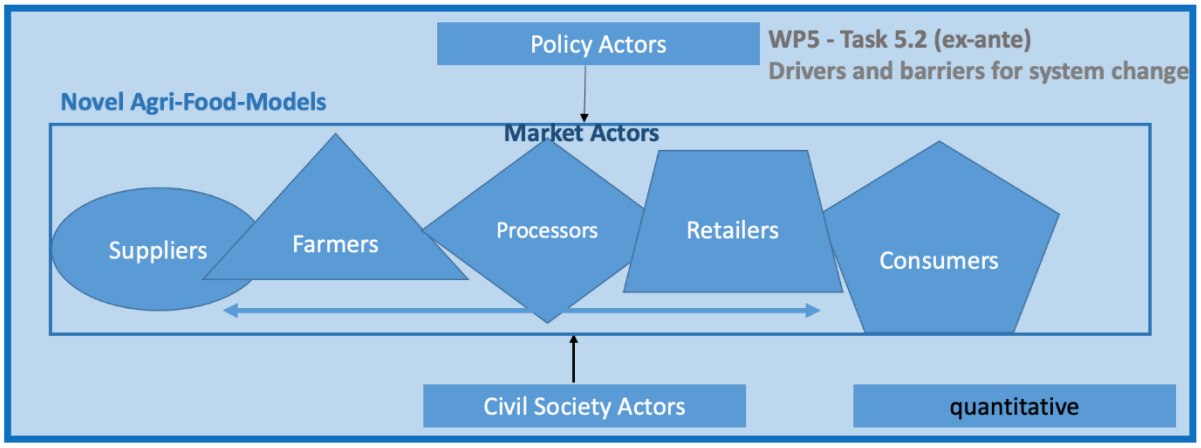


Figure 14 Empirical approach in Task 5.2

How to proceed with the development of the research design for each of the case studies?

In the next step we will work on the concrete research design of each case study and the related experiments. We can use for this important step results of the first SPI workshops as well as the very helpful overview on the potential research agenda identified in D2.2 (Literature review). Table 3 provides an overview of some interesting points of research gaps which we build on in different task. This short overview clearly indicate that the VISIONARY project will be able to fill in research gaps identified for behavioural aspects of the agri-food system.

Table 3: Consideration of identified research gap within our case studies (for references see D2.2)

Potential research agenda for sustainable agriculture (source: D2.2)	Will be approach in
…farmers' identity (Prokopy et al., 2019) and the influence of their perceptions of risk and uncertainty (Mercer, 2004)	Task3.2, Task 3.3, Task 3.4
Socio-demographic factors – especially age – continue to wield a pivotal influence over decision-making processes …	Task3.2, Task 3.3, Task 3.4
…that affect farmers' decisions when faced with mandatory and voluntary schemes.	Task3.2, Task 3.4
… cross-culture studies to reach a better understanding of how different cultural backgrounds influence the adoption of sustainable farming practices (Dessart et al., 2019).	many comparative studies approaches
… it is important to encompass the viewpoints of stakeholders, this aspect may have been relatively underexplored in prior research (David et al., 2022).	Task5.1, Task5.2, Task5.3
"Therefore, the emergence of models that are more specific to the contexts of adoption, as well as a combination of multi- and transdisciplinary models from economics, marketing, and sociopsychological models and their extensions, is increasingly recommended to explain the adoption of sustainable agricultural innovations" (Rosario et al., 2022, p. 16).	Our CF and AF
Potential research agenda for sustainable food consumption (source: D2.2)	
The impact of framing sustainable food products as healthy and environmentally pro-social might also pose a new research topic worth delving into (Sanchez et al., 2021). Sanchez et al. (2021) also suggest to investigate the influence different eco-labels have on consumers' buying behaviour, as well as situational factors such as time pressure, portion size and palatability.	Task3.3, Task4.3
Four reviewed articles propose that future investigations conduct research in real-life settings, as answers to hypothetical questions in surveys and interviews are less accurate representations of actual behaviour	Task4.3
A comparative analysis across multiple drivers of alternative protein consumption is called for (Onwezen et al., 2021).	Task5.1
Aschemann-Witzel and Zielke (2017) suggest differentiation between regular and occasional buyers to have a more detailed picture of consumption drivers between different consumer types.	Task4.3
Future research should consider broadening their geographical scope to multiple countries (Cecchini et al., 2018), advanced and developing economies ought to be equally represented in further analyses to explore disparities in consumers behaviour of buying organic food in diverse contexts (Katt & Meixner, 2020).	Task 4.3, Task5.2, Task5.2
The intricate landscape of behaviour change, encompassing supplementary facets like habits, external elements of the food environment, and the efficacy of interventions, necessitates a comprehensive approach that integrates multiple academic disciplines concurrently (Kwasny et al., 2022).	our interdisciplinary system approach
Potential research agenda for food supply chains (source: D2.2)	
Dania et al. (2018) advise researching the collaboration behaviour factors among agri-food supply chain actors to generate more accurate knowledge and to investigate the relationship between the different factors that influence decision-making.	Task3.3, Task3.4, Task4.2, Task5.1, Task5.2

Feldmann and Hamm (2015) argue that future researchers should consider delving into the examination of contextual factors and their effects on consumer behaviour, and at the same time, they should pay attention to the validation of these factors.	many comparative studies approaches
According to Rathgens et al. (2020), further investigation would benefit from focusing on the background factors influencing consumers' and producers' (especially smallholders) perceptions and behaviour towards alternative trade arrangements.	Task4.2
They believe that researching consumer values, loyalty, and corporate social responsibility (CSR) related to food retailers is important in filling current knowledge gaps.	Task4.2, Task4.3, Task5.1, Task5.2
Feldman and Hamm (2015) also advocate for more culturally diverse research that includes different countries as sociocultural factors might influence attitudes and behaviour differently.	many country comparative studies

General conclusions of the literature review

"…we posit that forthcoming research endeavours concerning the decision-making processes of both farmers, consumers, and food supply chains would greatly benefit from the application of a holistic approach."

4. Methods for research and analysis

In this chapter, the core methodological approaches of the VISIONARY project are presented. Each of the methods is presented in terms of a general description, followed by the application in the project and finally, there is a brief description of key take-aways of the agri-food system change in terms of the mental models and how it is related to the method. They are presented in accordance with the sampling approach (demand and supply side and systems thinking). The presented methods in chapter 4 concern only WP3,WP4,WP5.

4.1 Experimental Methods applied to analyze behavioural change of production side (farmers)

4.1.1 Contextualized field experiments

Author of method description:

Simone Cerroni

General description of method:

A contextualized field experiment is equivalent to a framed field experiment. A framed field experiment employs a nonstandard subject pool (i.e., not students); a non-abstract framing, meaning that the experimenter uses a specific field context familiar to the subjects participating to the experiment; and an imposed set of rules that enforce incentive compatibility. An example would be

eliciting farmers' risk preferences using contextualized instead non-contextualized lotteries as it often happens in the literature. For example, contextualized lotteries can simulate a situation in which farmers have to decide whether to purchase an insurance product or not. Contextualization may increase external validity but it may reduce internal validity of experimental results. As any other economic experiment, a contextualized field experiment requires that experimental subjects are incentivized and exposed to belief or preference elicitation methods that are incentive compatible, meaning that induce subjects to reveal their truthful beliefs or preferences (e.g., non-hypothetical discrete choice experiments, experimental auctions, multiprice-list format, quadratic scoring rules). Incentive compatibility is therefore a theoretical property. However it is empirically enforced by rewarding experimental subject depending on their choice behaviour and performance in the experimental tasks.

The basic process of a contextualized field experiment involves a few key steps:

1. Experimental subjects receive a monetary incentive to participate, called show-up fee.

2. Experimental subjects are exposed to experimental tasks that are generally based on incentive-compatible belief and preference elicitation methods. The choice of the methods depend on the objectives of the experiment (i.e. collecting data about beliefs, preferences or attitudes).

3. Experimental subjects are receive and additional reward according to their choice behaviour and performance in one or more experimental tasks.

4. After all experimental subjects have completed the experiment, the data is analysed statistically to generate findings regarding experimental subjects' beliefs, preferences and attitudes

5. Finally, the results are typically used by policy makers, non-profit organizations and private companies to make informed decisions.

Planned application in VISIONARY:

In VISIONARY, we will use contextualized field experiments to study farmers' acceptability of financial mechanisms to reduce greenhouse gas emission at farm level as well as to elicit beliefs and attitudes that might affect acceptability.

Insights from Mental Model Interviews

2. Why did you choose to apply your specific method (s) to the food system?

simulation games- farmers should face tasks that are similar to real life: investments games (techs.)- + scale down economic consequences - loss or rewards in the end

contextualized field experiments to study farmers' acceptability of financial mechanisms to reduce greenhouse gas emission at farm level as well as to elicit beliefs and attitudes that might affect acceptability

farmers as businessmen- incentives and financial instruments in mental model- behavior shift ?

simulating though there is no taxation in farmers emissions in EU

acceptability, beliefs, attitudes (also towards the consequences within the simulation)

behavioral factors (expectations of the technologies, market mechanisms etc)- understanding this info- create financial instrument that are efficient - facilitating uptake

3. How does the method(s) work(s)? can you represent in a diagram, how the method explores the specific links?

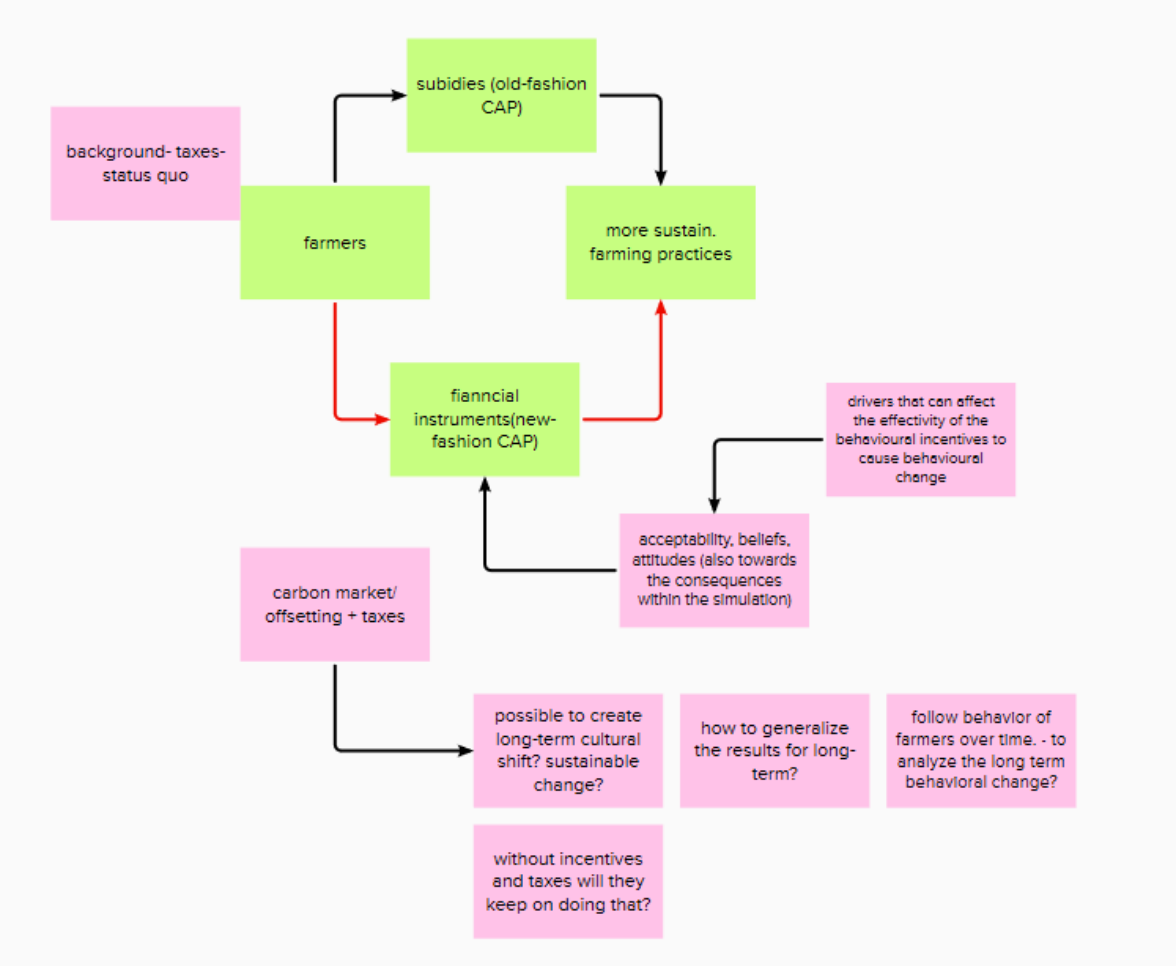


Figure 15 Representation of how Contextualized field experiments for eliciting preferences and beliefs explores the targeted links in the food system

4.1.2 Discrete Choice Experiments (Task 3.3, Task 3.4)

Author of method description:

Christoph Schulze, Tobias Holmsgaard Rønn

General description of method:

Discrete choice experiments (DCEs) are a quantitative survey based research method used to understand people's preferences for attributes of specific goods. These goods can be products, services, policies, or anything else that people might make a choice about.

The basic process of a DCE involves a few key steps:

1. First, a range of attributes and attribute-levels is identified for the good(s) of interest, based on literature reviews, focus groups interviews and cognitive (expert) interviews. These goods can be different products, services, policies, or anything else that the research is focused on. For example, a DCE might be used to study people's preferences for different types of cars, that differs (have different attribute-levels) in terms of specific features and prices (attributes).

2. Second, based on the identified attributes and attribute-levels, and an appropriate experimental design that as far as possible enables elicitation of preferences for the individual attributes, a sequence of different "choice sets" is created in which a number of alternatives, that differs in terms of attribute-levels, are presented together (see Figure 1).

3. Next, a group of participants (called "respondents") are presented with the choice sets and asked to indicate which alternative they would choose. The participants will often be presented with several different choice sets, so that the researchers can study how preferences change depending on the options available.

4. After all the participants have completed the experiment, the data is analysed statistically to understand the relative importance of the different attributes to the participants when making their choices.

5. Finally, the results are typically converted into valuation-measures such as the respondents' willingness-to-pay or willingness-to-accept for the different attribute-levels. These may be used by companies, organizations, or governments as estimates for the market value of future market products, a compensation requirement for implementation of more sustainable practices or as estimates for the value of non-market goods to enable assessment of the social value that e.g. may result from policy implementation.

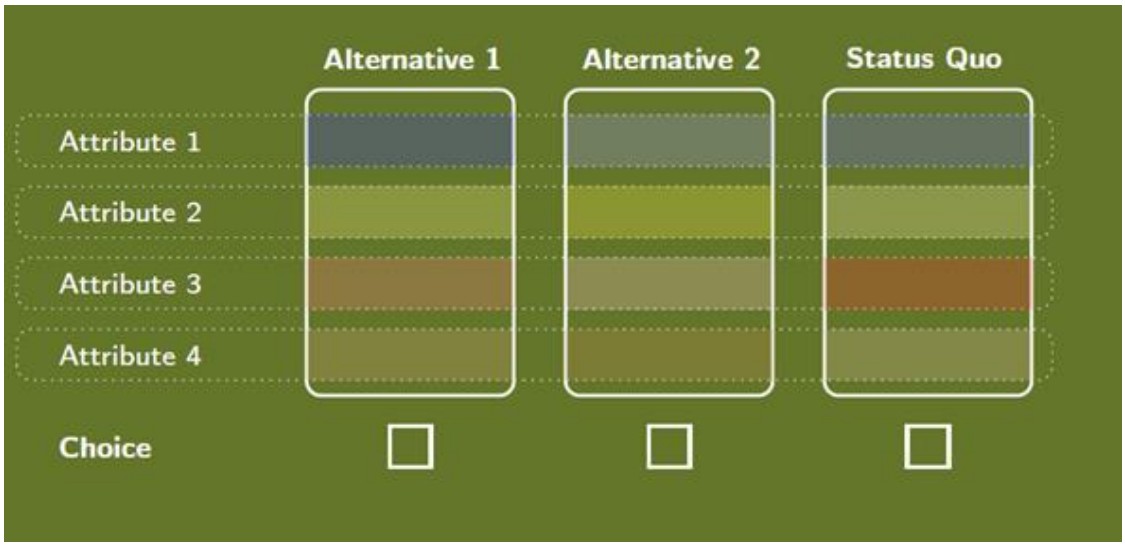


Figure 16 Abstract representation of a choice card

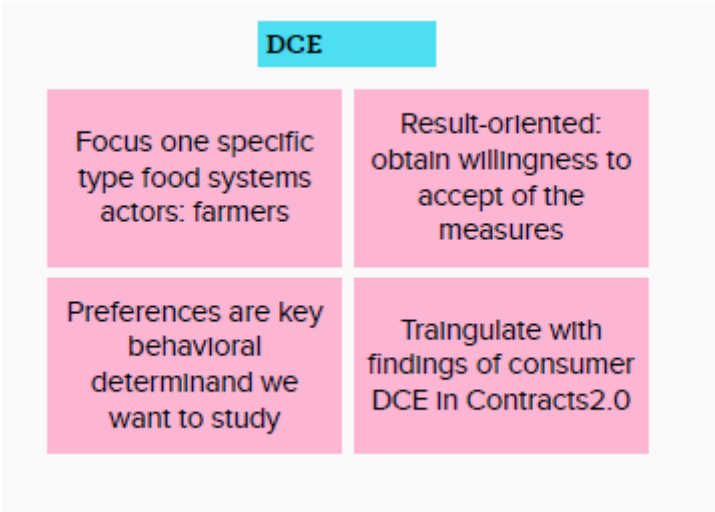
Planned application in VISIONARY:

In VISIONARY, we will use Discrete Choice Experiments to study farmers' preferences for label based approaches (Task3.2) coordination mechanism between farmers (Task3.4).

Insights from Mental Model Interviews Interview with Christoph Schulze (task 3.3)

Why did you choose to apply your specific method (s) to the food system?

-Think in terms of the mental model you build



How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

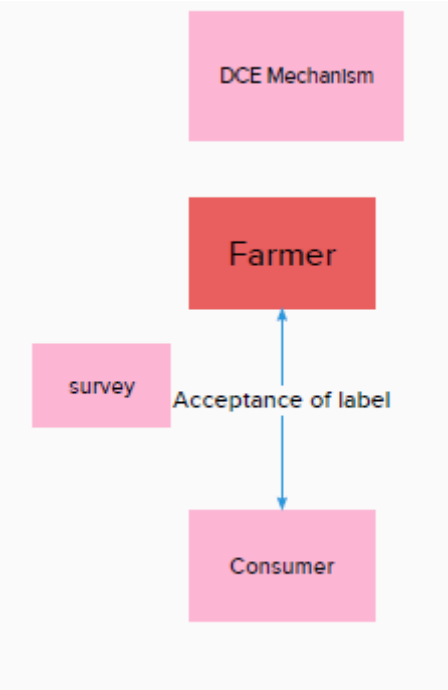


Figure 17 Representation of how DCE explores the targeted links in the food system

4.2 Experimental Methods applied to analyse behavioural change of the production side (consumers)

4.2.1 Field experiments with supermarkets (Task 4.3)

Author of method description:

Meike Janssen

General description of method:

Field experiments with supermarkets are a research method to test the effectiveness of point-of-sale interventions. The outcome variable could be purchase (measured in sales), store/product image, awareness, loyalty, etc. Possible interventions that can be tested in field experiments are all elements that can be manipulated in a supermarket setting, e.g.

- product placement (e.g. at eye-level versus further down in a shelf)
- product salience (e.g. shelf labels, posters, special displays, bundle placement)
- information provision (e.g. through labels, posters, QR codes)
- store atmosphere (e.g. lighting, music, colours, general layout)

The basic process of a field experiment with supermarkets involves the following elements:

- Choice of intervention (and outcome variable) to be tested
- Selection of test stores and control stores, e.g. through judgmental sampling
    - With physical supermarkets, difference-in-difference effects are estimated
    - If no control stores are available, then the data is limited to before-during-after effects
    - When cooperating with an online store, the interventions can be tested with an A/B-testing procedure where store visitors are randomly assigned to either the treatment or the control group, which is the same procedure as a randomized controlled trial
- Throughout the process ensuring good communication and collaboration between researchers and retail partners
- The study can (but does not have to) involve an on-site survey of store customers, e.g. to introduce a treatment to a sub-group of customers and/or to further investigate the factors that influence the intervention effect

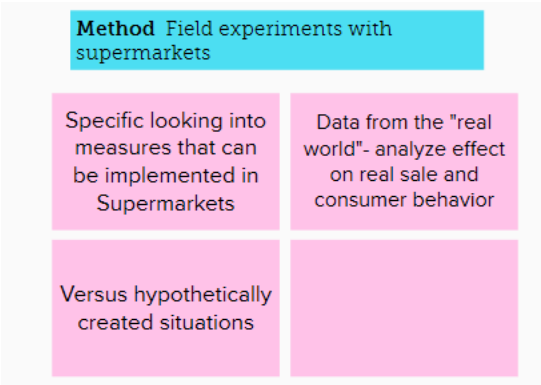
Planned application in VISIONARY:

In VISIONARY, we will use field experiments with supermarkets to study the effect of in-store interventions on purchases of sustainable foods (T4.3).

Insights from Mental Model Interviews

Why did you choose to apply your specific method (s) to the food system?

-Think in terms of the mental model you build



How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

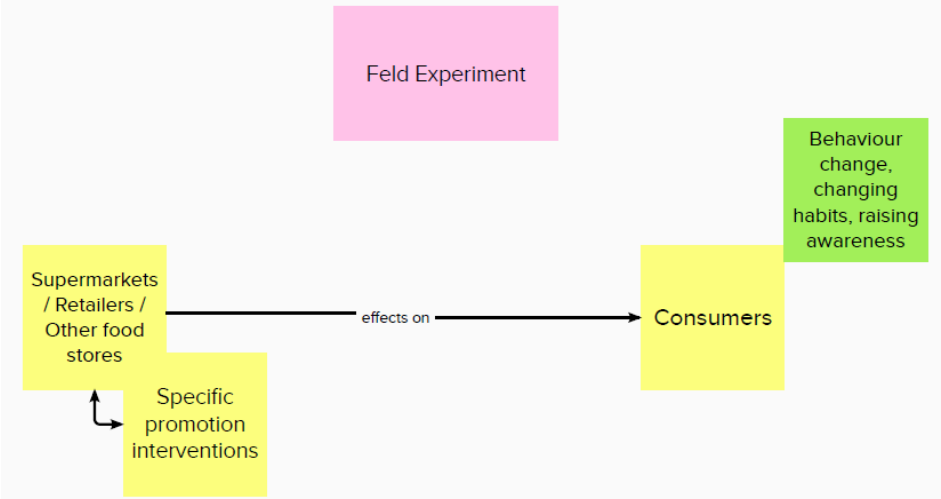


Figure 18 Representation of how Field Experiments explores the targeted links in the food system

4.2.2 Consumer survey (Task 4.3)

Author of method description:

Meike Janssen

General description of method:

Consumer surveys are a method that can be used for eliciting a broad range of factors related to consumer decision-making. When combined with an experimental element, data on cause-and-effect relationships can be collected.

Planned application in VISIONARY:

In VISIONARY, a cross-country consumer survey will be used to identify factors that foster consumer demand for sustainably produced food, taking into account the preferences and habits of different

consumer segments. We will test the effectiveness of promotion measures aimed at raising consumers' trust in sustainable products and their perceived quality, to make recommendations (in terms of strategic product positioning, promotion and labelling) for the upscaling and outscaling of private value chain initiatives. We will conduct stated preference experiments (e.g. conjoint analysis, purchase simulations) embedded in a consumer survey across six countries (minimum of N=800 per country). The selection of promotion measures to be tested will be based on successful examples of initiatives in T4.2 and other projects (e.g. Contracts2.0).

Insights from Mental Model Interviews Meike Janssen

Why did you choose to apply your specific method (s) to the food system?

- Target consumers- key part of the system
- -how to encourage them to buy more sustainable food?

How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

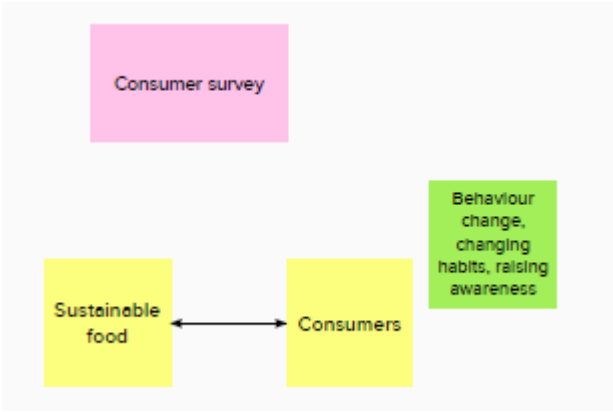


Figure 19 Representation of how Consumer Survey explores the targeted links in the food system

4.3 Methods applied to better understand and analyse the agri-food-system

Methods described here are used in WP5. Task 4.2 has also an comprehensive view on the whole system on the basis of regional based small initiatives. Here the broad range of qualitative and quantitative methods are planned to use. This methods such as key informant interviews, focus group discussions, participant observation, and surveys with standardised questionnaires are not described in detail in this section.

4.3.1 Mental models

Author of method description:

Katrin Prager

General description of method:

Mental models (in some ways similar to 'fuzzy cognitive maps') generate a diagrammatic representation of how a person thinks about and understands a phenomenon in the world around them; it illustrates how they make sense of that phenomenon. The method is suited to generate systemic insights. Mental models are typically generated by interviewing people individually and then aggregating their mental models, but can also be generated jointly by a group of people.

The basic process of producing a mental model involves a few key steps:

1. Semi-structured interviews are conducted, commonly around only 1 or 2 key questions. Prompts are taken from the participant's answers to explore concepts of interest further.

2. During the interview, the interviewer captures key concepts mentioned by the interviewee and writes them down (on a post-it; or on a sticker in a visualisation software). The concepts are connected by arrows to indicate their relationship, and a plus/minus indicates whether the relationship between concepts is positive or negative. (As an additional option, relationships can be given a weight e.g. in percent or 'high/ medium/low'.) The participant is asked to check whether their model is complete and they are happy with the representation. Interviews are audio-recorded to allow scrutinizing the material again, should questions arise in the following analysis.

3. Individual diagrams are a visual output of different stakeholders' mental models and how they understand a food system and their role within it (Example Figure 1). Raw mental models can be digitized for easier sharing.

4. For analysis, similar (raw) concepts are condensed into a broader concepts. Concepts can be sorted into categories (e.g. types of barriers and drivers as perceived by stakeholders). Consolidated mental models can be visualised as diagrams (Example Figure 2), for example colour-coding concepts that belong to the same category.

5. Computer software can be used to calculate the parameters of an individual or consolidated mental model, for example, the number of connections, density, centrality, number of transmitter and receiver concepts. Relationships can be weak or strong, positive or negative, and reveal feedback loops. Centrality of concepts can indicate their importance. Specific parameters and the complexity of mental models can be compared between countries, topics, environmental transitions, and stakeholder types.

Planned application in VISIONARY:

In VISIONARY, we will use mental models in task 5.3 to understand how key actors conceptualise the food system and their role within it, which helps identify leverage points to move towards a more sustainable food system. This will reveal actors' understanding of what the system components are and how they influence each other, as well as how actors assess their ability and capacity for change.

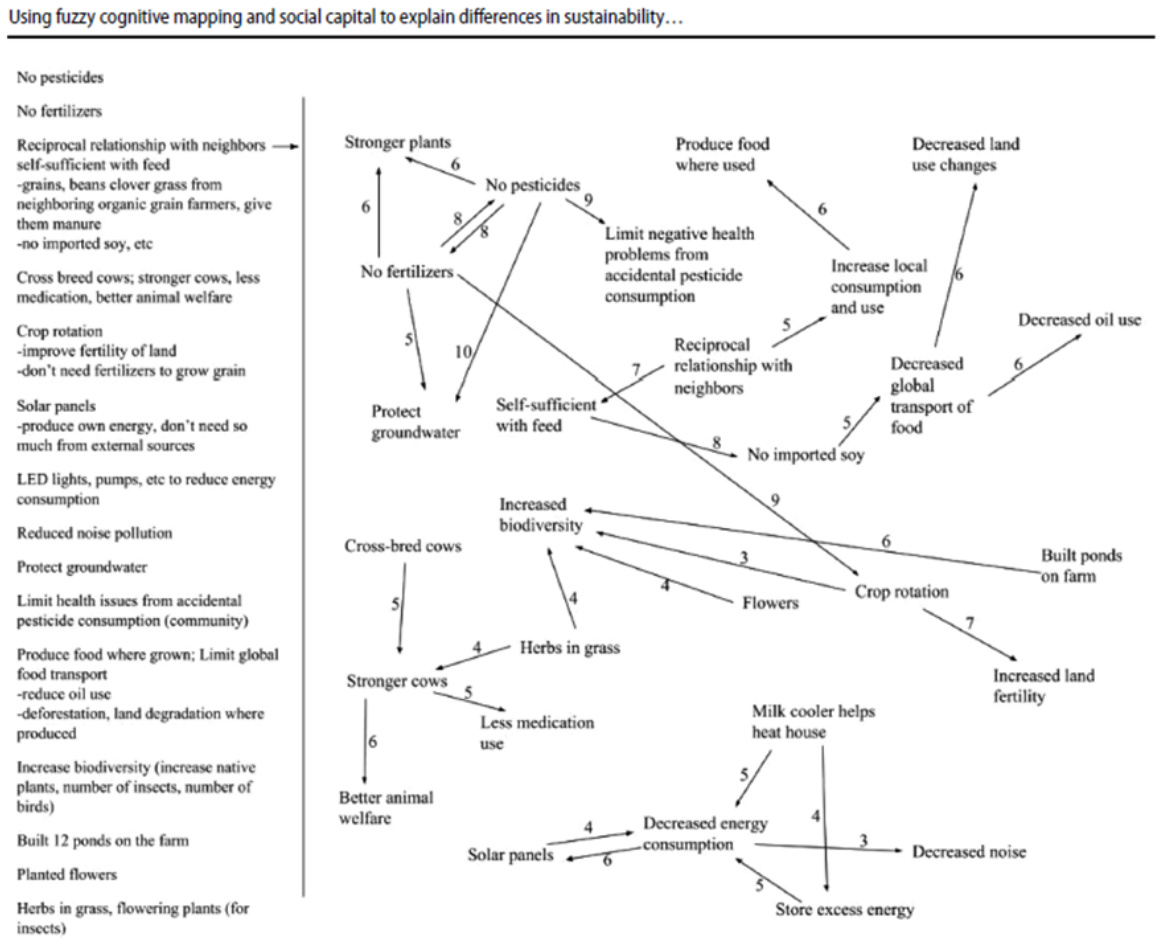


Fig. 1 Example of a digitized raw fuzzy cognitive map. On the left are the initial concepts that we recorded as farmers answered the two questions: What sustainability practices do you implement on your farm? And, what impacts do these practices have (can include environmental, economic, and social)? On the right is the mapping of the direction and strength of relations between concepts

Figure 20 Example of a digitized raw fuzzy cognitive map (from Averbuch et al. 2022)

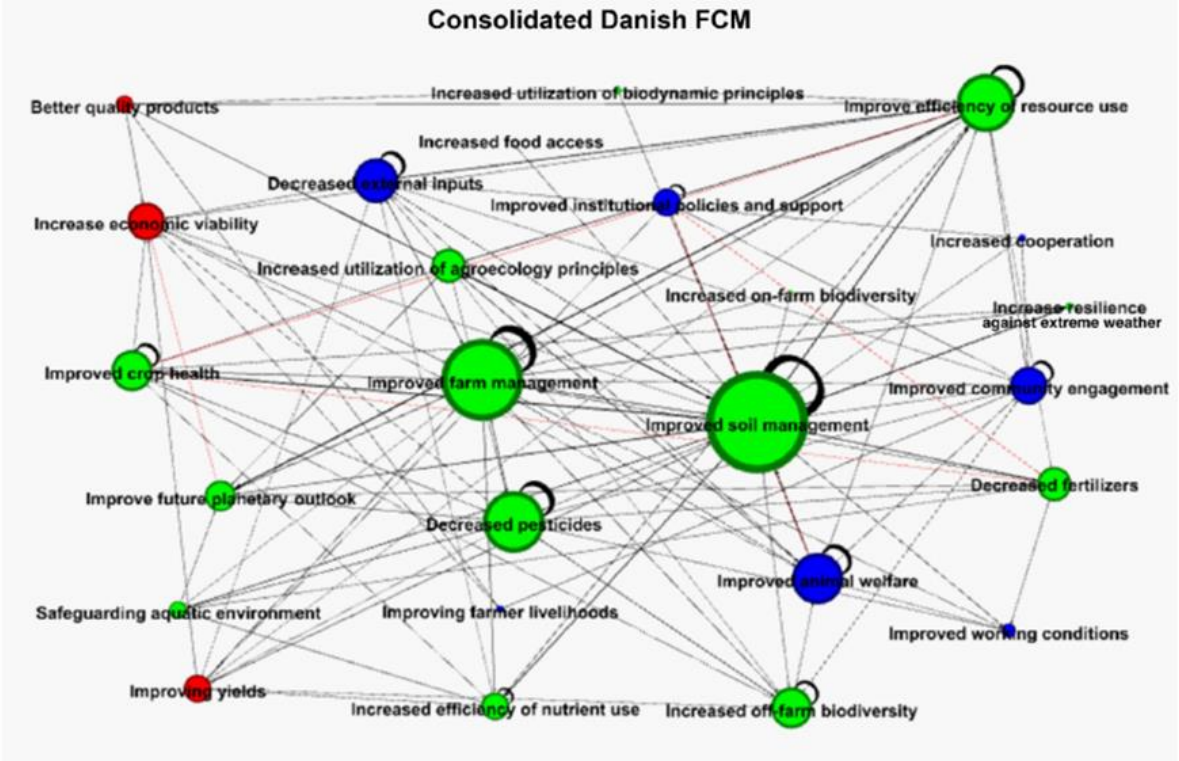


Figure 21 Example of a fuzzy cognitive map (consolidated from different Danish respondents) from Averbuch et al. 2022

Insights from Mental Model Interviews

Why did you choose to apply your specific method (s) to the food system?

-Think in terms of the mental model you build

observation to triangulate what is said in interviews	as preparation for refining other methods (surveys, experiments)
better understand the barriers to change	can be part of action research, i.e. researcher helping to make a change in the real world
in depth information- open questions allow actors to talk about the topics that do not come up in more structured (closed methods)	

How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

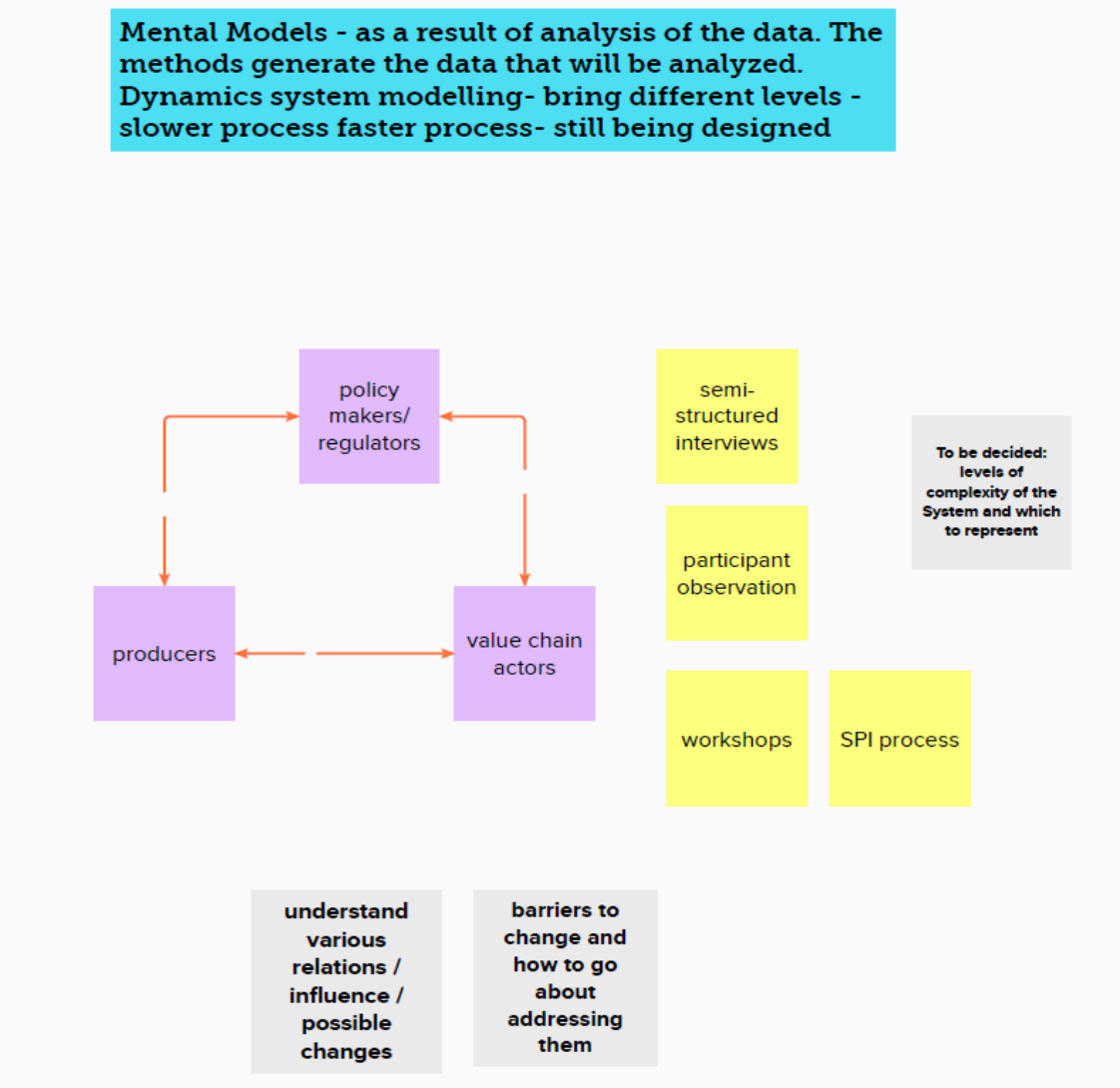


Figure 22 Representation of how Mental Models analysis explores the targeted links in the food system

4.3.2 Q-Methodology

Author of method description:

Christoph Schulze, Tobias Holmsgaard Rønn

General description of method:

Q-methodology is an interview based research method used to study people's subjectivity, or their unique perspectives, beliefs, and attitudes. It is a combination of both quantitative and qualitative research methods.

The basic process of Q-methodology involves a few key steps:

1. First, a set of statements or items related to the research topic are created based on literature reviews, focus group interviews and cognitive (expert) interviews. This is called the concourse. There are no limit to the number of statements included in the concourse, and the idea is then to capture all statements that are relevant to the topic, and hence represent the “population” of opinions. These could be statements like "I believe that climate change is primarily caused by human activities," or "I think that vaccines are safe and effective."

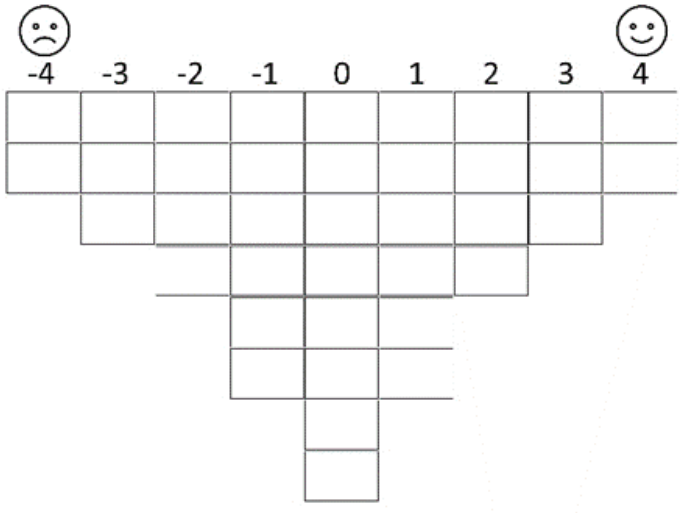
2. Second, a sample of the concourse is picked out, which is called the Q-set. A Q-set may be identified in a structured or unstructured way, yet the idea is that should be broadly representative of opinions on the topic. A Q-set usually consist of 30-80 statements.

3. Next, a group of participants (called "P-set") are asked to sort these statements into a grid (see Figure 1), according to how much they e.g. agree or disagree with each statement, or how important they find each statement. Each participant will rank the statements in individual interviews or (online) questionnaires according to their own personal beliefs, attitudes, and perspectives.

4. After all the participants have completed their sorting, the data is analysed statistically via factor analysis to identify patterns and commonalities among the participants. This can reveal different "points of view" or "subjective positions" on the topic being studied.

5. The results from step 3 are linked to qualitative information provided in the interviews/questionnaires and interpreted accordingly.

6. Finally, the results are typically reported in a way that illustrates the different perspectives of the participants, rather than trying to draw definitive conclusions or generalize to a larger population.



Example of a Q-grid

Planned application in VISIONARY:

In VISIONARY, we will use Q-methodology to see how relevant food system actors evaluate bottlenecks and levers along the value chain of plant based protein products (task5.2).

Insights from Mental Model Interviews

Why did you choose to apply your specific method (s) to the food system?

-Think in terms of the mental model you build

Production system that is still new in the market- assess how this change can be accpted - system change that is unkown	assesing multiple possible bariers of adoption of the new system
how to implement these shifts?	complex interactions of variables- map what barriers and which seem to be the hardest ones to overcome - what are the knowledge gaps?
goal- inform policy interventions having the multiple variables in account	explore- get imput from different actors in the agri-food sector
Mix of qualitative and quantitative information (either type of information will not allow you to make judgments of attititues; you need both)	Arguments of drivers or barriers of different actors
Combining objective criteria with qualitative information to correctly interpret different viewpoints	

How does the method(s) work(s)? Can you represent in a diagram, how the method explores the specific links?

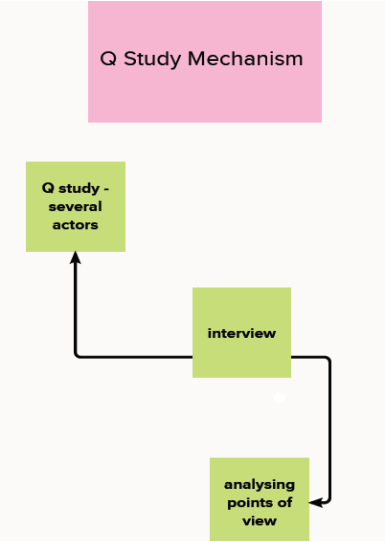


Figure 23 Representation of how Consumer Survey explores the targeted links in the food system

4.3.3 Factorial Survey Experiments (to be discussed)

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Appendix

Appendix 1

Table of appendix 1 presents the practical application in terms of the work packages of VISIONARY. The main scope, goals, methods, and strategy for each of the WP is given. The left column presents the assigned overarching research questions (provided until now by the research leads) for the WPs. It is important to notice that there are overlaps regarding methods for each of the work packages.

Table appendix 1: Overview of work packages of VISIONARY

Work Package name and scope - Analytical framework focus	Symbol, RQs
WP 3 Agri-environmental experimentation Scope: identify the key factors determining farmers' behavioural responses to policy initiatives to promote transitions towards sustainable farming systems. Three key sustainability transitions: Climate neutrality, halting biodiversity decline, good ecological status of freshwater and marine waters. How? By analyzing what policies in the food, rural and agri-environmental domain look like that may promote the needed changes in behaviour. We identify how behavioural approaches and experiments in particular can help identify the most effective policy interventions in different socio-ecological contexts across the EU. Goals : ● Identify effective policy interventions for key sustainability transitions including behavioural motivations and barriers. ● Outline the design and the potential of agri-environmental policy interventions, AECS designs in particular, to promote transitions towards key sustainability objectives of the EU. ● Compare and contrast the promising interventions and barriers across the EU farming systems to better understand how the legal, social and ecological context shapes the potential of different policy interventions. Methods: discrete choice experiments, contextualized economic experiments (individual and group based), and studies of experiences from past implementation of agri-environmental policy interventions.	 Policy experimentations Main Research Question Is the business model/value creation approach an appropriate way to explore and promote farmers' adoption of sustainable practices? → Behavioural economics approach to farmers
WP4 Value chain initiatives and business models WP4 focuses in particular on the behaviour and decision-making of farmers, upstream and downstream actors as well as consumers in order to identify successful business strategies and models in a number of specific value chains. It focuses on exploring how private operators can succeed in creating markets for sustainably produced food through successful business models and cooperation among value	 identify successful business strategies

chain partners building on common interests, and why they are motivated to do this. How? By investigating private initiatives among operators in agri-food value chains (i.e. value chain initiatives) that deliver sustainable, climate-neutral and biodiversity-friendly food, while taking into account the nature of the policy context. The key question is how private operators can succeed in creating markets for sustainably produced food through successful business models and cooperation among value chain partners building on common interests, and why they are motivated to do this. Goals ● Identify the behavioural levers and lock-ins that incentivize/ prevent operators to participate in value chain initiatives that foster the transition to sustainable, climate-neutral and biodiversity-friendly production systems. ● Identify characteristics of an enabling policy environment that are shared by successful initiatives across countries and settings, and those that are context-specific to derive insights on transferability and replicability of value chain initiatives. Methods: qualitative and quantitative research methods, including key informant interviews and participant observation, surveys with standardized questionnaires (e.g. consumer survey) nudging instruments in the field experiments conducted in retail shops, Q Methodology	Main Research Question -.How new knowledge on behavioural insights can contribute to creating value in new Sustainable Business Models? -.How Sustainable Business Models can modify/intervene in other actors' behaviour (e.g. consumers, clients, providers, partners)? → Behavioural economics approach to consumers and systems thinking approach to other stakeholders
WP5 Leverage points in the agri-food system Objectives: This WP aims to generate insights at a system level. How? This will be done by investigating two example transitions at a system level, and by bringing together the different strands of the review and empirical work in WP2-4 and 6. This is essential in order to improve our understanding of the agri-food system as a whole, as the insights on policy interventions and value chain initiatives need to brought together not only for the specific value chain, but combined with the mapping of the policy context and behavioural drivers of relevant actors in the value chain to represent the dynamics of the more complex agri-food system. Goals ● Analyse existing production system-based transition pathways to overcome barriers, better use leverage points and foster implementation using a cropping system and a farming system as examples ● Analyse the properties characterizing food systems in Europe to identify system level barriers for change (lock-ins) and potential leverages and assess their potential ● Explore the conditions necessary for upscaling and outscaling interventions and initiatives that have been identified to hold high potential in WP3 and 4 ● Integrate the combined behavioural findings from WP3, 4 and 5 into a systems	 Systems thinking Main Research Questions -How does systems thinking (or the lack of) influence the interaction among actors, the SPI process and its outcomes? - Can we connect/reconcile in a coherent manner the two streams of knowledge (farmers' and consumers' behaviour)? Can the concept of value creation/SMB be the link we need for this? -How does systems thinking (or the lack of) influence the interaction among actors, the SPI process and its outcomes?

approach to improve understanding of transitions of European agri-food systems Methods: Mental model interviews, Q Methodology, Discrete Choice Experiment	→systems thinking approach to other stakeholders
Work Package name and scope - Knowledge integration	Complements Analytical framework
WP6: Science-Policy Interfaces and relationship building Objectives Crosscutting WP. The overall aim of WP6 is to enable the co-design of policies and business models by working with food system actors to 1) inform what is tested in WP3 (Policy experimentation) and WP4 (Value chain experimentation) and 2) interpret the results of this experimentation in the context of designing new and innovative policy interventions and business models (including the identification of potential complementarity between them) for adopting more climate-neutral and sustainable food production systems. Goals ● Launch and develop a series of multi-level science-policy interfaces (SPI) as novel platforms for knowledge exchange to better inform policy design and business model development (Task 6.1) ● Conduct policy and regulatory context mapping to analyse the regulatory and policy mix relevant to each selected case study (Task 6.2) Undertake participatory foresight exercises to derive needs / scenarios / interventions to be tested in WP3 and WP4 (Task 6.3) ● Build the capacity of policy-makers, value chain actors and researchers to work together in the SPIs and contribute effectively to the co-design process (Task 6.4 and 6.5) ● Facilitate a co-design process within each SPI for the development of new and innovative policy interventions and business models (Task 6.6)	 Co-design of policy and business models