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Enhancing the social acceptability of sustainability transitions through governance

Lessons learned from England's post-Brexit agricultural sustainability transition

A Thesis submitted for the degree of Doctor of Philosophy

School of Agriculture, Policy and Development

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Original authorship

Declaration: I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

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Abstract

Sustainability transitions are assumed to be one of the key solutions to society's grand challenges such as climate change, environmental degradation, and growing inequality. This assumption has led to multiple international commitments to realize sustainability transitions, including the Paris Agreement and the European Green Deal. However, attempts to implement sustainability transitions often lack social acceptability and are confronted with societal protest. Despite a rich body of literature around the dynamics of sustainability transitions, there exists a knowledge gap on how to address this lack of social acceptability through governance. This thesis addresses this knowledge gap with insights from a critical case study of England's post-Brexit agricultural sustainability transition. The main pillar of this sustainability transition is a shift from direct payments to farmers based on the amount of land that they manage to payments for efforts undertaken to provide public goods. The aim of this thesis is to explore how sustainability transitions could be governed to enhance the social acceptability of both the sustainability transition process and its outcomes. The analysis is based on literature reviews, interviews with stakeholders, a survey with English adults, and a policy analysis of key policy documents related to the English agricultural sustainability transition. Based on this, this develops a Sustainability Transition Governance framework and provides practical lessons for the governance of sustainability transitions. Overall, this thesis highlights the importance of monitoring and reflecting societal perceptions throughout a sustainability transition process; allowing diversity in problem and solution frames; creating flexibility in the measures designed to bring about a sustainability transition; providing clearly worded, long-term goals; interlinking problem(s), goal(s), and mechanisms to achieve the goal(s) of a sustainability transition; using integrated decision-making; building trust; showing credibility; being transparent in all sustainability transition processes; and taking a holistic approach to governance.

Keywords: Sustainability transition, social acceptability, governance, perceived legitimacy, perceived justice, perceived adaptive capacity, willingness to adapt, agriculture

Dedication

To my family

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Contents

List of publications

This thesis builds on the following papers, referred to by Roman numerals in the text:

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Abbreviations

AVE	Average Variance Extracted
CAP	Common Agricultural Policy
CFA	Confirmatory Factor Analysis
DEFRA	Department of Environment, Food, and Rural Affairs
EFA	Exploratory Factor Analysis
EFRA	Environment, Food, and Rural Affairs Committee
ELM	Environmental Land Management
FAO	Food and Agriculture Organisation of the United Nations
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
KMO	Kaiser-Meyer-Olkin test
UN	United Nations

1. Introduction

Across the globe, societies are facing large scale challenges ranging from climate change, biodiversity loss, environmental degradation, and the spread of diseases, to growing inequality and demographic changes. Most of these challenges are highly interlinked. Whilst the first four of these challenges relate to changes in the natural environment, it is now common knowledge that they are the result of how humans have set up their societies and interact with nature. The Intergovernmental Panel on Climate Change (IPCC), summarizing the physical science basis of climate change, states that "*it is unequivocal that human influence has warmed the atmosphere, ocean and land*" (IPCC, 2021, p. 4), with greenhouse gas emissions identified as the main driver. In its global assessments of biodiversity and land degradation, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) highlights changing land and sea use, pollution, exploitation, and climate change as key direct driving forces behind biodiversity loss and land degradation, which are in turn caused by indirect drivers resulting from societal values and human behaviour such as consumption. These drivers threaten on average 25 percent of animal and plant species with extinction and increase the probability of violent conflict and mass migration (IPBES, 2018, 2019). In addition, climate change, biodiversity loss, and environmental degradation together threaten food security worldwide (Food and Agriculture Organisation of the United Nations [FAO], 2019). It is assumed that in order to address these challenges, we need wide-ranging, structural changes across societal organisation toward more sustainable systems and practices (Oliver et al., 2021). These kinds of structural changes are often referred to as sustainable transformation when it relates to society as a whole, or as sustainability transitions when the changes are focused on a specific societal sub-system (Hölscher et al., 2018). These kinds of transitions are goal-oriented and require deliberate far-reaching policy changes across all areas of the concerned societal sub-system (Geels, 2011). The assumption of the need for sustainability transitions has led to multiple international conventions and agreements including the Rio Declaration on Environment and Development (United Nations [UN], 1992a), Agenda 2030 (UN, 2015a), the Paris Agreement (UN, 2015b), the United Nations Convention on Biological Diversity (UN, 1992b, 2021), and the European Green Deal (European Commission, 2019).

However, sustainability transitions are not straight forward processes that everyone will agree on and benefit from (Leach et al., 2007; Meadowcroft, 2011). Efforts to bring about sustainability transitions often lack social acceptability and are met with protest. This lack of social acceptability can become a hurdle to the implementation of a sustainability transition, may stand in the way of compliance with required measures, and might result in larger societal unrest (Herrero et al., 2020a; Markard et al.,

2020; Martin and Islar, 2020; Meadowcroft, 2011; Rothmund et al., 2016; Vringer and Carabain, 2020; Wieliczko et al., 2021). The yellow-vest protests in France (Chiarello and Libert, 2019; Martin and Islar, 2020) and farmers' protests in India (Bhatia and Katakam, 2021) and the Netherlands (Gijs, 2022), as well as the wider phenomenon of 'Not in My Backyard', where there is general support for the idea of a sustainability transition, as long as the negative effects of it are not personally felt (Dear, 1992; Sæþórsdóttir and Ólafsdóttir 2020), provide cases in point. The underlying reason for these kinds of protests can be found in the inherent characteristics of sustainability transitions.

First, sustainability transitions are inherently disruptive. On the one hand, they can considerably alter or disrupt the current societal systems that are deemed to be unsustainable. This is what makes them attractive as a solution to the large-scale challenges discussed above (Loorbach et al., 2017). On the other hand, this disruptiveness means that some people will lose out as a result of a sustainability transition, for example if their skills or knowledge become obsolete, their existing resources become irrelevant, or they are unable to adapt, whilst others may benefit (Kivmaa et al., 2021). The positive and negative consequences of the disruptiveness of a sustainability transition will therefore be distributed unevenly across society (Leach et al., 2007). Especially actors with a vested interest in the current system will likely be negatively impacted and hence be resistant to change (Geels, 2011). In addition, potential (long-term) consequences beyond the initial aim of a sustainability transition will be difficult to anticipate and may cause undesirable effects of their own (Kivmaa et al., 2021;Klerx and Rose, 2020; Sveiby, 2009).

Second, there are multiple possible pathways of change to address the above challenges toward a subset of alternative futures (Blok and Lemmens, 2015; Foran et al., 2014). The question of what sustainability itself entails and what should be sustained is contested (Parris and Kates, 2003; Leach et al., 2007). Each alternative interpretation of sustainability, its related ideal future(s), and the diversity of transition pathways that can be taken to reach those futures, will be experienced and valued differently by different people. What is perceived as a positive pathway and goal of a sustainability transition for one, might mean the loss of livelihood for another (Leach et al., 2007; Markard et al., 2012; Meadowcroft, 2011). The desirability of a certain sustainability transition and transition pathway, and the choice regarding which one should be prioritized, is therefore a value-based normative judgement, making sustainability transitions inherently normative.

Third, acknowledging the disruptiveness and normativity of sustainability transitions, and highlighting that they involve an active choice regarding the end goal(s) and path(s) of a transition, reveals their political nature. With political, I refer here to processes of power contestation and the impact of uneven power distribution on how resources, life chances, and well-being are distributed in society

(Stoker and Marsh, 2010); whereas power broadly refers to "*the capacity to effect outcomes*" (Morriss, [1987] 2002, 299). This can include both having power over and having power to, and can manifest itself in the form of domination or empowerment (Haugaard, 2012). Sustainability transition processes thus form contested arenas where differing interests compete over influence on the direction and manner in which society develops and how the consequences of the disruptiveness of a sustainability transition are distributed (Hammond, 2020; Kenis et al., 2016; Loorbach et al., 2017; Turner et al., 2020; Wigboldus et al., 2021).

If governments nonetheless intend to fulfil their obligations under the international agreements to bring about sustainability transitions, this raises the question of how these disruptive, normative, and political characteristics of sustainability transitions can be taken into account in the governance of these processes in a way that increases their social acceptability. Governance is conceptualised here as including both structures and processes of decision-making and implementation aimed at steering society into a specific direction (Baker, 2009; Lockwood et al., 2010), whilst social acceptability is understood to include both perceived legitimacy and justice of a sustainability transition process and its outcomes, and perceived adaptive capacity and willingness to adapt to a sustainability transition. It thereby covers both a normative evaluation of a sustainability transition (perceived legitimacy and justice) and links to behaviour in relation to a sustainability transition (perceived adaptive capacity and willingness to adapt). It follows a process-oriented interpretation in the sense that social acceptability is dynamic and results from the interaction between the acceptability object (a sustainability transition), the acceptability subject (stakeholders and society at large who make evaluative judgements of a sustainability transition), and the context within which the acceptability evaluation is made (Busse and Siebert, 2018; Lucke, 1995).

Creating social acceptability of a sustainability transition process and its outcome has a functional role by contributing to ensure that the "*process can be sustained over time without eroding its own foundations*" (Voss and Kemp, 2006, p. 14) and easing the implementation of a sustainability transition (Markard et al., 2020; Martin and Islar, 2020; Meadowcroft, 2011; Rothmund et al., 2016). It also has a normative connotation which is in line with the call for 'just transitions' as first expressed by labour organisations in the 1970s (Cha, 2020; Galgóczi, 2020; Newell and Mulvaney, 2013; Sabato and Fronteddu, 2020) and more recently incorporated in multiple international agreements and declarations such as the Paris Agreement (UN, 2015b), the International Labour Organisation's Guidelines for a Just Transition (International Labour Organisation, 2015), the Silesia Declaration on Solidarity and Just Transition (UN Climate Change Conference, 2018), the European Green Deal

(European Commission, 2019), and the draft text for the post-2020 global biodiversity framework (UN, 2021).

1.1. Current understanding of the governance of sustainability transitions

None of the aforementioned international agreements provide a blueprint for governance of how to achieve a sustainability transition. In the scientific literature on sustainability transitions, the Multi-Level Perspective and Transition Management are the historically dominant approaches that have looked at sustainability transition dynamics and how they can be influenced (Köhler et al., 2019; Martin et al., 2018; Rauschmayer et al., 2015; Truffer et al., 2022). The Multi-level perspective describes how innovation niches, regimes (currently dominant and institutionalised ways of delivering societal functions), and the landscape (macro level societal and environmental processes) interact. It provides a framework to understand (historical) transition dynamics across societal levels and how (radical) niche-innovations can become dominant and alter or replace the, often path-dependent, regime. Understanding of these dynamics can be utilised to create favourable conditions for specific niche-innovation(s) to be able to rival the dominant regime and ultimately bring about a sustainability transition (Geels, 2019; Geels and Schot, 2007; Grin et al., 2010; Smith et al., 2010). Transition Management, on the other hand, is rooted in complex system and governance theory. It gives a framework to either analyse or shape transition processes around strategic (long-term vision and goal development, focused on culture), tactical (identification of steering mechanisms, focus on structures), operational (identification of short-term experiments and actions, focus on practices), and reflexive (monitoring, assessment, evaluation, learning) activities. The framework is flexible and can be applied on different societal scales (Loorbach, 2010; Rotmans et al., 2001). However, these approaches, and the literature on the governance of sustainability transitions more widely, have often been criticised for neglecting the role of power, politics, legitimacy, and individual agency in sustainability transitions (e.g. Avelino et al., 2016; Dentoni et al., 2017; Huttunen et al., 2021; Markard et al., 2012; Meadowcroft, 2011; Rauschmayer et al., 2015). Sustainability transition researchers have attempted to address this critique (Avelino and Wittemayer, 2016), and in recent years there has been a diversification of theories and conceptual frameworks used to study sustainability transitions (Truffer et al., 2022). In relation to power and politics, attention has now been paid to (changing) power relations between the diverse actors in sustainability transitions, power dynamics between regimes and niches, empowerment processes, the situated nature of power in sustainability transitions through the impact of historical and spatial contexts, and the politics in relation to decisions on the directionality of sustainability transitions (Avelino and Wittemayer, 2016; Avelino et al., 2016;

Meadowcroft, 2011). Most research on the governance of sustainability transitions concentrates on climate change and energy and mobility transitions (El Bilali, 2020; Hinrichs, 2014) and an increasing number of researchers are now focusing on the idea of just and legitimate sustainability transitions (Bennet et al., 2019; Cha, 2020; Newel and Mulvaney, 2013; Sareen and Haarstad, 2020; Stupak et al., 2021). The dominant approach in this literature on just and legitimate sustainability transitions has become to prescribe a specific notion of justice or legitimacy and then assess whether this notion is adhered to or how it can be achieved (e.g. Bennet et al., 2019; de Geus et al., 2022; Droubi et al., 2022; Heffron, 2022; Heyen et al., 2021; Knox et al., 2022; Kronsell, 2013; Sunio, 2021; Vringer and Carabain, 2020). But this neglects to take account of the normativity of justice and legitimacy itself (Montenegro de Wit and Iles, 2016; Smaal et al., 2020; Wang and Lo, 2021; Wijsman and Berbés-Blázquez, 2022; Wolff, 2008). Thus, whilst this is a step toward addressing the disruptiveness of sustainability transitions, the approach remains instrumentalist, without coming to terms with the normativity and politics underlying sustainability transitions (Wigboldus et al., 2021). The interaction between the disruptive, normative, and political characteristics of sustainability transitions remains understudied in the sustainability transition literature. Köhler et al. (2019), in their review of literature on sustainability transitions refer to this as "*a moral vacuum in transition research*" (p. 16), accentuating the fragmentation in sustainability transition literature that examines implications of either the disruptive, normative, or political nature of sustainability transitions but rarely the interconnectedness of these characteristics and the implications thereof. Similarly, the works by de Geus et al. (2022), Hendriks (2009), Markard et al. (2012), Upham et al. (2015), and Wironen et al. (2019) highlight that questions concerning how heterogenous public opinions can be taken into account and how the social acceptability of sustainability transitions can be improved through governance remain largely unanswered. In addition, Truffer et al. (2022), in their perspective on the future of sustainability transition research, call for the need to increase understanding of the dynamics and implications of sustainability transitions in relation to public policy whilst Oliver et al. (2021) highlight the need for increased systemic thinking, transdisciplinary approaches, continuous learning, and the consideration of different phases through which sustainability transitions pass. In line with the work by these authors and linking to the current lack of clear guidance for the governance of sustainability transitions, I therefore argue that there is a need to develop a more comprehensive understanding of the governance of sustainability transitions in a way that explicitly acknowledges their disruptive, normative, and political nature and thereby increases their social acceptability.

1.2. Objective of the thesis

The overarching objective of this thesis is, therefore, to explore how sustainability transitions could be governed to enhance the social acceptability of both the sustainability transition process and its outcomes. In doing so, I aim to contribute both theoretically, by building theory around the governance of sustainability transitions, and empirically, by providing practical lessons for governance.

To meet my dual aim, I will address the following research questions:

1. What are the structural components of sustainability transitions?

2. What influences social acceptability perceptions of a sustainability transition?

3. How can governance be shaped to enhance the social acceptability of a sustainability transition?

The two 'what' questions are exploratory in nature whilst the 'how' question is explanatory. Together they can help to address considerations around the social acceptability of sustainability transitions (Köhler et al., 2019) and address the knowledge gap on how to simultaneously take the disruptive, normative, and political nature of transitions into account in the governance of sustainability transition processes.

In order to answer these research questions and fulfil my objective, I examine both previous literature from various academic disciplines and collect empirical data in the context of the English post-Brexit agricultural sustainability transition. The governance of agricultural sustainability transitions has so far been understudied in sustainability transition research in comparison to the governance of sustainability transitions in other sectors such as e.g. energy or mobility (El Bilali, 2020; Melchior and Newig, 2021). Yet, tackling the challenge of how food is produced sustainably is key for the future of civilization today, because it is dependent on a stable agricultural system in which farmers can reliably produce sufficient food to free enough people from activities related to food production, as this creates the opportunity to develop the diversity of institutions, jobs, art forms, etc. that make up a modern society (Tauger, 2011, p. 1). Focusing on an agricultural sustainability transition as a case is therefore of practical relevance but also contributes to widen and deepen our understanding of the governance of sustainability transitions beyond the energy and mobility sector. The English post-Brexit agricultural sustainability transition in particular can be considered a critical case of agricultural sustainability transitions and, because it is currently ongoing, it provides an opportunity to explore

perceptions of social acceptability as and when they develop in relation to governance practices, which can contribute to the theoretical understanding of how these kinds of perceptions are formed.

1.3. Outline of the thesis

This thesis is based on a collection of papers. In the next chapter, I provide background information on agricultural sustainability transitions in general, and the post-Brexit English agricultural sustainability transition in particular. This is followed by a description of the research design, including argumentation for why the English agricultural sustainability transition is a suitable case for this study, and methodology. I then provide a brief summary of each of the appended papers. Lastly, I present and discuss a synthesis of the collective empirical and theoretical results of this thesis to answer my research questions and fulfil my objective.

2. Case study context

In this chapter, I first provide an overview of the rationale behind the call for agricultural sustainability transitions as well as the current understanding of these processes. I then introduce the English post-Brexit agricultural sustainability transition. I provide an overview of the English agricultural sector in the years leading up to the beginning of the sustainability transition (2014 - 2020) as well as how the sustainability transition plans developed during the period in which I prepared for and collected the data on which this thesis is built (February 2020-July 2022). It should be noted, however, that this is a dynamic policy area.

2.1. Current understanding of agricultural sustainability transitions

The agricultural sector is one of the sectors that has been highlighted as requiring a sustainability transition (Dornelles et al., 2022; El Bilali, 2020; FAO et al., 2021; Martin et al., 2018; Young Park et al., 2021). Currently dominant agricultural practices, which are in part a result of the agricultural policies that incentivise particular ways of farming (FAO et al., 2021; Pe'er et al., 2020), considerably contribute to climate change, biodiversity loss, environmental degradation, and social inequality (Awuchi et al., 2020; Cadieux and Slocum, 2015; IPCC, 2019; Mares and Peña, 2011; Poore and Nemecek, 2018). Simultaneously, agricultural systems are increasingly under pressure from these same challenges, as they alter the natural conditions within which agriculture has to function and change the dominant requirements that society asks agriculture to fulfil (Burkett et al., 2014; IPBES, 2019; Nelson et al., 2005; Pichs-Madruga et al., 2016). For example, climate change increases variability of weather patterns and extreme weather events that alter the conditions that crops and livestock need to be able to withstand, and an increase in the global population is leading to higher output demands (Hazell and Wood, 2008; van Vliet et al., 2015). Efforts to set in motion these kinds of sustainability transitions have already begun. For example, in the European Union, reforms to the Common Agricultural Policy (CAP) are underway to bring it in line with the environmental ambitions of the Green Deal (European Commission, 2021) and in England, Brexit is being used by the Department of Environment, Food, and Rural Affairs (DEFRA) as a window of opportunity to structurally change agricultural policy to incentivise a change in agricultural practices toward more environmentally friendly ways of farming and thereby create an agricultural sustainability transition (DEFRA, 2018a; 2020a; 2020b).

However, agricultural sustainability transitions, and more specifically the governance of agricultural sustainability transitions, have only recently become a topic of scientific inquiry in the sustainability transition literature and insights into their workings and governance are still fragmented and limited (El Bilali, 2020; Melchior and Newig, 2021). There has been considerable attention in the wider agricultural transition literature to the agricultural transition that took place in New Zealand in the mid-1980s (e.g. Gouin et al., 1994; Johnsen, 2003; Turner et al., 2020), but because the reforms leading to this transition did not come forth out of environmental concerns and were limited to a removal of subsidy programs (Vitalis, 2007), this transition was not strictly speaking a sustainability transition (Geels, 2011). Lessons that can be drawn from that case can therefore only be applied to the governance of agricultural sustainability transitions to a limited extent. In addition, there has been research that applied a transition perspective on historical agricultural transitions and other kinds of agricultural transitions and transformations that were primarily concerned with improving social conditions of workers or technological change (e.g. Baur and Iles, 2022; Kerridge, 1969; McWilliams, 1941; Van der Veen, 2010), but as the context and characteristics of the kinds of agricultural sustainability transitions that societies are facing today differ from these kinds of transition processes (Hölscher et al., 2018; Geels, 2011) it is unclear in how far insights from these strands of literature can be generalised to the kinds of agricultural sustainability transitions that societies are facing today and that this thesis is concerned with. This limited knowledge on how to govern agricultural sustainability transitions is problematic given the repeated calls for agricultural sustainability transitions by the international scientific community (IPBES, 2019; IPCC, 2019), the commitments of the international community to bring about sustainability transitions (European Commission, 2019; UN, 1992a, 1992b, 2015a, 2015b, 2021), and the potential role that governance design can play in enhancing or worsening the social acceptability of sustainability transition processes and outcomes.

Like in the sustainability transition literature more broadly, the Multi-Level Perspective and Transition Management dominate as approaches in the literature on the governance of agricultural sustainability transitions and, hence, the research gaps in relation to the governance of agricultural sustainability transitions are similar as in relation to sustainability transitions more broadly (Dentoni et al., 2017; El Bilali, 2020; Martin et al., 2018; Melchior and Newig, 2021; Sarabia et al., 2021). In their recent review on literature on the governance of agricultural sustainability transitions, Melchior and Newig (2021) point out that the focus in this strand of literature is primarily on lock-ins in the status quo, and potential transition pathways and how to achieve them. A recent development is a stronger focus on the application of just transition thinking to agricultural sustainability transitions (Aubert et al., 2021; Blattner, 2020; Carlisle et al., 2019; Dale, 2020; Hebinck et al., 2021; Hedberg, 2021; Murphy et al., 2022; Stevis, 2021; Tschersich and Kok, 2022; Whitfield et al., 2021; Wieliczko et al., 2021; Young Park

et al., 2021). However, these articles tend to mirror the prescriptive approach taken in the just transition literature more broadly, thereby neglecting the potential implications of taking an explicit normative stance in governance on what a just agricultural transition should entail. In addition, questions on how to legitimize agricultural sustainability transitions remain largely understudied (notable exceptions are Akimowicz et al., 2022; Montenegro de Wit and Iles, 2016; van der Velden et al., 2022; van Oers et al., 2018).

When using a wider lens and looking at literature on the governance of agricultural innovation rather than agricultural sustainability transitions (given that innovation forms a central part of sustainability transitions), an extensive literature review (the particular methods of which are described in chapter 3.5.1.), indicates that the main focus in the literature on the governance of agricultural innovation is on adaptive capacity and uptake of innovations, Responsible Research and Innovation, co-innovation, and (Mission-oriented) Agricultural Innovation Systems. Factors that have been identified as influencing adaptive capacity include social capital, access to resources, innovative capacity, knowledge and education, perceived self-efficacy, ability for collective action, degree of diversity, psychosocial factors, and the (flexibility of the) institutional context/structure (e.g. Asfaw et al., 2016; Lyle and Ossendorf, 2005; Mase et al., 2017; Morton et al., 2017; Zeweld et al., 2019). Various ways of stimulating learning for innovation and the increase of adaptive capacity and the role of information networks in learning processes have received specific attention (Anh Tran, 2020; Beers et al., 2019; Blundo-Canto et al., 2017; Cadger et al., 2016; Di Lacovo et al., 2017; Hermans et al., 2015; Ingram, 2015; Isaac, 2012; Lundström and Lindblom, 2018; Pant, 2014; Shaw and Kristjanson, 2014). Another form of capacity that is addressed is transformative capacity. Here, articles examine the role of psychosocial and cultural factors and current levels of transformative capacity (Hubeau et al., 2019; Marshall et al., 2016; Vänninen et al., 2015), the role of transformative capacity to create resilience (Darnhofer et al., 2010; James and Brown, 2019), and trade-offs in transformations toward sustainability (Kanter et al., 2018). Overall, the majority of these capacity articles focus on one societal level, i.e. they address the capacity of the individual farmer/farming household, a (farming) community, a system or subsector within agriculture, or the country level, with individual farm(er)s/farming households being studied most frequently (see also Eakin et al., 2016). Only very few articles examine the relation between societal levels, their interactions, and the effects that this has on the adaptive or transformative capacity across these levels (exceptions are e.g. Chaudhury et al., 2017; Chhetri et al., 2012; Cohen et al., 2016; Turner, Klerkx, et al., 2017). Nevertheless, insights from this literature on adaptive, innovative, and transformative capacity can potentially add to the dominant approaches in the wider governance of sustainability transitions literature by gaining deeper insights into the potential disruptive impacts of sustainability transitions on individuals and aspects

that may mitigate these impacts, and by increasing the emphasis on the role and agency of individuals (i.e. micro level). Having sufficient adaptive capacity provides a minimum requirement for individuals to have agency in relation to a sustainability transition and forms the basis for individuals' power in sustainability transition processes (both in terms of having power over and having power to effect outcomes) (Haugaard, 2012; Morriss, 2002). This is essential as the collective behaviour of many individuals combined provides the key to the direction and the success or failure of sustainability transitions (at the meso and macro level). The wider adaptive governance literature can assist in integrating the lessons from this adaptive capacity literature into understandings of the governance of sustainability transitions through its focus on flexible, learning-based, processes that link individuals (or actors) and local contexts to institutions and wider socio-ecological system dynamics (Allen et al., 2023; Chaffin et al., 2014; Sharma-Wallace et al., 2018).

Articles focusing on Responsible Research and Innovation highlight the social and ethical aspects of innovation, thereby providing a potential avenue through which the limited attention to social acceptability perceptions in the dominant sustainability transition governance literature could be addressed. They thematise the need for anticipation of consequences, inclusion of stakeholders, reflexivity, and responsiveness (Eastwood et al., 2019; Rose and Chilvers, 2018; Rose et al., 2021), with the underlying aim to improve the societal uptake of innovations (Asveld et al., 2015). The overwhelming majority of articles using the Responsible Research and Innovation framework are case studies which address the (potential) application of responsible innovation processes or use the framework to assess one specific (type of) innovation such as smart/digital farming options (Bronson, 2018, 2019; Eastwood et al., 2019), gene editing (Bogner and Torgersen, 2018; Bruce and Bruce, 2019; Macnaghten, 2016), development and/or use of biofuel (Di Lucia and Ribeiro, 2018; Shortall et al., 2015; Temples and van den Belt, 2016), use of unmanned aerial vehicles (Devit et al., 2019; Frankelius et al., 2019), or technological innovation in a broader sense (Klerkx and Rose, 2020; Overton et al., 2019). The other empirical cases either focus on the possibility for responsible innovation in a specific agricultural sub-sector (Bruijnis et al., 2015; Purwins and Schulze-Ehlers, 2018), the assessment of tools for responsible research and innovation (Tricarico et al., 2020), or the assessment of valuation of the use of responsible innovation practices and its effect on competitiveness (Lees and Lees, 2018). Few articles focus on theory development (Blok et al., 2018; Gremmen et al., 2019; Long and Blok, 2018; Rose and Chilvers, 2018). Together, these articles raise awareness to the normative and disruptive nature of innovation, but often lack a reflection on their own underlying normative starting points (Blok and Lemmens, 2015), and they give only limited attention to political dynamics. An approach that does take an explicit reflexive stance is reflexive governance, but this is seldom used in relation to agricultural innovation and sustainability transitions (exceptions are Hendriks and Grin, 2007; Kirwan

et al., 2017; Marsden, 2013; McNutt and Rayner, 2014; Metze and van Zuydam, 2018). We therefore currently lack in depth understanding of how insights from reflexive governance, including the use of triple-loop learning, (e.g. Feindt and Weiland, 2018; Pickering 2019; Voss and Bornemann, 2011; Voss and Kemp, 2006) can be used in the governance of agricultural sustainability transitions in a way that increases the social acceptability of the sustainability transition processes and their outcomes.

Closely related to the Responsible Research and Innovation dimension of stakeholder inclusion, many articles have been written that examine co-innovation processes. These articles highlight that the inclusion of stakeholders in the innovation process has the potential to enhance the acceptance and applicability of the end result and can create a bridge between knowledge and action (Kok et al., 2021). This strand of literature has links to, and reflects insights from, the wider literature on collaborative governance that highlights that the outcomes of collaborative stakeholder inclusion processes are not a given positive, but depend on how these processes are structured and conducted, how they take account of aspects such as differing power relations, capacities to participate, mutual trust, and shared motivations (Ansell and Gash, 2008; Emmerson et al., 2012). In the agricultural sustainability transition and innovation governance context, studies have focused on co-innovation projects related to one specific type of innovation such as digital agriculture, (Eitzinger et al., 2019), technological innovation (Hodges, 2012; Pang and Hu, 2014), biopesticides (Rijswijk et al., 2018), conservation agriculture (Titonell et al., 2012), and certain management practices (Klerkx et al., 2017; Malley at al., 2017), as well as on enabling innovation in a broader sense (King et al., 2019; Prost et al., 2018). Several articles have examined dynamics that are at play in co-innovation networks/systems (Fielke et al., 2018; Hermans et al., 2013; Klerkx et al., 2010; Lamers et al., 2017; Srinivasan and Elley, 2018; Turner et al., 2020), whilst others have focused on describing and assessing the outcomes of specific kinds of co-innovation projects in more overarching terms (Haas et al., 2016; Klerkx et al., 2017; Pinxterhuis et al., 2018; Swiergiel et al., 2019). In addition, a number of researchers have aimed to develop methods, principles, and tools for co-innovation (Berthet et al., 2018; Coutts et al., 2017; Ditzler et al., 2018; Kalkanci et al., 2019; Pigford et al., 2018; Quintero-Angel et al., 2020) and the co-creation of knowledge (Ingram et al., 2018; Magala et al., 2019; Pingault et al., 2020; Schindler et al., 2016; Turner, Williams, et al., 2017; Witteveen et al., 2017; Šūmane et al., 2018). Insights from the wider collaborative governance literature can potentially provide a bridge between insights from this body of literature on agricultural co-innovation, the dominant approaches in the governance of sustainability transition literature, and social acceptability perceptions.

Agricultural Innovation Systems approaches aim to both understand and enable agricultural innovation. They describe and examine networks of actors and the (institutional) structures that

influence how these actors interact with the aim of optimising the system for the specific innovation that is under study. Their strength lies in taking a systemic perspective and being able to identify how the network configuration of actors and their socio-institutional context either hampers or supports the innovation under study (Klerkx et al., 2010; Klerkx et al., 2012; Rajalahti et al., 2008). Their weakness lies in their limited attention to political and normative dynamics (Klerkx et al., 2012; Schlaile et al., 2017) and their focus on optimising the specific system under study without paying attention to how this may affect alternative innovation pathways (Pigford et al., 2018). Recent studies have further emphasised the normative orientation of Agricultural Innovation Systems, and linked them more closely to sustainability transitions, by examining how they can be used to support specific 'missions' to address large scale societal challenges, thereby creating Mission-oriented Agricultural Innovation Systems (Fielke et al., 2023; Klerkx and Begemann, 2020; Klerkx et al., 2022). As such, (Mission-oriented) Agricultural Innovation System approaches can contribute to the wider literature on sustainability transitions by highlighting the explicit normativity of sustainability transitions and, in the context of agricultural sustainability transitions, by providing insights into what aspects need to be in place and come together to move a specific agricultural sustainability transition pathway forward. However, they provide only limited insights into questions of governance related to the social acceptability of prior defined missions of specific agricultural sustainability transitions. Linking (Mission-oriented) Agricultural Innovation Systems approaches to insights from adaptive, reflexive, and collaborative governance literature might be a way of mitigating this.

Overall, it is evident that the majority of literature on the governance of agricultural innovation focuses on one specific (type of) innovation or innovation project, with the most commonly addressed type of innovation being technological innovation (including e.g. digitalisation and gene editing) (exceptions are e.g. Dogliotti et al., 2014; Malley et al., 2017; Ragasa et al., 2016; Swiergiel et al., 2019). The governance and management of innovation processes that address other types of innovation such as management practices, policy instruments, institutional innovation, or the creation of new types of products and services are understudied. Furthermore, and because of this limited focus, there seems to be a lack of reflection in the governance of agricultural innovation literature on the overarching direction in which the agricultural sector is developing. Whilst individual (types of) innovations are being scrutinized, there is little debate about where the combination of all these innovations is taking us, how various innovations and their consequences relate to, and interact with, each other, what it means for society, and if the direction that is currently dominant (i.e. strong emphasis on technological fixes for all problems) is desirable both in the short- and long-term. Even though several articles (e.g. Devitt et al., 2019; Klerkx and Rose, 2020; Rose and Chilvers, 2018) raise the point that it is important to reflect on who benefits and who loses from certain innovations, which reflects the increased

emphasis on justice in the sustainability transition literature more broadly, this has not yet been examined on a larger scale. In addition, when reflections on potential consequences are made, they often only focus on the specific innovation under study without taking into account potential interactions with other innovations that could aggravate or mitigate both positive and negative consequences. This indicates a knowledge gap in this strand of literature on the potential long-term and structural (disruptive) effects of (the combination of multiple) innovations and their role in (re)distributing power among stakeholders within national agricultural systems as well as on a global scale.

Combining these knowledge gaps in the literature on the governance of agricultural sustainability transitions and agricultural innovation with the gaps in the wider sustainability transition literature, and being aware that it needs to be examined in how far the insights from agricultural innovation literature apply to agricultural sustainability transitions and sustainability transitions in general, makes it clear that whilst there exists considerable knowledge on different sub-aspects that are relevant to the governance of (agricultural) sustainability transitions in the sustainability transition literature, we still know relatively little on how to combine all these sub-aspects and how to govern these processes holistically and in a way that increases their social acceptability.

The case of the English post-Brexit agricultural sustainability transition offers an opportunity to address these knowledge gaps and fulfil the overarching aim of this thesis. While England was part of the European Union, it was bound to the CAP. Now, as a result of Brexit, for the first time since 1973, England has the opportunity to revise its approach to agriculture and to develop its own agricultural policy (Lightfoot et al., 2017). DEFRA is using this opportunity to create a transition toward more sustainable farming practices. The aim of this English agricultural sustainability transition centres around the creation of a collective good: improved environmental conditions (DEFRA, 2020a). To reach this aim, DEFRA is in the process of introducing deliberate means to direct and accelerate changes in agricultural practices (Rotmans et al., 2001) through extensive change in agricultural policy (DEFRA, 2020b). The extent of the policy changes and the aim to create on the ground change in agricultural practices in combination with an embeddedness in a wider context of changes in aspects such as a new Environment Act (Environment Act, 2021) and new trade agreements (Department for International Trade, 2022) which are all targeted at creating systemic change, or, to follow the terminology of the Multi-Level Perspective, a regime-shift (Geels & Schot, 2007), in the socio-ecological sub-system that is the agricultural sector, make this a clear example of an attempt to create a sustainability transition (Geels, 2011; Hölscher et al., 2018). Whether these efforts in the end will result in an agricultural sustainability transition on the ground remains to be seen. Regardless, however, this case provides a

good example around which efforts to govern ambitions for the creation of a sustainability transition can be examined.

2.2. The English post-Brexit agricultural sustainability transition

There have been several reforms of the CAP over the years (Massot, 2021a). Under the version of this policy that was in effect during the period between 2014-2020, the focal point that took up around 70% of national funding allocation was a Basic Payment Scheme (Direct Payments) under which farmers could receive subsidies based on the amount of land that they manage (Massot, 2021b). This system was meant primarily as income support for farmers (European Parliament, 2020). In the United Kingdom, support to farmers was operationalised through this Basic Payment Scheme, a Countryside Stewardship scheme aimed at improving biodiversity, water quality, and flood management, and support for rural businesses, including a Countryside Productivity scheme (DEFRA, 2014). As agriculture is a devolved matter, and the focus of this thesis is on England, the remainder of this chapter will describe the specifics for England.

In the period leading up to Brexit, and consequently England leaving the CAP (2015-2018[1]), the average farm business income was £43.400, of which 58% came from Direct Payments; although there were stark differences between farm types, farm sizes, and ownership type, as shown in Table 1. In total, 85.000 farms received Direct Payments, totalling up to £1.775 billion. Half of this budget was paid out to 10% of claimants, whilst 33% of claimants received less than £5.000 per claimant. Furthermore, 75% of farms were profitable, but two thirds of them were so only due to additional income from diversification, agri-environment schemes, and Direct Payments (DEFRA and Government Statistical Service 2019).

Whilst over the years CAP has developed to also include instruments that are aimed at supporting the environment, it has been widely critiqued for not properly addressing environmental degradation (Leventon et al., 2017; Pe'er et al., 2019). The government of England at the time of Brexit shared this view and decided to use Brexit as an opportunity to create a transition away from the unsustainable Direct Payment system to a supposedly sustainable system in which public money payments to farmers for the provisioning of public goods such as clean water, clean air, thriving wildlife, and natural beauty should bring about changes in agricultural practices.

[1] This was the most recently available periodical data at the time of writing.

Table 1. Contribution of Direct Payments to farm business income in the period 2016-2018 divided by farm type and farm size.
Based on: DEFRA and Government Statistical Service, 2019.

Farm Type	Average Farm Business Income	% Direct Payments	Farm Size[2]	Average Farm Business Income	% Direct Payments	Ownership type	Average Farm Business Income	% Direct Payments
Lowland grazing livestock	£17.700	86%	Spare & part time	£16.600	77%	Owner occupied	£30.800	60%
Cereals	£45.200	73%	Small	£26.100	73%	Mixed – mainly owner occupied	£54.300	53%
General cropping	£78.000	54%	Medium	£39.100	63%			
LFA Grazing livestock	£27.000	88%	Large	£56.100	58%	Mixed – mainly tenanted	£63.700	54%
Mixed	£29.600	103%	Very large	£127.900	46%			
Dairy	£75.900	34%	All farm types	£43.400	58%	Tenanted	£28.400	86%
Horticulture	£42.000	9%				All farm types	£43.400	58%
Poultry	£107.500	8%						
Pigs	£39.600	26%						
All farm types	£43.400	68%						

[2] Size determined based on standard labour requirements (SLR). Spare & part time refers to farms with less than 1 SLR, small includes farms with 1 to less than 2 SLR, medium includes farms with 2 to less than 3 SLR, large includes farms with 3 to less than 5 SLR, and very large includes farms with 5 or more SLR.

The sustainability transition started in 2021 and is scheduled to be completed in 2028. Over this period, the Direct Payments will gradually be rolled back (DEFRA, 2020b). The original ideas and direction for this sustainability transition were formulated in 2018 in a policy document entitled 'A Green Future: Our 25 Year Plan to Improve the Environment' which called "*for an approach to agriculture, forestry, land use and fishing that puts the environment first.*" (His Majesty's Government 2018a, p. 9). The legal basis for the sustainability transition was set in 2020 with the Agriculture Act 2020 (Agriculture Act, 2020), but the exact plans are still under development.

The cornerstone of the sustainability transition is a set of Environmental Land Management (ELM) Schemes which aim

> *"to deliver environmental benefits, paying farmers, foresters and other land managers for interventions and actions that improve and enhance our environment, or for maintaining current land management practices that secure environmental public goods"* (DEFRA, 2020a, p. 7).

This overarching aim is broken down into nine goals: clean and plentiful water; clean air; enhanced biosecurity; minimised waste/pollution; mitigating and adapting to climate change; reduced risk of harm from environmental hazards; thriving plants and wildlife; sustainable and efficient use of resources, including clean/green growth, increased productivity, increased resource efficiency, and a more dynamic, self-reliant agricultural industry; and connecting more people (from all backgrounds) with the environment (Agriculture Act, 2020; DEFRA, 2019, 2020a, 2020b, 2020c, 2020d, 2021a; His Majesty's Government, 2018a, 2018b). Besides the ELM schemes, there are a number of other schemes currently under development, a summary of which is provided in Table 2.

These sustainability transition plans are the result of a process in which DEFRA conducted a number of engagement activities with stakeholders, as summarised in Table 3. There were two public consultations: the Health and Harmony consultation that ran from February to May 2018 and a policy discussion consultation that ran from February to July 2020 (with a pause between April 8th and June 25th due to Covid-19). The Health and Harmony consultation was centred around a consultation document in which DEFRA laid outs its initial thinking on the future for the agricultural sector and policy proposals (DEFRA, 2018a). The consultation consisted of an online survey, the possibility to send in free form responses through e-mail and post, seven policy roundtables, and seventeen regional events in the form of workshops. The online survey and e-mail or post responses were open to anyone.

Table 2. Overview of Post-Brexit schemes proposed in England at the time of data collection (February 2020-July 2022).

Scheme	Aim	Source
Environmental Land Management		
Sustainable Farming Incentive	Support production of public goods, contributing to 25 Year Environment Plan, Net Zero, & animal health & welfare standards	DEFRA, 2021b
Local Nature Recovery	Making space for nature in the farmed landscape and countryside	DEFRA 2022a
Landscape Recovery	Support long-term significant habitat restoration & land use change	DEFRA 2022a
Farming in Protected Landscapes	Support nature recovery, mitigate climate change impact, protect/improve quality & character of the landscape, & provide opportunities for people to discover & enjoy the landscape & its cultural heritage	DEFRA, 2021c
Tree Health Scheme	Slowing the spread of pests & diseases in specific trees	Forestry Commission & DEFRA, 2021
Animal Health & Welfare Pathway	Gradual & continual improvement in farm animal health & welfare	DEFRA, 2022b
Annual Health & Welfare Review	Rewarding higher animal health & welfare, above the regulatory baseline	
Animal health & welfare capital grants	Support the delivery of health & welfare priorities	
Disease eradication & control programmes	Support to prevent & reduce endemic diseases and conditions	
Payments-by-results	Rewarding high animal health & welfare outcomes	
Farming Investment Fund	Improving productivity & bringing environmental benefits	DEFRA, 2020b
Farming Equipment & Technology Fund	Improve productivity & efficiency for farming, horticultural, & forestry businesses	Rural Payments Agency, 2021a
Farming Transformation Fund	Improve productivity, profitability, & environmental sustainability	DEFRA, 2020b
Water Management grant	More efficient water use for irrigation & securing water supplies for crop irrigation	Rural Payments Agency, 2021b
Improving Farm Productivity grant	Reducing environmental impacts	Rural Payments Agency, 2021c

Scheme	Aim	Source
Future Farming Resilience Fund	Support farmers to transition their business to the new policy landscape	DEFRA, 2021d
Farming Innovation Programme	Increase productivity, sustainability, & resilience, reduce environmental impact, apply agricultural research, & use science to address challenges	DEFRA, 2020b; UK Research and Innovation, n.d.a
Industry-led Research & Development Partnership Fund	Supporting research ideas, project implementation, development of new products or services, and long-term innovation	DEFRA, 2020b; Innovation Funding Service, 2022
Farming Futures Research & Development Fund	Supporting the Net Zero Strategy	DEFRA, 2022c
Projects to Accelerate Adoption Fund	Supporting farmer-led projects to trial the viability of new innovations on farm	DEFRA et al., 2021
New Entrant Support Scheme	Encourage new starters into farming	DEFRA, 2020b, 2021e; Bidstats, 2022
Lump Sum Exit Scheme	Supporting farmers who wish to retire or take up a different occupation & freeing up land for new entrants & existing farmers who wish to expand	Rural Payments Agency & DEFRA, 2022

Note: there also exist several schemes in support of woodland creation. These have been excluded here, as they are not mentioned as part of the transition plans.

The policy roundtables and regional events were targeted at farmers, land managers, landowners, agronomists, environmental specialists, and other 'interested stakeholders'. The regional events were co-hosted by government agencies and stakeholder organisations (His Majesty's Government, 2018a). The policy discussion consultation was an online consultation, open to anyone, that consisted of 11 open questions related to DEFRA's initial thinking on the design of the ELM schemes. The launch of the consultation was supported by interactive webinars with land managers and 'other stakeholders' (DEFRA, 2020a, 2021f).

Table 3. Overview of engagement activities in the transition design process.
Based on DEFRA (2018a, 2018b, 2020a, 2020e, 2020f, 2020g, 2021a, 2021f, 2021g).

Engagement activity	**Who can take part**
Consultation (Feb. - May 2018)	Anyone
Consultation (Feb. - July 2020 – paused between April 8-June 25 due to Covid-19)	Anyone
Policy roundtables, regional events, & interactive webinars accompanying the consultations	Targeted at farmers, land managers, landowners, agronomists, environmental specialists, & other 'interested stakeholders'
Stakeholder engagement group	Invited stakeholder organisations only
Test & Trials	Selected projects
National pilot focusing on the Sustainable Farming Incentive scheme	Initially farmers who previously received basic payments & whose land has certain characteristics; the final phase should be open to all farmers
National pilot of other ELM schemes	Details are not yet available
Workshops & webinars on specific sections of ELM	Anyone
Submitting written evidence to the Agriculture Bill	Anyone
Submitting written evidence to the Environment, Food & Rural Affairs Committee (EFRA) enquiry into ELM	Anyone
Presenting oral evidence to the EFRA enquiry into ELM	Invited speakers only

Besides these consultations, DEFRA is running test and trials processes (started in 2018, still ongoing) and national pilots of several of the schemes. The tests and trials aim to create on-the-ground evidence to support the further design of the ELM schemes. They intend to test out potential elements of the schemes and trial innovative approaches whilst also helping the sector to prepare for the sustainability transition. Stakeholders sent in proposals for test and trial projects from which DEFRA then selected projects that would be conducted (DEFRA, 2020e). The national pilots run from late 2021 to 2024 and test the construction of agreements, the mechanisms underlying the schemes (e.g. application, advice, and payment), and how to target incentives to reach specific locally targeted environmental outcomes.

In total, DEFRA hopes to engage up to 15.000 farmers over the lifetime of the pilot (National Audit Office, 2019; DEFRA, 2020h). Two other ways through which stakeholders could officially express their views on the sustainability transition plans and their legal foundation were by sending in written evidence to the proposed Agriculture Bill and by taking part in an inquiry from the Environment, Food, and Rural Affairs Committee (EFRA) (EFRA, 2020; UK Parliament, n.d.).

3. Research design and methods

In this chapter I reflect on my research philosophy as point of departure and provide an overview of the research design, ethical considerations, and main methods that I used in the collection and analysis of the data. In addition, I discuss potential limitations of the chosen design and methods.

3.1. Philosophical point of departure

The starting point for this thesis lies in my philosophical understanding of the world that perceptions of social reality are socially constructed through interactions and experiences with others and the world around us (Ormston et al., 2014). The societal and cultural structures within which we live shape the way in which we view the world and evaluate our interactions and experiences with others. At the same time, we are able to either maintain or alter those structures through our behaviour (Giddens, 1984). From this, it follows that our behaviour in relation to sustainability transitions, our acceptance of them or our protest against them, will be guided by how we interact with the sustainability transition process and view that process and its outcomes. Because of this, I chose to give peoples' perceptions centre stage throughout this thesis rather than closing the analysis down based on predefined criteria for social acceptability. However, and because societal and cultural structures shape how we construct our views, I believe that it is possible to identify common understandings of social acceptability in a specific society, which can then be used to draw out lessons for governance of sustainability transitions that can be wider applicable. In addition, I believe that this social construction of reality relates to social properties such as values, attitudes, and perceptions, but does not prevent the existence of objectivity. For example, it can be objectively stated that sustainability transitions are inherently normative, but how this normativity is perceived and valued is socially constructed. In that sense, my ontological point of departure may best be described as critical realist constructivism (Robson and McCartan, 2016).

As I myself am not free from my own cultural context, I want to highlight that my focus on the social acceptability of a sustainability transition is rooted in my personal, culturally shaped, normative view that this is the morally right approach to sustainability transitions. The empirical and theoretical contributions that I make in this thesis are therefore grounded in this normative moral conviction. However, beyond this initial normative starting point, I aimed throughout the study to be aware of, and critically reflect on, my own normative views and tried to minimise their influence on the data collection, analysis, and interpretation. Therefore, the views expressed in this thesis on what aspects

are important for the governance of sustainability transitions are grounded in the empirical material rather than in my own normative views on these aspects.

From an epistemological point of view, I want to recognise that the process of conducting this research will have likely had an influence on how the participants in this research constructed their perceptions around sustainability transitions, as they were asked to actively reflect on specific aspects of sustainability transitions and their design process that they previously may not have thought about (Silverman, 2014).

In addition, and in line with the above mentioned, I see scientific disciplinary boundaries as socially constructed and not necessarily being reflective of the interdependency and complexity of real-world phenomena such as sustainability transitions. I therefore chose to take a pragmatic approach in the sense that I did not bind myself to a specific scientific discipline, but draw on insights from multiple disciplinary backgrounds, including for example political science, geography, sociology, and environmental psychology, based on their instrumental value in relation to my research questions (Robson and McCartan, 2016). I took this same approach in relation to my research methods, where I used both qualitative and quantitative approaches based on their relative merit to support finding an answer to the research questions that I am concerned with in this thesis, as described in more detail under section 3.5.

3.2. Case study design and generalisability

This thesis is largely designed as a critical case[3] within a case study. I chose agricultural sustainability transitions as a case of sustainability transitions. I chose the agricultural sector as a case because agricultural sustainability transitions have been understudied in the sustainability transition literature in comparison to e.g. sustainability transitions in the energy or mobility sector (El Bilali, 2020; Melchior and Newig, 2021). Yet it is one of the key contributors to climate change, environmental degradation, and biodiversity loss (Awuchi et al., 2020; IPCC, 2019; Poore and Nemecek, 2018) and a central sector underpinning modern civilization (Tauger, 2011). In addition, the disruptive, normative, and political characteristics of sustainability transitions are common to sustainability transitions in any sector (Avelino et al., 2016; Geels, 2011; Kivmaa et al., 2021; Köhler et al., 2019) and the general stages that a sustainability transition goes through are similar for any kind of sustainability transition (Du Preez and Louw, 2008; Smith et al., 2010). Therefore, in the case where results from this thesis are linked to the nature of sustainability transitions in general rather than to the specifics of the agricultural context,

[3] Also referred to as 'crucial case' case study (e.g. Bennett, 2004; Levy, 2008).

it is possible to draw theoretical generalisation for the governance of sustainability transitions in general, beyond the agricultural context. Future research will be needed to examine whether these theoretical generalisations hold in practice (Carminati, 2018; Lewis et al., 2014).

I chose the empirical focus on the English agricultural sustainability transition because it can be considered a critical case of agricultural sustainability transition. A critical case is a case that has "*strategic importance in relation to the general problem*" (Flyvbjerg, 2006, p. 231). The criticalness of a case results therefore from the empirical properties inherent in the case and the relation of those properties to the phenomenon or theory that is of interest (Gerring, 2007). Critical case studies can be used both in an explanatory and exploratory way and provide the opportunity to develop and test theory (Rowley, 2002), which aligns well with the dual aim of this thesis. The case selected here is a 'most likely' type of critical case. 'Most likely' critical cases are cases where it is considered most likely that a theory will hold (Bennett, 2004; Gerring, 2007; Levy, 2008): "*If it is not valid for this case, then it is not valid for any (or only few) cases*" (Flyvbjerg, 2006, p. 230).

The English agricultural sustainability transition can be regarded as a case of sustainability transition because it fulfils the four key characteristics of a sustainability transition. First, it fulfils the characteristic of having a focus on a specific societal sub-system, i.e. the agricultural sector (Hölscher et al., 2018). Second, it fulfils the characteristic of having a deliberate directionality on improving environmental conditions, in contrast to more 'quasi evolutionary' transitions that tend to have no clear prior defined direction and come about as a result of (economic) optimisation efforts and gradual evolvement of interactions between (technological) innovations and their application in daily life (Smith et al., 2005). Third, it fulfils the characteristic of focusing on the creation of a collective good, i.e. enhanced environmental conditions. Fourth, and finally, it also fulfils the characteristic of having a lack of obvious (economic) benefits to the stakeholders in the sector of concern (i.e. the agricultural sector), due to the focus on a collective good and the lack of a rationale of economic optimisation as the measures needed to implement the transition and reach the goals of the sustainability transition are often (initially) less cost effective and less 'comfortable' than the state that is being transitioned away from, which means that there is a need for policy change in order to provide the incentives and frame conditions needed to implement the sustainability transition (Geels, 2011; Hekkert et al., 2020; Meadowcroft, 2011).

The English agricultural sustainability transition can be considered a most likely critical case of agricultural sustainability transition for several reasons. First, large scale policy change to bring about a sustainability transition, such as proposed in the English case, is a specific type of change that has a guaranteed impact on many people. It sets the context for a sustainability transition and requires

active changes in behaviour (Lindberg et al., 2019). Consequently, it provides a situation where stakes are high and likely diverse. It is therefore most likely that different normative views and power struggles can become visible in this sustainability transition process. Second, policy change and societal change generally happens through incremental processes of gradual change and small alterations to the existing policy structure and societal systemic characteristics over time, in an evolutionary fashion (Kern and Howlett, 2009; Rotmans et al., 2001). In this case however, England has been set free from its original policy landscape that was bound by the regulations from the European Union and is now aiming to create a complete break with the old policy and related agricultural practices in a relatively short timeframe (DEFRA, 2020b, 2020c). It is therefore most likely that the disruptive, normative, and power dynamics that are always present within sustainability transition processes will be amplified in this case (Kivmaa et al., 2021). Third, and finally, the English agricultural sustainability transition is currently ongoing, which means that the farmers and other stakeholders are directly confronted with a sustainability transition that they need to react to in one way or another. It therefore allows for the examination of perceptions in relation to the sustainability transition as it happens rather than pro- or retrospectively, making it most likely that perceptions on the sustainability transition are very present in the minds of the stakeholders. This is an important characteristic because the perceptions in the moment will ultimately influence stakeholders' behaviour in relation to a sustainability transition, not the perceptions they have (far) in advance or afterward (Ajzen, 2011). The case chosen for this study can thus be regarded as a most likely critical case of agricultural sustainability transition because if certain normative, political, and disruptive dynamics inherent to agricultural sustainability transition do not come forward in this case, it is unlikely that they will be present in other (or only few) cases of agricultural sustainability transitions and will therefore most likely not be relevant to the governance of such processes. Because of this characteristic of my selected case, it allows for empirical and theoretical generalisation (Bennett, 2004; Flyvbjerg, 2006; Lewis, et al., 2014; Rowley, 2002) which is necessary to fulfil my thesis' dual aim of theory development and the identification of widely applicable empirical lessons for the governance of sustainability transitions.

However, because this thesis builds on a west-European case only, the results should not unreflectively be generalised to different parts of the world. I argue that, due to the cultural closeness, the results can be generalised to European Union countries. When considering the application of these results to countries beyond the European Union, additional attention should be paid to potential cultural differences in the notion of social acceptability (Lewis et al., 2014).

3.3. Setup of the study

This thesis is a compilation, built around four papers, each of which emphasise different aspects of my three research questions. Paper I has as its main analytical focus generic structural components that a sustainability transition consists of and thereby addresses my first research question and contributes to reduce the fragmentation in the current literature on the governance of sustainability transitions (Allen et al., 2023; El Bilali, 2020; Melchior and Newig, 2021). Papers II, III, and IV address my second and third research questions by examining the various aspects that make up perceptions of social acceptability: perceived legitimacy (paper II), perceived justice (paper III), and perceived adaptive capacity and willingness to adapt (paper IV) (Busse and Siebert, 2018). Each of these papers thus focuses on different aspects of social acceptability perceptions, but together they provide in-depth insight into how people form their social acceptability perceptions of sustainability transitions and how governance might be able to contribute to enhance the social acceptability of sustainability transitions. As such, these papers together contribute to our understanding of how governance can engage with the implications of the disruptive, normative, and political nature of sustainability transitions (de Geus et al., 2022; Hendriks, 2009; Köhler et al., 2019; Markard et al., 2012; Upham et al., 2015; Wironen et al., 2019).

Papers II, III, and IV can be considered embedded case studies as each focuses on the perceptions of a different group of people within the overarching case of the English post-Brexit agricultural sustainability transition. Paper II focuses on self-proclaimed stakeholder organisations' perceptions, paper III examines perceptions of the general English adult population, and paper IV focuses on perceptions of farmers and organisations that support farmers through the sustainability transition. The rationale for choosing this approach, rather than to focus on one group of people throughout all papers, was to capture the breadth of people who are affected by a sustainability transition. In addition, by using multiple embedded cases, I strengthen my foundation for theoretical generalisation (Robson and McCartan, 2016). The rationale behind focusing on self-proclaimed stakeholder organisations in paper II on perceptions of legitimacy was enabling the inclusion of a wide range of diverse interests in the sustainability transition, the reach that organisations have (i.e. they are representative for a wide array of stakeholders and speak on behalf of their members), and their active interest in the sustainability transition. Especially the latter two points make them important actors in creating support for, or protest against, a sustainability transition. For paper III on perceived justice, the rationale for focusing on the general English adult society was that societal perceptions of injustice are motivators for political protest (Rothmund et al., 2016; Wieliczko et al., 2021), which can undermine a sustainability transition (Herrero et al., 2020b; Markard et al., 2020; Martin and Islar,

2020; Meadowcroft, 2011). Being able to account for societal justice perceptions is therefore of central importance to the governance of sustainability transition processes. For paper IV on perceived adaptive capacity and willingness to adapt, the reason to focus on farmers and organisations supporting farmers through the sustainability transition was that farmers are the central target in the sustainability transition design in England and are therefore the stakeholders who likely need to make most adaptations.

By connecting the insights gained from answering my first two research questions I fulfil my aim of theory development. By connecting and integrating the findings in relation to my second and third research questions with the developed theoretical framework I fulfil my second aim of providing practical lessons for governance. The two aims together fulfil my overarching objective. Figure 1 provides a schematic overview.

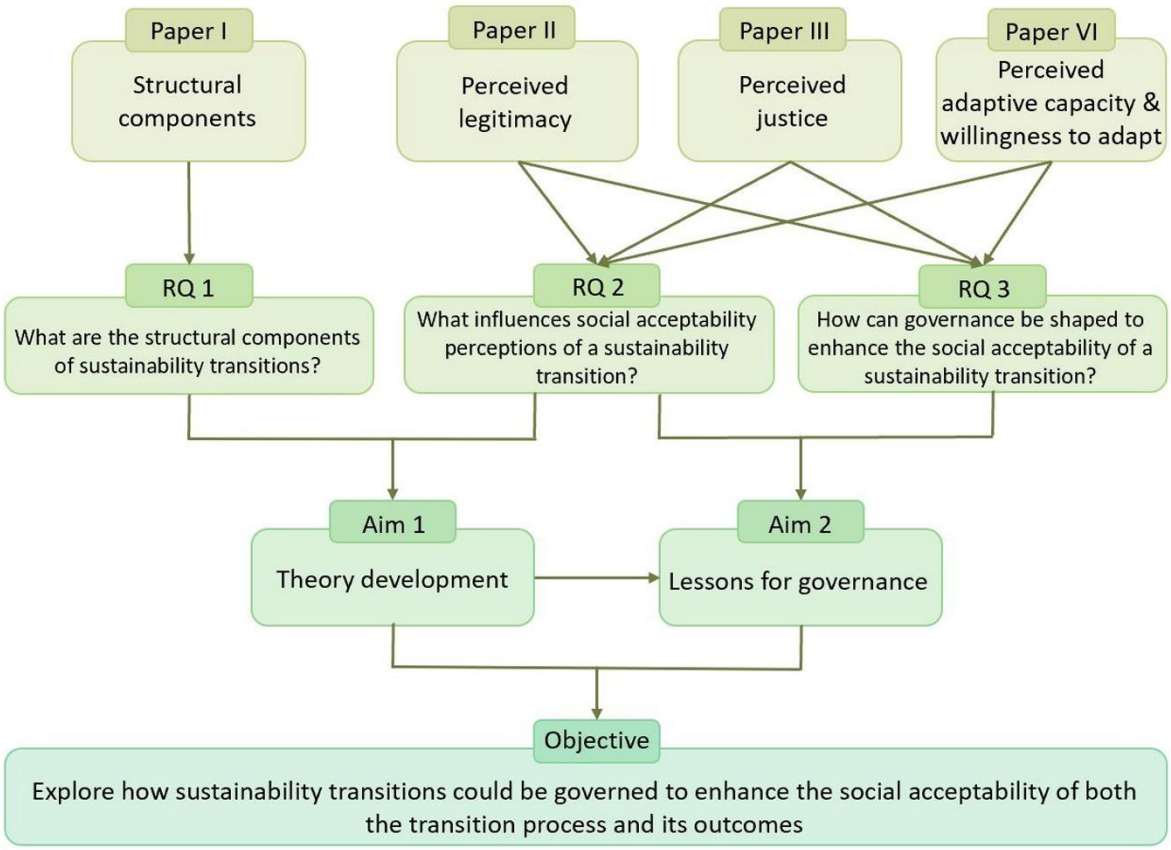

Figure 1. Schematic overview of how the different papers contribute to the overall objective.
Findings in relation to RQ 1 are presented in chapter 5.1, findings in relation to RQ2 are presented in chapter 5.2. Chapter 5 as a whole fulfils my first aim. Findings in relation to RQ3 are presented in chapter 6, which also fulfils my second aim.

3.4. Ethical considerations

As this thesis included research with people (interviews and a survey), it is important to reflect on ethical considerations. Following the University of Reading standards (University of Reading, n.d.a), I applied for ethical clearance from the School for Agriculture, Policy, and Development Ethical Clearance Committee for all research activities involving people. Ethical clearance was granted for all activities.

For papers II and IV, which build on interview data, potential participants were contacted through e-mail or via phone with a brief description of the project and aim of the interview and how I obtained their contact information, and were asked if they would generally be interested in taking part in an interview. If they indicated that they were potentially interested, they received a follow up e-mail with the specifics of the interview and a participant information sheet that described the project in more detail, explained why they were chosen as a potential participant, and how their data would be handled should they choose to participate. This information was also repeated at the beginning of the interview to ensure that participants could give their informed consent to participation (Allmark et al., 2009). All interviews were recorded and transcribed with the consent of participants.

As the interviews for paper IV with farmers had the potential to cause personal upset, prior to the interviews I reflected on what questions may potentially be upsetting and how I would handle the situation if this would occur. This included informing the farmer that they do not have to talk about anything they do not want to talk about, being prepared to stop asking questions in a specific direction when it is obvious that the questions cause upset, and, where appropriate, being prepared to point the farmer in the direction of potential places of support (Knott et al., 2022).

All interview recordings were stored in password protected files and were deleted once transcribed. As it was not possible to fully anonymise the transcriptions of the recordings, they are likewise stored in password protected files. Contact details and participant background information have been stored in two separate, password protected files. All files were stored on my password protected laptop and I was the only person who had access to them. I also developed anonymised summary tables of key themes in the interviews, which enable the sharing of material upon request in line with open and transparent research standards (UK Research and Innovation, n.d.b). All non-anonymised material will be destroyed at the end of the project, but no later than 31.01.2028. Utmost care has been given to ensure that, in the published research material, no data is linked to identifiable individuals or organisations. However, in the cases where the target population was small (the organisations

interviewed for paper IV), I informed the potential participants prior to participation that I cannot guarantee that people will not be able to guess the organisations that I spoke to.

To ensure that the participants felt like their participation was not just a one-way street of information sharing, once research material that their interviews contributed to was accepted for publication, I shared this with them. When participants indicated that they were more generally interested in the development of the project, I also kept them updated on any other project related publications.

For paper III, which builds on survey data, data collection both for the pilot and the full survey happened anonymously. For the pilot, I recruited participants through university mailing lists. Interested participants could click on a link that would redirect them to the survey, where they received additional information on what to expect and data handling. As the main goal of the pilot was to improve the full survey, pilot data will be destroyed at the end of the project, but no later than 31.12.2025.

For the full survey, participants were recruited through a Qualtrics survey panel. The majority of the samples that Qualtrics use come from traditional, actively managed, double opt-in market research panels. Qualtrics' sample partners randomly select respondents for surveys where respondents are likely to qualify, with some exclusion taking place based on category exclusion, participation frequency, etc. Respondents were invited through email invitation, in-app notifications, SMS notifications, and/or when they sign in to a panel portal. In these e-mails or notifications, the potential participant was only informed that the survey is for research purposes, how long the survey is expected to take, and what incentives are available for participation. Once the potential participants opened the survey link, they saw a page with additional information on what the survey is for, what they can expect from participating in it, how their data will be used, and how they can contact me if they have any questions. In addition, it was highlighted that if they click on to the next page, they give their consent to participate in the study.

As the data were collected by Qualtrics as a third party, I ensured that they followed the University of Reading's guidelines and the contract agreements on anonymous data collection, preventing the collection of any type of identifiable data such as names, e-mail addresses, or IP addresses. This enabled me to guarantee anonymity to the participants. This was an important requirement, as I collected sensitive information on aspects such as political orientation, income level, and religion. To align with standards on open and transparent research (UK Research and Innovation, n.d.b; University of Reading, n.d.b), the data obtained in the survey are deposited to the University of Reading's Research Data Archive for open access (de Boon, 2023).

Overall, as I see it as my responsibility to contribute to an open research culture, I opted to publish research output related to this PhD project under a Gold Open Access license where my budget allowed.

3.5. Data collection

3.5.1. Literature review (papers I, II, III, and IV)

Paper I is built on an extensive literature review of research articles with a focus on the governance or management of agricultural innovation or agricultural sustainability transition as well as dominant theoretical approaches in the agricultural innovation and agricultural sustainability transition literature. Whilst closing down the search around these topics, the review was not constrained based on disciplinary boundaries and is therefore interdisciplinary in nature. The rationale behind choosing this method was that it enabled me to create an overview of the available knowledge and to connect insights and theoretical developments from multiple disciplines that are often not engaging with each other in a more holistic way to reflect the interconnectedness of the setting within which sustainability transitions take place (Robson and McCartan, 2016). In addition, this meant that I could integrate the strengths of multiple theoretical frameworks into one framework and address their respective weaknesses. I used the Web of Science core collection database as a starting point for this review, but added additional articles through snowballing and expert feedback on the initial list of selected articles. The search terms, as displayed in Table 4, were generated through an initial scanning of literature on agricultural innovation and governance and adjusted after several trial searches.

Table 4. Search Criteria for literature review paper I.

	Search Criteria
Indexes	SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI
Timespan	1945-2020 (as the search was conducted on March 10, articles published after that date were not included)
Search string	TS=(agri* OR farm* OR horticultur*) AND (innovat* OR “socio-technical transition” OR pathway OR future OR vision*) AND TS=(“reflexive governance” OR “adaptive governance” OR “transition governance” OR “deliberative governance” OR “participatory governance” OR “transformative governance” OR “reflective governance” OR “responsible governance” OR “adaptive management” OR “transition management” OR “deliberate transformation” OR “reflective deliberation” OR “responsible innovation” OR “responsible research and innovation” OR “responsible research & innovation” OR “co-innovation” OR “participatory innovation” OR “collaborative innovation” OR “inclusive innovation”) OR (“adaptive capacity” OR “transformative capacity” OR “innovative capacity” OR “responsive capacity”)
Inclusion criteria	have a central focus on agricultural innovation processes and the management or governance of these processes or the capacity to undertake such processes

The selection process for article inclusion in the final review is displayed in Figure 2.

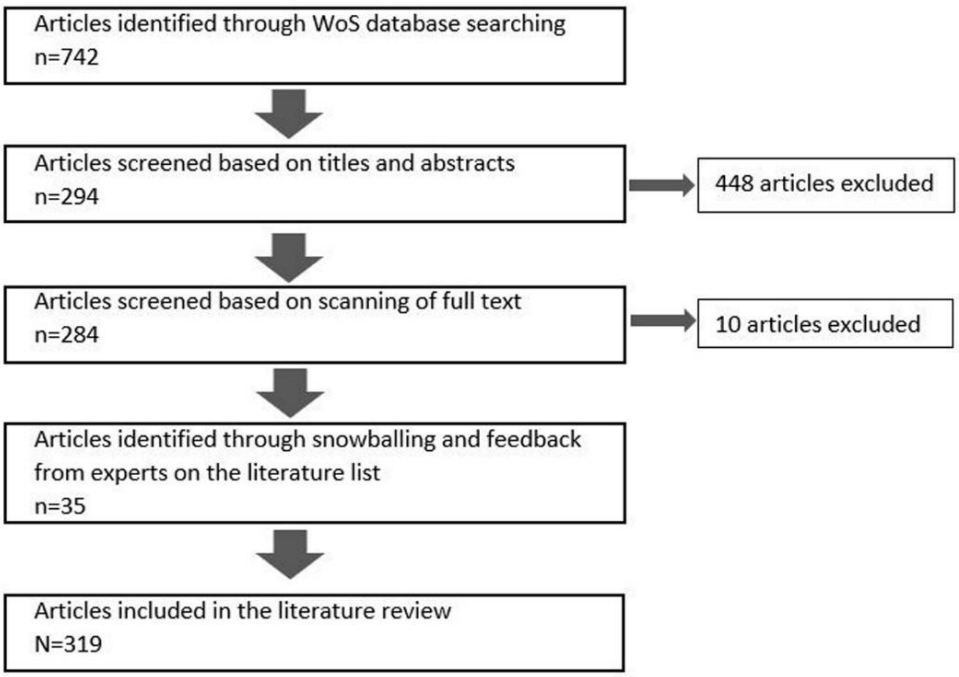

Figure 2. Selection process of articles that were included in the literature review of paper I.

The theoretical approaches that I chose to be added to the review were selected based on their prominence in the literature included in this extensive literature review, their specialisation on components that were dominant in the reviewed articles, and their complementarity to each other. They included the Multi-Level Perspective, Agricultural Innovation Systems, Innovation Management, Responsible Research and Innovation, and Theory of Planned Behaviour. In addition, to bring these theories and the key themes from the literature review together into one comprehensive framework, to further operationalise the normative and political dimension of transitions, and to strengthen understanding of the role of governance in the socio-ecological context within which agricultural sustainability transitions take place, I was inspired by insights from the literature on the governance of socio-ecological systems and the work by Emerson and Nabatchi (Emerson et al., 2012; Emerson and Nabatchi, 2015). It must be noted, however, that whilst this literature review was extensive, it was not exhaustive. I.e., there exist other theories and strands of literatures that did not figure dominantly in this literature review, due to the used search string and inclusion criteria, that may be able to provide additional insights that are relevant to our understanding of how governance can potentially contribute to enhance the social acceptability of sustainability transition processes and their outcomes depending on how the governance arrangements are designed and how they influence collective behaviour and link collectives of individuals (or actors) and local contexts to institutions and wider socio-ecological system dynamics within sustainability transition processes. This is a limitation of this

study, but one that had to be made based on practical considerations of scope and available resources and time constraints. Potential literatures that future research could draw on to further develop the work that is presented in this thesis include, but are not limited to, political economy, political ecology, literature on the diffusion of innovations, philosophical approaches to (ethics in) innovation, psychology of innovation, critical agrarian studies, and rural sociology.

Papers II, III, and IV also included literature reviews, but these were more restrictive and fulfilled a somewhat different purpose. For paper II and III these reviews were non-systematic but aimed at saturation of the material. I searched for articles both through Web of Science and Google Scholar as well as through snowballing. For paper IV, the review included all the articles that I identified in the review for paper I which were coded under the theme of adaptive capacity. Additional articles were added through snowballing and a broad search on Google Scholar and Web of Science to identify articles that had been published after the review for paper I was conducted. For these three papers, the purpose of the review was to operationalise the central concept of the paper: perceived legitimacy, perceived justice, and perceived adaptive capacity and willingness to adapt respectively. This then served to structure both the empirical data collection and the data analysis, and to place the study results into the context of previous research. As with the literature review for paper I, these literature reviews were interdisciplinary in nature, covering fields such as political philosophy, social psychology, environmental governance, environmental justice, food justice, social justice, and sociology. The focus on these strands of literature was chosen because they have specialised on questions surrounding the normativity in systemic societal structures and distributional mechanisms of costs and benefits in society, as well as social acceptability perceptions both at an individual (micro) and societal (meso) level. Therefore, combining insights from these strands of literature with the insights from the literature on the governance of sustainability transitions and the literature on the governance of agricultural innovation and agricultural sustainability transitions can be a fruitful undertaking to address the current knowledge gap in the sustainability transition literature around how governance can potentially help to enhance the social acceptability of sustainability transition processes and their outcomes depending on how governance arrangements are designed. Equally as with the literature review for paper I, these literature reviews were not exhaustive and future research can focus on integrating insights from other fields such as political economy, political ecology, and social movement studies into the work that is presented in this thesis.

3.5.2. Policy data (paper II)

Paper II includes an analysis of policy documents related to the central ELM schemes of the proposed English post-Brexit agricultural sustainability transition. The purpose of this analysis was to gain insight

into the transition design (the problems it is trying to address, the goals it wants to achieve, and the measures that are proposed to reach those goals) and the process through which this was developed. This material was also used as input to the interviews for paper II. Policy documents were selected in a bottom-up manner, starting from the policy domain (Ossenbrink et al., 2019). I created an initial list of 28 documents based on systematic searches for agriculture related documents on the UK government and UK parliament websites. I sent this list to civil servants within DEFRA and the Department of Business, Energy, and Industrial Strategy to ensure that there were no relevant documents missing, as all documents that I initially selected were (co-)authored by either of these departments. After this, I narrowed the list down to 9 documents, based on their relevance to ELM. In order to include information on the design process, I added 5 official reports related to engagement opportunities. All documents were published between 29.03.2017 (the date that Brexit became official) and 25.03.2021 (before I started the interviews). Table 5 provides an overview of the included documents.

Table 5. Selected documents for the policy analysis.

Date of publication	**Title of document**	**Relation to ELM**
Jan. 2018	A green future: Our 25 year plan to improve the environment (inc. Annex 1-3)	Sets out the goals that ELM is striving to fulfil
Feb. 2018	Health & Harmony: the future for food, farming & the environment in a green Brexit	Consultation document that described DEFRA's initial thinking on agricultural policy after Brexit
Sept. 2018	Health & Harmony: the future for food, farming & the environment in a green Brexit. Summary of responses	Summarizes the input that DEFRA received on the Health & Harmony consultation
May 2019	At a glance: summary of targets in our 25 year environment plan	Sets out goals that ELM is striving to fulfil
June 2019	National Audit Office Early review of the new farming programme	A review by the National Audit Office of DEFRA's progress to date with the development of new agricultural policy
Feb. 2020	Farming for the future. Policy & progress update	Describes the current plans related to ELM & how the transition from CAP to ELM will gradually take place
July 2020	Environmental Land Management tests & trials. Quarterly evidence report. July 2020	Summarizes key findings so far from ELM Tests & Trials
Sept. 2020	Environmental Land Management tests & trials. Quarterly evidence report. September 2020	Summarizes key findings so far from ELM Tests & Trials
Nov. 2020	Agriculture Act	Provides the legal basis for ELM

Date of publication	Title of document	Relation to ELM
Nov. 2020	The path to sustainable farming – an agricultural transition plan 2021 to 2024	Describes the schemes that will be available in the transition period from CAP to ELM & how the reforms link to other policies
Nov. 2020	Multi annual financial assistance plan for the plan period 2021-2027	Describes the objectives for the transition period from CAP to ELM
Jan. 2021	Test & trials – Phase 3 'Landscape Recovery'	Notifies of a next phase in the Test & Trial project under ELM
Feb. 2021	Environmental Land Management. Policy discussion document	Describes the current design of ELM
March 2021	Sustainable Farming Incentive: Defra's plans for piloting & launching the scheme	Sets out in more detail the plans for the piloting of this component of the ELM scheme

3.5.3. Interviews (papers II and IV)

Papers II and IV are built around in-depth, semi-structured interviews. For both papers, the focus was on peoples' perceptions around the English post-Brexit agricultural sustainability transition and how their experiences with the transition process influence their views and motivations for behaviour in relation to the English post-Brexit agricultural sustainability transition. Finding answers to the 'why' and 'how' questions was essential to address the underlying research questions related to these articles. The aim was not to identify facts about the English post-Brexit agricultural sustainability transition and transition design process, but rather to explore experiences with the English post-Brexit agricultural sustainability transition process and the way in which it is currently governed and how this influences how people construct their perceptions around the English post-Brexit agricultural sustainability transition. Therefore, I chose in-depth interviews as a method for these papers as they can reveal in detail experiences and motivations behind perceptions and help us gain insight into why people hold certain views (Miller and Glassner, 2021; Rubin and Rubin, 2012; Silverman, 2014; Yeo et al., 2014). I opted for interviews rather than focus groups because I wanted to conduct a detailed investigation into the views of the individual stakeholders within their own context and individual circumstances. A focus group would not have allowed me to do this to the same extent (Lewis and McNaughton Nicholls, 2014). A limitation of this method is that I am not able to include a representative number of participants, and the conclusions that I draw based on this material can therefore not be easily and broadly generalised. To address this limitation, as described below, in the selection of participants I took care to include a wide range of interests and diverse views, aimed for data saturation, and linked back the results to previous research and theoretical understandings (Carminati, 2018; Maxwell, 2021; Saunders et al., 2018). For both papers, I conducted a pilot interview,

prepared interview guides with general themes for discussion (as shown in paper II Annex C and paper IV Annex C), followed recommendations on interview structure and how to ask questions in a non-leading way as suggested by Yeo et al. (2014) and Robson and McCartan (2016), and used probes to ask for further clarification of answers when required.

For paper II, I conducted 14 interviews with self-proclaimed stakeholder organisations representing social interests, economic interests, environmental interests, and farmer, forestry, and landowner interests. I selected potential stakeholders for the interviews from a publicly available list of stakeholders who have given input to DEFRA's 2018 consultation around ELM (DEFRA, 2018b) or who sent in evidence to the process leading up to the Agriculture Act (UK Parliament, n.d.). From this list of 589 self-proclaimed stakeholders, I created a purposive sample in which I focused on the organisations' reach across England, different degrees of involvement in the English post-Brexit agricultural sustainability transition design process, and diversity of interests within each broad interest category. I continued contacting stakeholder organisations until I fulfilled these criteria and reached data saturation in the responses of the interviewees. I contacted 54 stakeholder organisations and 14 organisations agreed to be interviewed (two in the economic interest category, four in all other categories). Those who did not take part in the interviews either did not respond to my repeated requests (24), stated that ELM was not their main priority (six), or did not have the capacity to participate (10). All interview participants worked directly with ELM for their organisation and therefore had first-hand experience and knowledge of their organisation's views on the content of ELM and the process by which it is being designed. The interviews took place between the 8th of April and the 1st of June 2021 and lasted between 55 and 90 minutes. Due to the COVID-19 lockdown restrictions they were all conducted online, via MS Teams. I conducted and transcribed all the interviews. Prior to the interviews, I sent all participants a summary of the findings from the policy analysis so that they had the opportunity to reflect on their organisation's views on these specific aspects of ELM. This summary, which can be found in paper II Annex B, was also used during the interview as an anchor point for the conversation. During the interview, the interviewees were asked to reflect on what their organisation perceives to be the main problems that need to be addressed in relation to agriculture and whether the problems that the English post-Brexit agricultural sustainability transition is aiming to address are acceptable or whether there are aspects missing or included that should not be included. They were also asked about their views on the goals of the English post-Brexit agricultural sustainability transition and how they relate to the goals of their respective organisation. Other aspects that were covered in the interviews included views on the proposed policy instruments to bring about the sustainability transition, views on and experience with the transition design process, and overall support or lack thereof for the ELM in its current form.

For paper IV, I conducted 15 interviews with 16 farmers (two of the farmers were married to each other and were interviewed together) and nine interviews with 11 representatives of eight organisations who have received an assignment from DEFRA to provide business support to farmers in the early transition stages (for two organisations I interviewed two representatives simultaneously, and for one organisation I conducted two separate interviews with two representatives). I contacted potential farmers through mailing lists of farming organisations, the Just Farmers platform[4], the Farming Forum[5], a farmer WhatsApp group, and snowballing. In doing so, I contacted 61 farmers directly, and many more indirectly. I aimed to include farmers across England, spanning all agricultural sectors and farm types, ownership types, and a diverse range of age, gender, farm size, and experience with farming and environmental schemes. To ensure that I could also include farmers with poor or lacking internet connections, I offered to conduct interviews either via MS Teams, telephone, or in person. For the organisations, I invited all of the 19 organisations who at that time received an assignment from DEFRA under the Future Farming Resilience Fund to provide business support to farmers at the start of the English post-Brexit agricultural sustainability transition (Powley, 2021). The eight organisations that agreed to take part in the interviews were active across England, covered all agricultural sectors, and had collectively supported over 5.000 farmers in relation to the English post-Brexit agricultural sustainability transition through workshops or one-on-one advice. They therefore had detailed insights into the challenges and opportunities that farmers see on the road to adaptation. By combining the farmer interviews and organisation interviews I reached data saturation. However, whilst I ensured to include interviewees across farming sectors, farming types, locations across England, and stage in life, and furthered my reach by including representatives of organisations who work with many farmers, my sample is not representative and is relatively small compared to the total number of farmers that are active in England. In addition, it is a commonly known problem that some farmers are more difficult to include in research (Hurley et al., 2022), indicating that it is highly likely that a sample of farmers such as the one I used is skewed toward farmers who are generally more engaged with the English post-Brexit agricultural sustainability transition. However, many of the sentiments that were expressed in the interviews are also reflected in the general trends in opinions that have been recorded in DEFRA's Farmer Opinion Tracker for England in the last three years (DEFRA, 2021h; 2021i; 2022d), and therefore are likely to be largely in line with the wider farming community. The interviews took place during April-July 2022, lasted between 27 and 68 minutes, and were all conducted and transcribed by me. One farmer interview took place in person, three farmer interviews

[4] A project that aims to increase openness in British agriculture by providing a platform through which researchers and media can get in contact with independent farmers.
[5] A UK-run online forum for discussions about agriculture.

were conducted via phone, and all other interviews were conducted via MS Teams. The interviews with farmers focused on their views on their ability to adapt to the English post-Brexit agricultural sustainability transition and what they perceived to be the biggest challenges and sources of support for adaptation. They also covered their general views on the English post-Brexit agricultural sustainability transition, their willingness to adapt, and their motivations for adaptation.

3.5.4. Survey (paper III)

Paper III is built around survey data. The rationale for using a quantitative survey for this paper is that this is a method that is appropriate for addressing descriptive 'what' questions (Robson and McCartan, 2016), which aligns with the research question underlying this paper. In addition, as this paper focuses on perceptions held by the English adult population, it was important to use a method that is capable of giving a representative view of what perceptions are present in the English society (Querós et al., 2017). A limitation to the survey method is that I lose depth in the data as regards to why people think what they think (Robson and McCartan, 2016). I aimed to mitigate this by including several open-ended questions in the survey, where participants could provide additional information if they wished to do so.

As the survey was distributed online through a survey panel from Qualtrics, it is also important to reflect on the (dis)advantages of this approach. The advantage of this approach, and the reason why I chose it, is that it enabled me to reach out to, and create a representative sample of, the English adult population that reflected the distribution of age, gender, income, educational level, and region in England. This would not have been possible otherwise, as there is no database available that links these characteristics to postal addresses. This therefore helped me in addressing coverage by ensuring that the sample I included was close to the characteristics of the overall population. However, it has to be noted that this approach did mean that only those people who have signed up to be part of a survey panel and those who have internet access could participate, which negatively impacts coverage errors (Coughlan et al., 2009; Schonlau et al., 2009). Another challenge with this approach is that I do not have full information regarding the response rate and consequently nonresponse, which made it impossible to identify whether there is a significant difference between survey participants and those people who decided not to take part in the survey (nonresponse error) (Dillman et al., 2014). This is, however, partially mitigated by the fact that the final sample was representative in terms of the above-mentioned key population characteristics.

I carefully designed the survey following broadly the steps and recommendations as suggested by Robinson (2018) and with the aim to minimise measurement error (Dillman et al., 2014). The survey

covered questions relating to perceptions on distributional justice, procedural justice, and recognitional justice and their respective constructs and sub-constructs. An overview of the full survey can be found in de Boon (2023). Where possible, the items used in the survey were based on previously used and tested items and all were grounded in theoretical operationalisation of the assessed concepts. All items were critically evaluated for their comprehensiveness, understandability and language, closeness to the concepts that were assessed, and neutrality of wording in two one-hour workshops (one with six environmental governance researchers and one with five agricultural innovation researchers), five cognitive interviews with people from the general public (age range 39-68, three female, two male), and a quantitative pilot with 81 participants (staff and students at the University of Reading). As the survey was self-administered and anonymous, I was able to reduce bias in answers provided based on expected societal desirability (Larson, 2019). In addition, to minimise systemic bias resulting from item-ordering, for all questions, all items were shown in random order (Wilson and Lankton, 2012; Wilson et al., 2017).

The survey was live collecting responses between January and April 2022. To ensure the representativeness of the sample and the quality of the data included, attempted responses were terminated when a quota in a certain group (e.g. age, income, education level) reflecting the known population value was met (Heen et al., 2014), when a respondent was younger than 18, or when they were speeding through the survey. Responses were excluded from the final sample based on duplication, straight lining, or partial responses (Qualtrics, n.d.). For a breakdown of the sample distribution compared to the English population distribution see paper III Appendix A Table A.2.

3.6. Scientific standards for data collection

Table 6 provides an overview of the collected material. To ensure the quality of the material, I took several precautions. For the extensive literature review for papers I and IV and the policy data for paper II, I took a systematic approach in collecting the material and asked for feedback from experts in the field to ensure that I did not miss any key documents. Similarly, for the literature reviews related to papers II and III, I ensured that in the operationalisation of the concepts concerned I did not miss key aspects by including feedback from workshops and discussions with experts both on environmental governance and agricultural innovation and (qualitative) pilots.

For the qualitative interview material, I focused on diversity in the inclusion of participants, data saturation, and transparency in my methodology. I also piloted the interview guide and used a flexible design to ensure that I captured the information in the interviews that I was aiming to include (Robson and McCartan, 2016; Yeo et al., 2014). By being transparent in how I collected, analysed, and presented

the data (for example by making the interview guides publicly available, clearly describing the analysis process, and including quotes to support my interpretation), I strengthened the confirmability, trustworthiness, and auditability. By linking back to and comparing the data with results from previous studies and theoretical understandings, I increased the generalisability of the results (Daniel, 2019; Nassaji, 2020).

For the quantitative material, I focused on representativeness and generalisability by ensuring that the sample reflected key population characteristics and I used a fixed design to ensure measurement standardisation (Dillman et al., 2014; Robson and McCartan, 2016). I also statistically evaluated construct reliability and validity (Mat Roni and Djajadikerta, 2021; Raykov, 2001; Taber, 2018), and, where these were not adequate, I excluded individual items or entire constructs from the final analysis. This ensured that I could reduce potential measurement errors (Dillman et al., 2014).

Table 6. Overview of collected material.

Data collection	Year	Paper	Target	Sample size	Measure to ensure data quality
Literature review	2020	I	Literature on governance & management of agricultural innovation and sustainability transition	319	Systematic approach; expert feedback
	2021	II	Literature on perceived legitimacy	>40	Expert feedback
	2021	III	Literature on perceived justice	>65	Expert feedback
	2020; 2022	IV	Literature on perceived adaptive capacity & willingness to adapt	>100	Systematic approach; expert feedback
Policy data	2021	II	Documents related to the proposed ELM Scheme	14	Systematic approach; expert feedback
Interviews	2021	II	Self-proclaimed stakeholder organisations	14	Pilot interview; diversity of participants; flexible design; data saturation; transparency in methods; connecting back to previous research
	2022	IV	Farmers Representatives of organisations supporting farmers through the sustainability transition	16 11	
Survey	2022	III	General English adult population	400	Representativeness; fixed method; evaluation of construct reliability & validity

3.7. Empirical data analysis

3.7.1. Qualitative analysis (papers I, II and IV)

For the analysis of the qualitative material, I followed the method for thematic analysis as described in Braun and Clarke (2006). As described below in more detail, I used an iterative, mainly mixed deductive-inductive approach where I started the analysis from a predefined analytical frame but remained open to new patterns that might be apparent in the data (Robson and McCartan, 2014). I primarily focused on what the participants explicitly said (semantic themes), but also considered how something was said and in what context, thereby capturing how participants constructed their expressed views and their relative importance (at a more latent level). Combining these two contributed to addressing the dual aim of this thesis of theory building and identifying practical lessons for governance (Braun and Clarke, 2006). In addition, this method of analysis was flexible enough to be compatible with the different analytical frameworks that I used in the various articles, whilst at the same time providing a clear structure for systematic analysis (Robson and McCartan, 2014).

For the literature review in paper I, I analysed the material to identify key structural components that are important for the governance of sustainability transitions in an iterative and inductive way. In the first round of analysis, based on the abstracts of the articles, I created a spreadsheet in which I recorded the author(s), year of publication, title, the country or region studied, the overarching and detailed focus of the article, the main topic, the method used, the theoretical framework used, whether it focused on innovation in general or a specific innovation or technology, and whether the article included an empirical case or was theoretical. In the second round, I grouped the articles based on their primary focus (capacity, co-innovation, co-creation of knowledge, responsible innovation, pathways, perceptions, governance, and overarching reviews) and created summaries of each of the articles. In the third round, I analysed these summaries to identify reoccurring components that had been highlighted as playing a role in innovation processes and their governance. Finally, I presented these components to my co-authors and collected feedback on them at conferences and departmental seminars, to ensure that I had not overlooked central components.

For the policy data for paper II, I started out by coding the documents in NVivo 12 around deductively generated themes based on my operationalisation of perceived legitimacy and analytical frame (problem formulation, goal formulation, and solution formulation/policy instruments; see paper II Table 2 for details). In a second step, for each of these themes I coded inductively for all sub-themes. In doing so, I separated out specific mentioned problems, targets, and policy instruments. In a third

and final step, I revised all these sub-themes and coded them into more overarching themes based on their commonality.

For the analysis of the interview transcripts for paper II, I used the same analytical frame, but conducted the analysis in a spreadsheet rather than in NVivo. For each of the themes and sub-themes from the analytical frame and the policy analysis I summarised the interviewees' views and included quotes that supported those summaries. I also created overall summaries of the main points highlighted in each interview. Whilst I grouped the interviewees based on the specific stakeholder interest type that they represented, I analysed the transcripts separately, to ensure that I would also be able to capture differences in views within stakeholder interest types. Having this material summarised in a spreadsheet enabled me to easily identify differences and similarities in views both between individual interviewees and between stakeholder interest types.

For the analysis of the interview transcripts for paper IV, I returned to using NVivo 12. The reason for this was the amount of material, which would make summary overviews in a spreadsheet unwieldy. In a first step, I analysed the interview transcripts from the interviews with the farmers in a separate file from the analysis of the transcripts from the interviews with the organisation representatives. For both, I categorized the material in an iterative manner into initial overarching themes, sub-themes, and categories within the sub-themes following the dimensions of adaptive capacity as I had previously identified in the literature (perceived adaptive capacity, willingness to adapt, and institutional characteristics, for details on the sub themes see paper III, Figure 1). Where appropriate, I added additional themes inductively. These inductively generated sub-themes and categories represented aspects of perceived adaptive capacity that had not been prominent in the previous literature. In a second step, I collated the themes, sub-themes, and categories from both analyses into one framework to create an overarching picture of the material. Dividing the analysis in these two steps allowed me to create both an overarching understanding of the material and to identify potential differences in perceptions between the farmers and the organisations' representatives. In addition, by moving back and forth between the two separately coded materials and the combined overview I could evaluate my consistency in the coding process.

3.7.2. Quantitative analysis (paper III)

Prior to the analysis, I downloaded the dataset from Qualtrics and recoded the dataset to be more intuitive. For example, where Qualtrics' standard coding for a seven-point Likert-scale answer option was from one to seven, I changed this to minus three to plus three to reflect the negative, neutral, or positive characteristic of the answer provided. Equally, when a question was a reversed-question, I

reversed the scoring. A data dictionary that describes the pre-processed data for each of the questions and answer options, the scoring for answer options that was initially assigned by Qualtrics, and the recoded scoring, is available in de Boon (2023). As the final dataset did not include any responses with missing data, I did not have to be concerned with any measures to take account of these (Rubin and Little, 2020).

As the underlying research questions for this article aimed at identifying the underlying dimensions of people's normative justice evaluations and examining whether these can be used to assess societal perceptions of what a just sustainability transition means to a specific society, the quantitative analysis focused on the identification of latent constructs present in the collected data, which could show the dimensions and sub-dimensions that people use to make justice evaluations, and the reliability and validity of the survey instrument to assess the various justice dimensions. For both of these purposes, and because the survey instrument that I developed has not been tested in previous studies, a combination of Exploratory and Confirmatory Factor Analysis (EFA and CFA respectively) was an appropriate method of analysis (Worthington and Whittaker, 2006). EFA can be used to empirically identify latent constructs, or factor structures, without the use of restrictions based on a prior defined theoretical structure. It can explain in a parsimonious way covariation in observed, or measured, variables (Flora et al., 2012; Watkins, 2018). This therefore enabled me to examine whether the factors in the empirical data that I collected reflected the structure that I expected based on previous theory, or whether it suggested a potentially alternative structure. CFA on the other hand is a method that can be used to assess the validity and reliability of constructs and should generally follow an EFA analysis (Worthington and Whittaker, 2006). Both EFA and CFA can thereby contribute to theory building and the development of an instrument (summated rating scale) that can have empirical use in the support of the governance of sustainability transitions. To conduct this analysis, I followed broadly the steps as suggested by Boateng et al. (2018), Robinson (2018), and Spector (1992).

First, to get a feeling for the data, I examined mean values, standard deviations, Mardia's skewness and kurtosis, and the Henze-Zirkler multivariate normality test to determine whether the normality assumption was met, which was not the case. I also examined the suitability of the data for factor analysis with the Kaiser-Meyer-Olkin (KMO) test, where values above 0,70 indicate that the data are suitable (Watkins, 2018; Worthington and Whittaker, 2006).

Second, as the KMO test was satisfactory, I assessed Cronbach alpha and conducted EFA. Cronbach alpha is a measure of scale reliability (internal consistency reliability) with values of 0,70 or above generally stated as the cut-off value, but with some room for leeway (Bagozzi and Yi, 2012; Taber, 2018). I used common factor analysis, MinRes as estimation method as this does not require the

fulfilment of specific distributional assumptions, and oblimin as factor rotation method as the nature of the justice constructs makes it highly likely that the factors are correlated (Watkins, 2018; Worthington and Whittaker, 2006). As criteria for factor retention, I used a combination of the Kaiser's criterion (where factors with an Eigenvalue of <1 are retained), examination of the scree plot, parallel analysis, and theoretical sense (Kahn, 2006). Criteria used to determine item deletion or retention were based on item loadings and cross-loadings, as well as Cronbach alpha if item is dropped (Worthington and Whittaker, 2006). This was an iterative process in which I retained or deleted individual items, followed by another EFA and examination of Cronbach alpha values, until I identified a stable, satisfactory factor structure.

Third, I conducted CFA and examined the average variance extracted (AVE) to assess construct validity, with AVE values of 0,50 or higher considered being acceptable (Hair et al., 2019; Lockwood et al., 2015). I used a robust version of the maximum likelihood estimator with scaled test statistics (equal to Yuan Bentler) and robust standard errors (Huber-White) (Maydeu-Olivares, 2017; Rosseel, 2014). To assess construct reliability, I examined Raykov's rho coefficient, where values should ideally be above 0,70 (Hair et al., 2014; Peterson and Kim, 2013; Raykov, 2001). To assess discriminant validity, I examined the Fronell-Larcker Criterion, where the square root of AVE of a construct needs to exceed the correlation of the construct with the other constructs (Mat Roni and Djajadikerta, 2021).

Fourth, for three of the justice perception sub-dimensions, the way the questions and items were designed was inappropriate for an EFA and CFA analysis. Instead, I therefore focused the analysis on determining whether there was a significant difference between items through a Friedman Test (Pimentel et al., 2016), assessed the strength of the difference with Kendall's W (Field, 2005), and identified which items grouped together through a Wilcoxon Signed Rank test (Smalheiser, 2017). For these sub-dimensions I also examined mean values, standard deviations, and combined frequency tables.

In a final step, I created summated rating scales for the justice perception constructs and sub-constructs by calculating the weighted summated mean. I used weighted means to account for the difference in strength of each of the items in relation to the construct (DiStefano et al., 2009; Robinson, 2018). These final two steps supported the empirical contribution, by enabling the illustration of the usefulness of the survey instrument in a policy design context.

I conducted all the analyses in RStudio version 1.4.1717 (Rstudio Team, 2021) using the packages lavaan (Rosseel, 2012) and psych (Revelle, 2022). Overall, as I had no previous experience with these kinds of quantitative analysis and the use of R, throughout the quantitative analysis process, one of

my co-authors for paper III, Dr. Sabrina Dressel, supported me by teaching me how to work with R and things to consider in the analysis, answering any questions that I had, and going through the analysis together with me to ensure that my coding was correct.

4. Summary of appended papers

This chapter provides a summary of the four papers around which this thesis is built. The full versions of these papers are attached at the end of this thesis. As related in chapter 3.3., paper I addresses the first research question of my thesis, i.e. What are the structural components of sustainability transitions? Papers II, III, and IV together address the second and third research questions by examining different aspects of the concept of social acceptability (perceived legitimacy, perceived justice, and perceived adaptive capacity and willingness to adapt), i.e. What influences social acceptability perceptions of a sustainability transition; and how can governance be shaped to enhance the social acceptability of a sustainability transition? A discussion of how the findings of these papers interconnect with each other and answer my overarching research questions is presented in chapters 5 and 6.

4.1. Paper I. Governing agricultural innovation: A comprehensive framework to underpin sustainable transitions

This paper starts from the premise that sustainability transitions are highly complex, normative, and political processes. Governing them in a socially acceptable way requires understanding of all the structural components that come together to shape the direction and outcome of sustainability transition processes. This paper highlights that, hitherto, approaches to (agricultural) sustainability transitions tend to specialize on a specific scale or sub-aspect of innovation or sustainability transition processes. For example, the Multi-Level Perspective focuses on the macro and meso level of sustainability transitions where it examines dynamics between niche-innovations, regimes (currently dominant and institutionalized way of delivering societal functions), and the landscape (macro level societal and environmental processes). The Agricultural Innovation Systems approach focuses on the meso level, examining networks of actors and the (institutional) structures that influence how these actors interact, with the aim of optimising the system for the specific innovation that is under study. The Responsible Research and Innovation approach connects the meso- and micro level and highlights social and ethical aspects of innovation with the underlying aim to improve the societal uptake of innovations. The Innovation Management approach focuses on the micro level, where attention is paid to individual innovation processes with a focus toward different stages that comprise an innovation process. Individually, these approaches give valuable insights into their respective focus area, but they do not provide the comprehensive understanding of sustainability transition processes that is required

to govern agricultural sustainability transitions sustainably. Based on an extensive literature review, this paper combines theoretical developments from multiple disciplines related to 1) the micro level: individual human behaviour and individual innovation processes, 2) the meso level: interactions between innovation processes and the contextual factors that impact upon them, 3) the macro level: the broader system within which the innovation processes take place, and 4) the way in which 1, 2, and to a certain extent 3 are shaped through governance whilst simultaneously feeding back into the governance process themselves. The resulting framework describes seven key structural components and their interactions: macro context, governance system, immediate context, innovative and adaptive capacity of the actors, psychosocial factors, and the innovation process itself. Based on these components and the potential disruptive, normative, and power dynamics within them, I propose a set of guiding questions for reflection that can support the governance process and make explicit the specific normative and political underpinnings of sustainability transition processes.

4.2. Paper II. Perceived legitimacy of agricultural transitions and implications for governance. Lessons learned from England's post-Brexit agricultural transition

This paper starts from the premise that it is essential for the social acceptability of a sustainability transition that stakeholders perceive a sustainability transition as legitimate. A lack of perceived legitimacy can be a hurdle to the implementation of a sustainability transition, stand in the way of compliance with the required measures, and result in societal unrest. In this paper, I examine how the governance of agricultural sustainability transitions can be shaped to improve the perceived legitimacy of a sustainability transition. Through a combined lens of normative and sociological approaches to legitimacy, I investigate legitimacy perceptions in relation to the English post-Brexit agricultural sustainability transition, both in terms of input legitimacy (problem and goal formulation), output legitimacy (policy instruments), and throughput legitimacy (processes). Building on a policy analysis and 14 semi-structured interviews with self-proclaimed stakeholder organisations representing farmer, forestry, and landowner interests; social interests; environmental interests; and economic interests, I find that goal alignment and clarity and credibility of goal formulations are essential in order to create perceived input legitimacy. In terms of perceived output legitimacy, I find that perceptions on the effectiveness of the design of the transition and specific policy instruments, as well as their diversity and fairness, play a central role. In terms of perceived throughput legitimacy, the results show that meaningful stakeholder inclusion and transparent processes are key factors. Generally, the results show that across all dimensions of perceived legitimacy, clarity and diversity in design and processes is essential. When stakeholders underwrite the spirit of a sustainability transition but do not have faith

in the policies that should bring about that sustainability transition and do not understand how specific decisions have come about, the perceived legitimacy of the sustainability transition will be negatively affected. I conclude that a combined lens of normative and sociological legitimacy forms a useful framework for future research to critically evaluate the normative and power dimensions of sustainability transition processes. In addition, it can support governments in their efforts to develop policies for agricultural sustainability transitions that will be accepted by society.

4.3. Paper III. A psychometric approach to assess justice perceptions in support of the governance of agricultural sustainability transitions

This paper starts from the premise that societal justice perceptions play an important role in the social acceptability of a sustainability transition, as perceptions of injustice are motivators for political protest and can undermine sustainability transition efforts. Besides this instrumental importance of justice perceptions, the call for 'just transitions' as incorporated in multiple international agreements and declarations also highlights a widely accepted normative stance, i.e. a conviction of how sustainability transitions ought to be conducted. However, it is to date unclear what exactly a just transition looks like and how this can be achieved. Furthermore, the international agreements, like many scientific articles, fail to recognise that justice has no universally agreed meaning. However, without a clear idea of what is perceived as a just transition, it will be very difficult to achieve. In this paper, I therefore develop an instrument, in the form of a survey that builds on the underlying dimensions that are generally used to make justice evaluations, which can give decision-makers insights into societal perceptions of what a just agricultural sustainability transition means to them. To build the instrument, I draw on insights from political philosophy, social psychology, environmental justice, food justice, and social justice literature and apply these to the context of the English post-Brexit agricultural sustainability transition. To assess reliability and validity of the tool, I collected data from a representative sample of 400 English adults and analysed these through Exploratory and Confirmatory Factor Analysis. I identify three dimensions that are used to form normative claims of justice, each consisting of several sub-dimensions: a) Distributional Justice, encompassing topics (environmental, economic, food, socio-environmental), policy focus (environment and animal welfare, social support, reducing agriculture), principles (equality, equity and need, entitlement, merit), and personal impact (self-improvement, not-worsening); b) Procedural Justice, encompassing degree of involvement and principles (equality, equity and need, entitlement, merit); and c) Recognitional Justice, encompassing stakeholder inclusion (agricultural, forestry and landowner interests, environmental and future generations' interests, social interests, economic interests), social inclusion

(minorities, children and disabled people, sexes), geographical scale (local, regional, national, global), and knowledge types (scientific, local/traditional). I establish adequate construct reliability and validity for a number of constructs such as equality, entitlement, and merit as principles of Procedural Justice, whilst others will need further refinement.

4.4. Paper IV. To adapt or not to adapt, that is the question. Examining farmers' perceived adaptive capacity and willingness to adapt to sustainability transitions

This paper starts from the premise that for sustainability transitions to be a success in the long term, affected actors need to be able to adapt to each of the stages of the sustainability transition. It therefore turns attention to the farmers and examines what aspects are important for their perceived adaptive capacity and willingness to adapt to a sustainability transition. Having sufficient adaptive capacity is a minimum requirement to be able to actively engage with sustainability transition processes and, in combination with the (un)willingness to adapt, forms the basis of farmers' agency and their ability to position themselves in relation to the sustainability transition and possibly even contribute to influence its direction. As such, it is the core from where pro-active engagement with sustainability transition processes, and the power to affect outcomes and transition pathways, can develop. It also influences who will be able to benefit from a sustainability transition and who will likely be disadvantaged. It is therefore a highly political aspect of sustainability transitions. So far, adaptive capacity literature has mainly focused on farmers' adaptive capacity in relation to climate change or individual innovations. However, as adaptive capacity always stands in relation to what the actor is adapting to, there is currently a knowledge gap on adaptive capacity in relation to sustainability transitions specifically. In this paper, I aim to address this by deepening our understanding of perceived adaptive capacity and willingness to adapt to a sustainability transition through 24 in-depth, semi-structured interviews with English farmers and organisations that work to support farmers in the context of the English post-Brexit agricultural sustainability transition. The interviewed farmers and organisations together cover all agricultural sectors and ownership types, a broad range of farm size, age, and experience with farming and environmental schemes, and are located all across England. The interview transcripts were analysed in NVivo 12 in an iterative manner, following the dimensions and sub-dimensions of adaptive capacity as identified in previous literature and adding additional themes inductively where appropriate. The results show many similarities with previous adaptive capacity literature, but also highlight aspects that have not yet been prominent and thus seem to be specific for adaptation in relation to sustainability transitions. These include the dual role that access to finances and information can play (especially the potential hampering factor of having access to plenty

of financial resources and ‘too much’ information), land ownership status, state of mind, succession options, feeling respected, appreciated, and understood, perceived level of control, and considerations of (global) consequences. Overall, the results show that many of the aspects influencing perceived adaptive capacity and willingness to adapt are highly interconnected. One aspect that is on its own seen as an enabling factor can potentially become a hampering factor when it interacts with another aspect. This means that when policy makers want to improve perceived levels of adaptive capacity and willingness to adapt, it is essential that they do not only focus on one aspect in isolation but take a more holistic approach. The overview of the structure of perceived adaptive capacity and willingness to adapt that I have built in this study can be used by policy makers in support of that. As the results appear to be linked more generally to the nature of sustainability transitions than to the specifics of the agricultural sector, I expect that these overarching lessons can also be relevant for sustainability transitions in other sectors.

5. Sustainability Transition Governance framework

In this chapter, I collate the findings of the four appended papers which are grounded both in my empirical case and in previous literature into a comprehensive Sustainability Transition Governance framework that shows the complex processes of a sustainability transition and the ways in which people form their perceptions of them (see also de Boon et al., 2022). The empirical, case specific, findings are described in detail in papers II-IV, and synthesised in chapters 5.2. and 6. The framework can be used diagnostically to examine past and current sustainability transition governance efforts in relation to why a specific sustainability transition effort was or was not regarded as socially acceptable and it can support policy makers in the design of ongoing and future sustainability transitions. In developing this framework, I provide answers to my first and second research questions: 1) What are the structural components of sustainability transitions? and 2) What influences social acceptability perceptions of a sustainability transition?; and fulfil my aim of theory building around the governance of sustainability transitions.

5.1. Structural components of sustainability transitions

This section of the framework presents the results in relation to my first research question and provides the structure of the Sustainability Transition Governance framework. The results from paper I show seven key structural components that come together and interact in sustainability transitions that are of central importance for the governance of such processes. As shown in Figure 3, they include the macro context, the immediate context, innovative and adaptive capacity of the actors, actors' psychosocial factors, innovation processes, output and outcomes, and the governance system itself. The immediate context, innovative and adaptive capacity of the actors and their psychosocial factors together form the foundation within which sustainability transition processes occur. The components are presented in chronological order: changes in the macro context, or in our perceptions of the macro context, form the motivational forces and starting point of a sustainability transition, the foundational components provide the context and bedrock that can enable a sustainability transition to take place, the innovation processes describe the different stages of a sustainability transition process, and the output and outcomes are the results of sustainability transition efforts. The governance system is presented as the last component because it reaches across, shapes, and connects all the other components. As depicted with dotted lines and arrows in Figure 3, the structural components of sustainability transitions are characterised by 'duality of structure' or 'mutual embeddedness' (Klerkx

et al., 2010; Markard and Truffer, 2008). This means that whilst the (meso and macro) structures within which the micro level actors of sustainability transition processes are embedded influence their individual and collective actions, at the same time those structures are a result of those collective (micro level) actions (Giddens, 1984). There consists thus a constant mutual responsiveness between all the structural components of sustainability transitions.

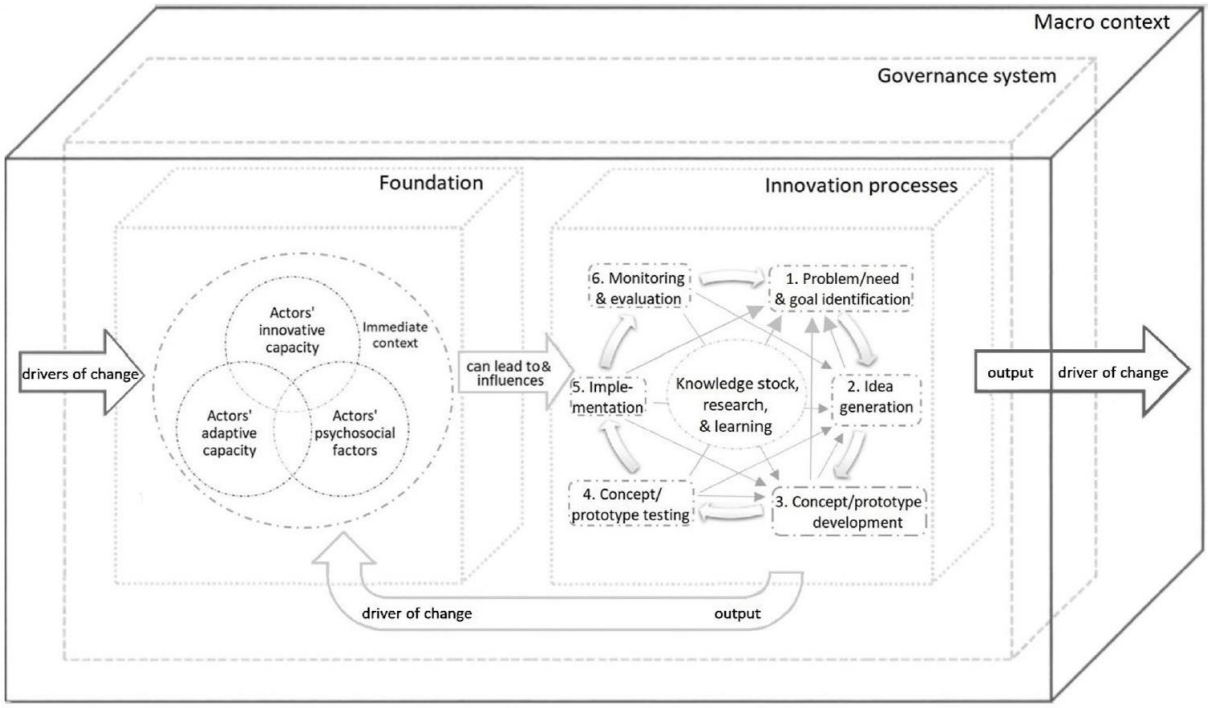

Figure 3. Structural components of sustainability transitions.
Inspired by Emerson et al. (2012), Du Preez and Louw (2008), and Kline and Rosenberg (2010).

Macro context. The macro context constitutes grand macro societal and ecological structures such as macro-political and economic developments, demography, biodiversity, and the climate. Whilst the average individual has no, or at most very limited, influence over these structures (Geels and Schot, 2007), alterations in these structures, or in our perception of them, form direct and indirect drivers of change and provide motivational forces for a sustainability transition. They alter either directly or indirectly the demands that society puts on a specific societal sector or the natural conditions within which a sector has to function (Hazell and Wood, 2008; van Vliet et al., 2015). As such, the motivations for a sustainability transition can develop both top-down, starting from changes in the macro context; bottom-up, starting from changing perceptions; or through a combination of these two. The macro context is also the place where the first normative and political dynamics of a sustainability transition arise: when are alterations in the macro context, or in our perceptions of the macro context, of such a nature that they are seen as a problem and require a sustainability transition, and what should the end goal of a sustainability transition be (i.e. new acceptable state of the macro context) (paper I)?

Foundation: Immediate context, Actors' innovative and adaptive capacity, and Actors' psychosocial factors. The foundational components influence the ease or difficulty with which a specific sustainability transition can be implemented, as well as how the consequences of a sustainability transition impact individuals. Simultaneously, however, these are also the components that must be altered or disrupted for a sustainability transition to take place (Kivimaa et al., 2021). The immediate context is formed by the local natural environment, physical infrastructure, the market, formal and informal institutions and organisations, and their respective innovative and adaptive capacity (Hekkert et al., 2007; Pigford et al., 2018; Rajalahti et al., 2008). Innovative capacity comprises actors' ability to create or generate innovations, e.g. changes to the business structure, management practices, etc., whilst adaptive capacity relates to the actors' capacity to implement those innovations (i.e. it describes the capacity to adapt to (anticipated) change). Both influence whether an individual has the capability to respond to a sustainability transition in a successful manner or can even affect a sustainability transition process and its outcomes (Aase et al., 2013; Bitterman et al., 2019; Cohen et al., 2016; McDowell and Hess, 2012; Schut et al., 2018; Weis and Bonvillian, 2013). The psychosocial factors highlight the normative orientation of an individual in relation to a sustainability transition and describe their willingness to adapt to it. They include aspects such as attitude to innovation, risk attitude, and self-identity (Caughron et al., 2021; Eakin et al., 2016; Grothmann et al., 2013; Mills et al., 2021; Zeweld et al., 2019). The foundational components together form another platform where the disruptive, normative, and political nature of sustainability transitions become evident. The disruptive character combined with the political dynamic at play here show themselves through how the structure of the immediate context and the distribution of innovative and adaptive capacity empower some to benefit from a sustainability transition whilst putting others out of the power to adapt, whilst the normative and political dynamics become evident through the actors' psychosocial factors and who has sufficient power to influence the sub-goals of a sustainability transition in such a way that they align with their own normative orientation (paper I).

Innovation processes. The innovation processes relate to the various generic structural stages that every kind of innovation process, including a sustainability transition, goes through, albeit on different scales, timelines, etc. These stages include: (1) problem and goal identification; (2) idea generation; (3) concept development; (4) concept testing; (5) implementation; and (6) monitoring and evaluation. They often overlap, and feedback loops to previous stages do occur. At the centre of each of these stages lies the existing knowledge stock, research and learning, and processes of knowledge exchange among the actors that are involved in the transition (Kline and Rosenberg, 2010; Sutherland et al., 2012; Tidd et al., 2005, p. 15). The first two stages set the strategic orientation of a sustainability transition and are closely linked to the processes at the macro structure. Stages 1-3 build on the

innovative capacity of the actors involved as they are focused on the development of innovative ideas to address perceived challenges. Stages 4-6 build on the actors' adaptive capacity as they focus on the practical application of innovative ideas. The innovation processes show their disruptive, normative, and political nature through each of the decisions that are made and the way in which they are made throughout each stage of the innovation processes (paper I).

Output and Outcomes. Sustainability transition processes generally produce both output and outcomes. Output refers to specific changes such as new policies or management practices whilst outcomes describe how these changes take shape over the short and long term (Emerson and Nabatchi, 2015). Outcomes are the results of a combination of the intended and unintended consequences of sustainability transition processes and their output and often reveal the disruptive nature of sustainability transitions (paper I). They can create lock-ins and influence the room for future changes (Voss and Kemp, 2006), which also makes them political, and they can have impact on all other structural components.

Governance system. Finally, the governance system describes how societies make and implement decisions related to public affairs, in this case sustainability transitions. It includes both structures and processes of decision making and implementation and determines how power is exercised and responsibilities are carried out (Baker, 2009; Lockwood et al., 2010). It comprises the patterns that result from governing activities and interactions between public and private actors who actively and purposefully aim at steering (sectors of) society into a certain direction (Jordan, 2008; Kemp et al., 2005). It is distinct from, and more encompassing than, government due to the inclusion of non-state actors as relevant and active entities in governing processes (Lemos and Agrawal, 2006). The governance system reaches across and influences all of the other structural components, and its specific form can change over time and differ per sustainability transition process. As it shapes all the sustainability transition processes, it forms a central platform through which the disruptive, normative, and political nature of transitions can be addressed. However, it is itself also embedded in, and part of, political dynamics which are shown through who is involved or excluded, whose interests are considered, what kind of knowledge is used as input, who makes decisions, and on what grounds (paper I).

5.2. Aspects influencing perceptions of social acceptability of a sustainability transition

In this section, I present the combined results from papers II, III, and IV in relation to my second research question: What influences social acceptability perceptions of a sustainability transition? I

structure this section along the structural components of sustainability transitions as presented in chapter 5.1. In doing so, I show how people form their social acceptability perceptions of a sustainability transition in relation to these structural components. The main focus here is on findings that transcend the English agricultural sustainability transition case, but a synthesis of key case-specific, empirical findings is provided throughout. Figure 4 provides an overview of the framework and Figure 5 provides an overview of the tendencies in perceived social acceptability in relation to the English agricultural sustainability transition.

Macro context. Because changes in the macro context, or in our perceptions of the macro context, form the motivational forces for a sustainability transition and are thus the starting point of a sustainability transition, the macro context is the first anchoring point around which people form their perceptions of the social acceptability of a sustainability transition. Combining the results from papers II, III, and IV shows that key aspects influencing perceptions of social acceptability in relation to the macro context concentrate around the overall problem (i.e. the issue(s) that a sustainability transition is aiming to address such as for example environmental degradation) and end goal formulation of a transition (i.e. the desired social, economic, and/or environmental state that a sustainability transition aims to achieve, such as for example a thriving natural environment). They include alignment with personal and societal interests and interlinkage. Alignment with interests influences social acceptability through its role in perceived legitimacy, perceived justice, and willingness to adapt, whilst interlinkage influences social acceptability through its role in perceived legitimacy.

Alignment with interests. Papers II, III, and IV show that the perceived alignment of the prioritisation of problems that should be addressed through a sustainability transition (i.e. the problem formulation), and aimed for end goal(s) with personal interests or the perceived wider interests of society has a positive role in the social acceptability of a sustainability transition. This also reflects insights by Grothmann and Patt (2005), Lockwood et al. (2015), Mills et al. (2021), Scharpf (1999), Suchman (1995), Vringer and Carabain (2020), and Wironen et al. (2019). This includes perceptions on the acuteness of addressing the problem formulation underlying a sustainability transition in relation to other processes that happen in the macro context (e.g. market changes, changes in trade agreements, or global political unrest) and the perceived relative risk of engaging with a sustainability transition. When a sustainability transition is regarded as coupled to all the perceived problematic processes in the macro context and as addressing all the perceived underlying causes of the problem(s), social acceptability of a sustainability transition increases (papers II and IV) (see also e.g. Cinner et al., 2018; Eakin et al., 2016; Grothmann and Patt, 2005; Zeweld et al., 2019). In addition, the results from paper II highlight that whilst the exclusion of problems or end goals that are regarded as

important has a negative impact on the social acceptability of a sustainability transition, the inclusion of additional problems or end goals beyond personal interests is not regarded as less acceptable. A broad problem and end goal formulation that can capture a diverse range of problem perceptions and desired end goals is thus more likely regarded to be socially acceptable than a narrow one. In the case of the English agricultural sustainability transition, it is evident that, overall, the problem and end goal formulation of the sustainability transition focused on environmental challenges are regarded as socially acceptable by stakeholders of all interest categories (papers II and IV) and general society (paper III). However, the perceived social acceptability of the problem and goal formulations would further increase for all stakeholders if it would also recognise additional challenges related to systemic marked failures around the cost of food (production) (papers II, III, and IV).

Interlinkage. A broad problem and end goal formulation that reflect personal interests on their own are, however, not sufficient for social acceptability. The various problem(s) and end goal(s) also need to be interlinked. For example, an end goal formulation around reducing greenhouse gas emissions is clearly interlinked with a problem formulation around climate change but an end goal of increased economic growth is not obviously linked with this problem formulation. Paper II shows that when end goals are regarded as being siloed and the link between end goals and the problem formulation is regarded as being unclear, the social acceptability of a sustainability transition is negatively impacted. This echoes insights from the work by Rogge and Reichard (2016), which calls for more consistent, coherent, and comprehensive approaches to policy making. In the case of the English agricultural sustainability transition, the majority of the stakeholders representing all interest categories currently perceive there to be a siloed approach to the identified overall problems and end goals, which negatively influences the perceived social acceptability of this sustainability transition (paper II).

Foundation: Immediate context, Actors' innovative and adaptive capacity, and Actors' psychosocial factors. The foundation is the second anchoring point around which people form their perceptions of a sustainability transition, as it forms the immediate setting within which a sustainability transition takes place. Combining the results from papers II, III, and IV shows that key aspects influencing social acceptability in relation to the foundation are focused around perceptions of the sub-goals of a sustainability transition, such as for example a specific target for increased water quality or reduced social inequality, and the behaviour of actors involved. In terms of the sub-goals, sub-goal alignment with interests, sub-goal achievability, and sub-goal integration influence social acceptability through their central role in perceived legitimacy, perceived justice, and perceived adaptive capacity and willingness to adapt. In terms of the behaviour of involved actors, social acceptability is influenced

through the role of actors' behaviour in creating credibility and feelings of respect and understanding, which in turn influence perceived legitimacy and perceived willingness to adapt.

Alignment with interests. Similarly as in relation to the macro context, the alignment of sub-goals of a sustainability transition with personal or societal interests is important for social acceptability of a sustainability transition, through its role in perceived legitimacy, justice, and willingness to adapt (papers II, III, and IV). As sub-goals of a sustainability transition are more specific than overall goals, their alignment with personal norms, values, and goals, including how they relate to personal lifestyles and stages in life and career, is often present in more detail in peoples' minds and more salient than the alignment with overall goals (papers II and IV). The results from paper II highlight that it is therefore not only important that the sub-goals in general align with interests, but that the emphasis, or relative importance, that is given to various sub-goals also reflects how stakeholders rank these sub-goals in terms of importance. For example, whether a sub-goal of giving everyone access to nutritious and affordable food should receive more or less importance in a sustainability transition than a sub-goal of giving everyone access to flourishing green spaces. For the English agricultural sustainability transition, the sub-goals of the transition are largely perceived to be in line with both personal and societal interests (papers II, III, and IV). However, especially farmers and economic interest stakeholders would like there to be an additional sub-goal that focuses specifically on food production. In addition, several of the farming, forestry, and landowner interest stakeholders, environmental interest stakeholders, and social interest stakeholders are not satisfied with the emphasis that is placed on some of the sub-goals over the others (papers II and IV). There is therefore room for improvement in terms of the perceived social acceptability of the sub-goals.

Goal achievability. Papers II and IV show that perceived sub-goal achievability influences social acceptability of a sustainability transition through its role in perceived legitimacy and perceived adaptive capacity and willingness to adapt. If the sub-goals of a sustainability transition are regarded as unachievable, given the specific foundational structures, social acceptability is negatively affected. This finding reflects insights from Grothmann et al. (2013) and Ruhrort (2022). Two central aspects that influence perceived sub-goal achievability include the sufficiency of government funding that is available to work toward the (sub) goals of a sustainability transition (paper II) and the sufficiency of available human resources and the authority needed to implement a sustainability transition. In a similar vein, the perceived sufficiency of stakeholders' resources to adapt to a sustainability transition is key (paper IV). However, the results from paper IV highlight, especially in relation to financial resources, that there is a very fine line here, as financial resources can be both an enabling and preventing factor to adaptation. Having insufficient financial resources can be a hampering factor as

there is no money available to invest in change, or a motivational force to make changes to keep your head above water. Equally, having access to sufficient financial resources can enable stakeholders to invest in adaptation, but can also form a barrier to it, as it reduces the incentive or need to make changes. Social acceptability perceptions in regard to goal achievability are sceptical in the case of the English agricultural sustainability transition. Stakeholders from all interest categories perceive there to be a lack of a sufficient, long-term government budget to work towards the stated goals, insufficient human capital in government to properly implement the sustainability transition, and generally insufficient clarity as to how the goals should be achieved (papers II and IV). In relation to the perceived sufficiency of stakeholders' resources to adapt to the sustainability transition there are mixed views. The minority of farmers are (believed to be) in a position where they can adapt to the sustainability transition and contribute to achieving the sustainability transition goals. Another minority of farmers are (believed to be) planning to use their available financial resources to not engage with the sustainability transition but instead to farm more intensively, which would negatively impact the achievability of the goals of the sustainability transition. The majority of farmers are not (believed to be) in a position where their financial and natural resources, including the natural characteristics of their farm and the ownership type they have over the farm, enables them to engage with the sustainability transition and contribute to goal achievability (paper IV).

Goal integration. Similarly as in relation to the macro context, interlinkage between sub-goals internally and between sub-goals and end goals is also important for the social acceptability of a sustainability transition in relation to foundational components (papers II and IV). However, beyond that, the results from paper II show that this interlinkage should extend beyond the sustainability transition itself through sub-goal integration: when it is perceived that there is dissonance within government (i.e. within the immediate context within which a sustainability transition takes place), for example between different government departments, regarding what they want to achieve, the social acceptability of a sustainability transition will be negatively affected (see also Huntjens and Kemp, 2022; Oliver et al., 2021). An example of this kind of dissonance would be an environmental government department setting a goal to reduce climate change whilst a government department responsible for industry and energy has a goal to open up new coal mines and gas fields. For the English agricultural sustainability transition, stakeholders from all interest categories perceive there to be a lack of goal integration, which negatively impacts the perceived social acceptability of the sustainability transition. The environmental, social, and economic interest stakeholders perceive there to be insufficient clarity of how the sub-goals fit alongside each other and how they relate to the problem formulation (paper II). Several of the farmers and organisations supporting farmers through the English

agricultural sustainability transition further perceive there to be contradictions in government agendas between different government departments (paper IV).

Credibility. Credibility of the sub- and end goals of a sustainability transition influences the social acceptability of a sustainability transition through its role in perceived legitimacy and willingness to adapt, with perceived credibility being a reflection of the actions that government takes and how they relate to the set goals (Rogge and Reichardt, 2016). Paper II shows that when governmental actions are perceived to be contradictory to the aimed for goals of a sustainability transition, for example when the goal of a sustainability transition is to reduce environmental degradation and biodiversity loss but the government is watering down environmental regulations, the social acceptability of a sustainability transition will be negatively impacted. This is also further influenced by the general degree of trust that stakeholders have in the government and the relationship between the stakeholders and the government resulting from previous experiences. Paper IV highlights that when previous actions by the government are regarded as illegitimate and untrustworthy and there is a lack of trust toward the government, the social acceptability of a sustainability transition will be negatively impacted. The demonstration of political will to reach the goals of a sustainability transition, showing that lessons are learned from past experiences, and building a sustainability transition on the structures that are already there can increase levels of trust by showing that statements on a sustainability transition are not merely made for PR purposes (see also Grothmann et al. (2013) and Lockwood et al. (2015)). In the case of the English agricultural sustainability transition, there is a clear lack of trust toward the government. Stakeholders from all interest categories question the credibility of the sustainability transition goals, as they do not trust that the government means what they promise and do not find there to be a sufficient regulatory baseline underpinning the sustainability transition (paper II). Multiple farmers perceive that DEFRA does not communicate openly about their real aims, does not follow through or even contradict their promises with their actions, does not learn from past experiences, and uses the sustainability transition as a PR project rather than as a genuine attempt to implement a sustainability transition (paper IV). This overall lack of perceived credibility negatively influences the perceived social acceptability of the English agricultural sustainability transition (papers II and IV).

Respect and understanding. Closely related to the degree of trust is the degree to which actors in the immediate context (both the government and the general public) show understanding and appreciation for the work that key stakeholders who need to adapt most to a sustainability transition are doing. Paper IV shows that, when these stakeholders feel like they are disrespected, not appreciated, and/or not understood, for example as a result of denigrating statements or scapegoating by politicians or the media, they are less likely to perceive a sustainability transition as socially

acceptable. This also links to the wider mental health and mental state of key stakeholders, where being in the right mindset to engage with change, feeling confident, having a positive outlook on life, and being able to cope with the mental stress of change are prerequisites to be able to engage with a sustainability transition (see also Mills et al., 2021). Multiple farmers in England feel demoralised and offended by how government and the media portray them and their work. Several perceive this to be to such an extent that it could be a motivation to leave farming altogether rather than to engage with the English agricultural sustainability transition. In addition, there are concerns about the mental health of farmers in England and perceptions that this sustainability transition will further deteriorate this situation by adding on additional stress and pressure. The combination of these mental health concerns and the perceived lack of appreciation, understanding, and respect of farmers in this sustainability transition discourse negatively influences the perceived social acceptability of the English agricultural sustainability transition (paper IV).

Innovation Processes. As the innovation processes draw and build on the macro context and the foundation, the aspects that are relevant for social acceptability in relation to those components also influence indirectly perceptions in relation to the innovation processes. These are not the only ways, however, in which social acceptability perceptions are formed around the innovation process. The results from papers II and IV show that two additional aspects, specificity and perceived control, directly influence social acceptability of a sustainability transition in relation to the innovation processes through their role in perceived legitimacy and perceived adaptive capacity and willingness to adapt.

Specificity. The results from paper II highlight that specificity in the formulation of sub-goals of a sustainability transition in innovation processes is essential for the social acceptability of a sustainability transition through its role in perceived legitimacy. To increase social acceptability of a sustainability transition, sub-goals need to be broken down into specific, measurable targets, linked to specific timelines, and be described in clear wording that does not leave room for multiple interpretations. For example, a sub-goal of 'increasing water quality' will be perceived as less socially acceptable than a sub-goal of 'reaching a high ecological status following the Environment Agency assessment criteria of 60% of all surface water bodies in England by 2030'. Equally, these sub-goals and the plans that are developed at each stage of the innovation processes need to be stable. Paper IV shows that having clear and stable plans in place ensures that the innovation processes can provide a solid base for stakeholders to build their adaptation decisions on, which increases their perceived adaptive capacity and willingness to adapt. The absence of detailed, consistent, and complete plans, on the other hand, negatively impacts perceived adaptive capacity and willingness to adapt and thereby reduces the social acceptability of a sustainability transition (see also Gupta et al., 2010).

Specificity is perceived to be lacking in the English agricultural sustainability transition, which negatively impacts the perceived social acceptability of this sustainability transition. The sub-goal formulations are perceived as lacking practical value by stakeholders from all interest categories because they do not include measurable targets and specific timelines and are open for diverse interpretations (paper II). In addition, there is perceived to be a lack of clear, stable plans for this sustainability transition (paper IV).

Perceived control. Stakeholders' perceived control throughout the innovation processes also influences the social acceptability of a sustainability transition through its role in perceived adaptive capacity and willingness to adapt. When the stakeholders feel like they can control and have ownership over the adaptation decisions and adaptation pathways they can take, they are more likely to be willing to make the required changes. One of the aspects that influences perceived control, as highlighted in paper IV, is the information that is provided throughout all the stages of the innovation processes. Providing the right amount of information, at an appropriate timeline, in accessible language, and through multiple channels has a positive impact on the social acceptability of a sustainability transition. This is in line with previous findings by Akkari and Bryant (2017), Eakin et al. (2016), Gupta et al. (2010), and Zeweld et al. (2019). In the case of the English agricultural sustainability transition, farmers' perceived control in relation to this sustainability transition is limited as there is a perception amongst multiple farmers that the government is painting the goal posts rather than that farmers have agency in this process. In addition, multiple farmers want to have the flexibility to decide how to enact guidelines in a way that works best for their specific farm, and they perceive that this is not guaranteed in the current sustainability transition pathway. Multiple farmers and organisations supporting farmers through this sustainability transition also have the perception that there is so much information being shared on the different aspects of this sustainability transition that it becomes difficult to identify what one needs to do with that information. This perception of limited control negatively influences the perceived social acceptability of the English agricultural sustainability transition as well as farmers' engagement with it (paper IV).

Output and outcomes. The component of output and outcomes is primarily relevant for social acceptability of a transition later on in the transition process. However, anticipated output and outcomes can also influence social acceptability even before the actual output has been produced and outcomes are achieved. The combined results from papers II, III, and IV show that key aspects that are important here include alignment with occupational identity, effectiveness, and interlinkage of the output, as well as the fairness of both the output and the outcomes. Alignment with occupational identity has a role in perceived adaptive capacity and willingness to adapt; effectiveness has a role in perceived legitimacy and perceived willingness to adapt; interlinkage has a role in perceived

legitimacy; and fairness has a role in both perceived legitimacy, perceived justice, and willingness to adapt.

Alignment with occupational identity. The alignment of the output with the occupational identity of those stakeholders who need to adapt to a sustainability transition is essential for the social acceptability of a sustainability transition. When the output is regarded as encouraging good work practices and fits into what the stakeholders consider to be part of their job, their willingness to adapt to a sustainability transition increases (paper IV). This reflects insights from Marshall et al. (2012) and Morton et al. (2017). There are mixed views as to whether the current output of the English agricultural sustainability transition aligns with farmers' occupational identity. There are farmers who perceive the output's focus on incentivising farmers to take care of the environment to be in line with their views on what farming is, as they believe that farming includes much more than food production. However, there are also farmers who believe their main job to be food production and they consider the output of the sustainability transition to be pushing them to do another job than farming. In addition, there are farmers who perceive the farming practices as described in the sustainability transition output to be poor farming practices. In the cases where farmers do not perceive the output of the English agricultural sustainability transition to be aligned with their occupational identity, this negatively impacts their perceived social acceptability of this sustainability transition (paper IV).

Effectiveness. Perceived effectiveness of the output to bring about the desired outcomes of a sustainability transition is another central aspect (e.g. Suchman, 1995; Upham et al., 2015; Vringer and Carabain, 2020). The results from paper II show that a mixture of different policy instrument types, e.g. financial (dis)incentives, regulations, information sharing, and collaboration, is generally perceived to be more effective than using few and similar instruments, as a mixture can take better account of the diversity in behavioural motivations and learning styles that different people can have. This point has to date received little attention in research focusing on the effectiveness of policy instruments (Pedersen et al., 2020). Creating output that is varied in terms of the solutions that it includes also helps to ensure that stakeholders can find an adaptation strategy that fits well with their specific circumstances (paper IV) and it limits the chance of exclusion by design. When the output is regarded as exclusionary, uniform, and ineffective, for example when financial incentives are only provided to a sub-set of the stakeholders, this negatively impacts the social acceptability of a sustainability transition (paper II). However, the results from paper IV highlight that it is important to find the right balance here. When there is too much variety in the output, this makes it overwhelming and complicated for the stakeholders to find appropriate adaptation strategies. Some degree of flexibility in the design of the output, so that stakeholders themselves can decide how to act on the output in a way that works best for their circumstances, can be used to find this balance. Perceptions on the effectiveness of the

output are further also influenced by whether the output is regarded as enforceable and by previous experiences with similar output (paper II). Perceptions of a lack of competence within the output and greenwashing negatively influence the social acceptability of a sustainability transition (paper IV). The results from papers II and IV show that there is a perceived lack of effectiveness of the output amongst stakeholders of all interest categories in the English agricultural sustainability transition which negatively impacts the perceived social acceptability of this sustainability transition. The stakeholders do not have a problem with the policy instrument types per se and think that a mixture of them potentially could be effective, but not in the way they are currently designed. The proposed policy instruments to provide financial incentives to bring about the sustainability transitions are regarded by stakeholders of all interest categories as providing too little incentives to farmers to engage with the sustainability transition, the information sharing mechanisms that are used are regarded as being too homogenous, the regulation system is regarded as unenforceable in its current form, and financial disincentives in the form of penalties are regarded as ineffective as long as compliance cannot be properly monitored. The proposed policy instruments in relation to collaboration are regarded as potentially effective, but it is perceived that they currently lack sufficient funding to live up to their potential (paper II). Overall, it is therefore perceived that the proposed sustainability transition plans in their current form are not capable of solving the problems that the sustainability transition is aiming to address (papers II and IV). Apart from the scepticism in relation to the effectiveness of the current design of the policy instruments, multiple farmers perceive that the policies are designed to fail because they perceive that they cannot be integrated with food production and that they will only lead to moving the environmental footprint of food production elsewhere, rather than actually improving environmental impact (paper IV).

Interlinkage. Interlinkage relates here to the extent to which the output in the form of specific policy instruments, measures, and actions are perceived to be linked to each other and to the sub-goals, end goals, and problem formulation of a transition. Clear interlinkage here would for example be setting strict regulations on pesticide use and providing financial incentives for the use of natural alternatives to pesticides, to reach the overarching goal of thriving wildlife, and address the problem of biodiversity loss. This has also been referred to as consistency (Rogge and Reichardt, 2016). It is closely linked to the interlinkage in the macro context and the goal integration in the foundation. The results from paper II show that when it is perceived that this kind of interlinkage is in place, the social acceptability of a sustainability transition increases. In the case of the English agricultural sustainability transition, stakeholders from all interest categories perceive there to be a lack of clear interlinkage between the output internally and between the output and (sub) goals and the problem formulation. This lack of

perceived interlinkage between the different aspects of the sustainability transition negatively impacts the perceived social acceptability of the English agricultural sustainability transition (paper II).

Fairness. Fairness relates both to the social acceptability of the output and the outcomes of a sustainability transition. In relation to the output, papers II and IV show that it is important for social acceptability that the output is regarded as not putting unnecessary pressure on stakeholders through unclarity or gaps in the phase of changeover between old and new policies and that they are not perceived as creating unfair conditions for stakeholders in comparison to the working conditions for stakeholders in other countries (papers II and IV); for example, having to work under much stricter environmental regulations and with fewer subsidies than stakeholders in the same sector in a different country. Similarly, in relation to the outcomes, papers III and IV highlight the importance of considering the right geographical scale (e.g. local, regional, national, or global) when assessing the impact of a sustainability transition, with 'right scale' being not an absolute, but a reflection of the values of the person making the social acceptability evaluation. Insights from paper III add to this that how a person themselves is impacted by a sustainability transition also plays a role (see also Schuitema et al. (2011) and Schuitema and Bergstad (2019)). There is a perceived lack of fairness amongst stakeholders of all interest categories in the English agricultural sustainability transition, which negatively impacts the perceived social acceptability of this sustainability transition. It is regarded that the current output leaves a disconnect in the transition from the old to the new system, that it excludes certain farmers by design, and that it creates unfair competition conditions for English farmers in comparison to farmers in other countries (papers II and IV). Furthermore, multiple farmers perceive there to be too little consideration of the implications of this English agricultural sustainability transition on a geographical scale beyond England (paper IV). The general English society also perceives that the implications of this sustainability transition should be considered on all possible geographical scales, but, in line with the current sustainability transition design, they place most importance on the consideration of local, regional, and national consequences (paper III). The personal impact on farmers who will be excluded by design and/or experience a loss of income in comparison to those who will positively benefit from this sustainability transition is also regarded as unfair by stakeholders from all interest categories (paper II). This also reflects the perspective from the general English society that the sustainability transition should not worsen peoples living circumstances (paper III).

Governance system. As the governance system reaches across and connects all of the other components, the aspects that play a role in the social acceptability of a transition that are linked to the governance system indirectly influence perceptions around all other components as well. They include responsiveness, distributional principles, meaningful stakeholder inclusion, knowledge type, and transparency. Responsiveness influences the social acceptability of a sustainability transition through

its role in perceived adaptive capacity; distributional principles and knowledge type play a role in perceived justice; meaningful stakeholder inclusion plays a role in both perceived legitimacy, perceived justice, and perceived adaptive capacity and willingness to adapt; and transparency plays a key role in perceived legitimacy.

Responsiveness. Responsiveness relates to whether the decision-making and implementation processes are set up in such a way that they can quickly respond to (unexpected) changes in the macro context or foundation (Gupta et al., 2010), such as for example the outbreak of a war or a natural disaster. The results from paper IV show that when the governance system is regarded as responsive, this positively impacts the social acceptability of a sustainability transition. These results also show that multiple English farmers perceive the government to be unresponsive to market changes and reactions from other countries to this. This perception of a lack of responsiveness negatively impacts the perceived social acceptability of the English agricultural sustainability transition (paper IV).

Distributional principles. Distributional principles describe the principles that are used in the decision-making process on how the costs and benefits of a sustainability transition are distributed. These principles include equality, equity and need, entitlement, and merit (Bennett et al., 2019; Liebig et al., 2016; Piachaud, 2008; Rasinski, 1987; Rothmund et al., 2016). When the principle, or combination of principles, upon which a decision is built in relation to how the costs and benefits of a sustainability transition are distributed is perceived as the right one according to the person making the social acceptability evaluation, the perceived social acceptability of a sustainability transition is positively impacted (paper III). In the case of the English agricultural sustainability transition, stakeholders from all interest categories perceive that all farming types should have equal opportunity to benefit from this sustainability transition, but they do not think that this is currently the case and this negatively impacts their social acceptability perceptions of this sustainability transition (paper II). The general English society perceives that applying equality as a distributional principle is socially acceptable (paper III), but it is unclear whether they think that this is sufficiently done in this sustainability transition.

Meaningful stakeholder inclusion. The results from papers II, III, and IV highlight that stakeholder inclusion can also positively impact the social acceptability of a sustainability transition, but only when it is done in the 'right' way. There are several aspects to this. First, it relates to the general degree of stakeholder involvement throughout the decision-making and implementation processes of a sustainability transition as well as which stakeholders or specific societal groups are considered, and what principles (i.e. equality, equity and need, entitlement, and/or merit) are used in deciding who should get most influence in the decision-making processes (Bennett et al., 2019; Kaljonen et al., 2021; Liebig et al., 2016; Piachaud, 2008; Sabato and Fronteddu, 2020; Vermunt and Steensma, 2016). When

the degree of stakeholder involvement throughout the innovation process is regarded as sufficient (i.e. neither too much nor too little), the right stakeholder and social group interests are considered in the decision-making, and the right principle is used to decide who gets most influence in the decision-making process throughout a sustainability transition according to the person who is making the social acceptability evaluation, the social acceptability of a sustainability transition will be positively affected (paper III). This is also reflected in previous work by Bennett et al. (2019), Crowe and Li (2020), Schlosberg (2013), Smaal et al. (2020), and Wieliczko et al. (2021). Second, it relates to the attention that is given to differences in power between stakeholders who are included in the decision-making and implementation processes, including attention given to differences in access to resources to invest in participation in the decision-making processes and in adaptation to a transition. When due attention is given to power differences, and efforts are taken to mitigate these differences, the social acceptability of a sustainability transition increases (paper II). Third, it relates to the extent to which input that has been provided by stakeholders throughout a sustainability transition is acted upon. If it is not clear how stakeholder input has been used, this will negatively impact social acceptability. Expectation management and clear communication is important in this regard, as this can clarify what stakeholders can expect from their engagement and the influence their input will have from the outset (papers II and IV; see also Bierman and Gupta (2011), Braun and Busuioc (2020), Steffek (2019), and Upham et al. (2015)). Stakeholders from all interest categories in the English agricultural sustainability transition and the general English society perceive that stakeholder inclusion in general is socially acceptable and consequently perceive the general effort of DEFRA to include stakeholders in the design process of this sustainability transition as socially acceptable (papers II, III, and IV). However, multiple farmers perceive collaboration to be taking up a lot of time and taking away from the clarity of the sustainability transition process, which has a negative impact on their perceived acceptability of this sustainability transition (paper IV). Furthermore, stakeholders from all interest categories perceive there to be inequality and insufficient attention to power imbalances in the collaborative processes (paper II), and multiple interests that are perceived to be important to be included are perceived to currently not be included in the collaborative processes (papers II and III). All stakeholders are also frustrated and disappointed on a perceived lack of action that has been taken on their input into this sustainability transition design process (paper II). All these aspects together indicate that there is a perceived lack of meaningful stakeholder inclusion amongst all stakeholders, regardless of a general appreciation of the opportunity to be included in the sustainability transition design process, and this negatively influences their perceived social acceptability of this sustainability transition.

Knowledge type. Closely related to meaningful stakeholder inclusion, the knowledge type (i.e. scientific or local/traditional knowledge) that is used as input into the decision-making processes throughout a

sustainability transition further influences the social acceptability of a sustainability transition. It relates to perceptions on whether the right kind of knowledge, according to the person making the social acceptability evaluation, is used as input into decisions related to a sustainability transition (Burchardt and Craig, 2008; Kaljonen et al., 2021; Martin et al., 2016; Stevis and Felli, 2020; Velicu and Barca, 2020). When the knowledge type that is preferred by the person who is making the social acceptability evaluation is used as input, the social acceptability of a sustainability transition increases (paper III). In the case of the English agricultural sustainability transition, the general English society perceives that a sustainability transition needs to build on both scientific and local/traditional knowledge (paper III). DEFRA's effort to include and build on the experience from farmers through the multiple pilots and engagement activities has therefore a positive impact on the perceived social acceptability of this sustainability transition (paper II). However, multiple farmers perceive that DEFRA do not make use of the right expertise to design this sustainability transition and are not listening to the ones that do, and this perception negatively influences their perceived social acceptability of this sustainability transition (paper IV).

Transparency. Transparency of structures and processes of decision-making and implementation throughout a sustainability transition is of central importance for the social acceptability of a sustainability transition. The results from paper II show that even when a decision-making process or the decision that comes out of that process is regarded as going against the interests of the person making the social acceptability evaluation, the overall social acceptability of the decision-making processes or specific decisions is improved when it is transparent how and why that decision was reached (see also Bennett et al. (2019), Gupta et al. (2010), Upham et al. (2015), and Vringer and Carabain (2020)). Stakeholders from all interest categories in the English agricultural sustainability transition express frustration with a perceived lack of transparency on how decisions are made, which decisions are already made, and which decisions are still open for debate in the sustainability transition design process (paper II). This is also reflected in multiple farmers' perception of a wider lack of transparency on what the government's plans are for this sustainability transition (paper IV). The overall perceived lack of transparency negatively influences the social acceptability perceptions of this sustainability transition (paper II and IV).

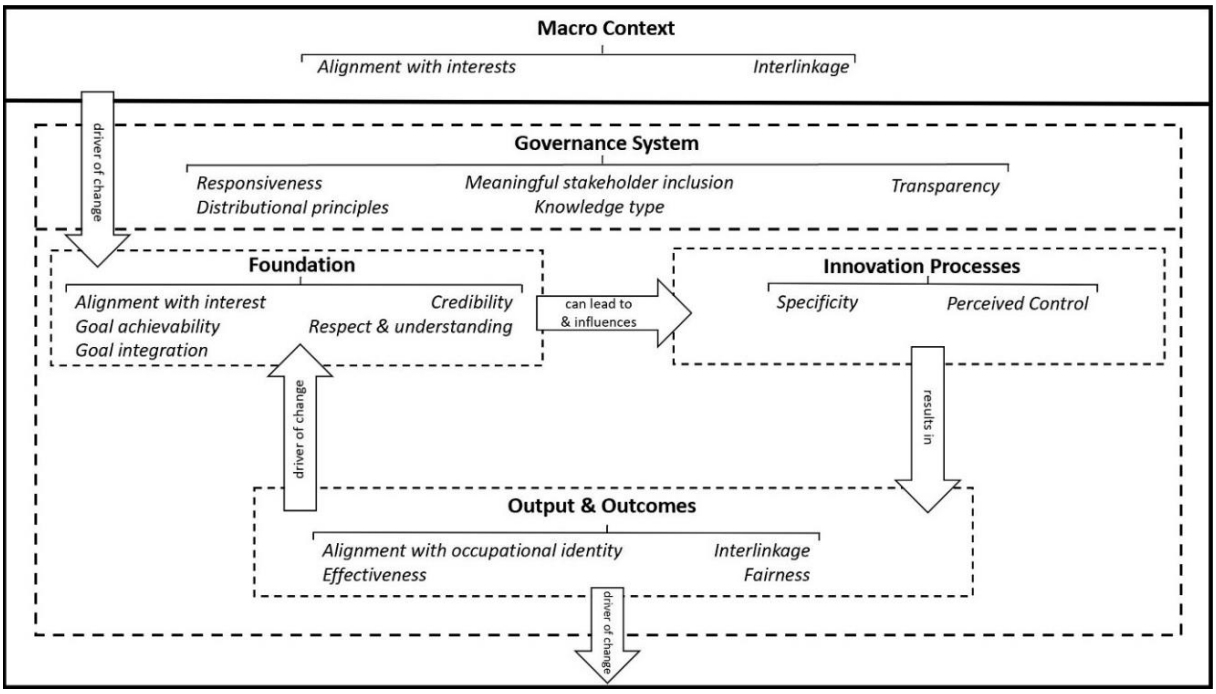

Figure 4. Sustainability Transition Governance framework.

The key components and related aspects of this Sustainability Transition Governance framework are the components and aspects that were most dominant in the previous literature and/or my empirical findings. They are the results of a critical case within a case study and a focus was placed on those components and aspects that are generalisable beyond the case that was studied. As such, they should be seen as a generic starting point for examinations of social acceptability perceptions of a sustainability transition. It is highly likely that for each specific sustainability transition in a particular context there will be additional components and aspects that play a role in social acceptability perceptions of sustainability transitions. The description of my key empirical cross-cutting findings of papers II-IV in relation to each aspect of the Sustainability Transition Governance framework provides an example of what the results of an analysis along the lines of this framework can look like. The appended papers provide additional detail and a more nuanced description of differences in perceptions (see papers II-IV). Overall, as graphically summarised in Figure 5, the analysis shows that for the English agricultural sustainability transition, at the base, in the Macro Context and Foundation, the aspects of alignment with interests primarily play a positive role in the perceived social acceptability of this sustainability transition. The aspect of alignment with occupational identity in the Output and Outcomes component and the aspect of knowledge type in the Governance System component play a mixed role in the perceived social acceptability of this sustainability transition, positively influencing perceptions for some, whilst negatively influencing perceptions for others. All the other aspects across the structural components primarily play a negative role in the perceived social acceptability of this sustainability transition.

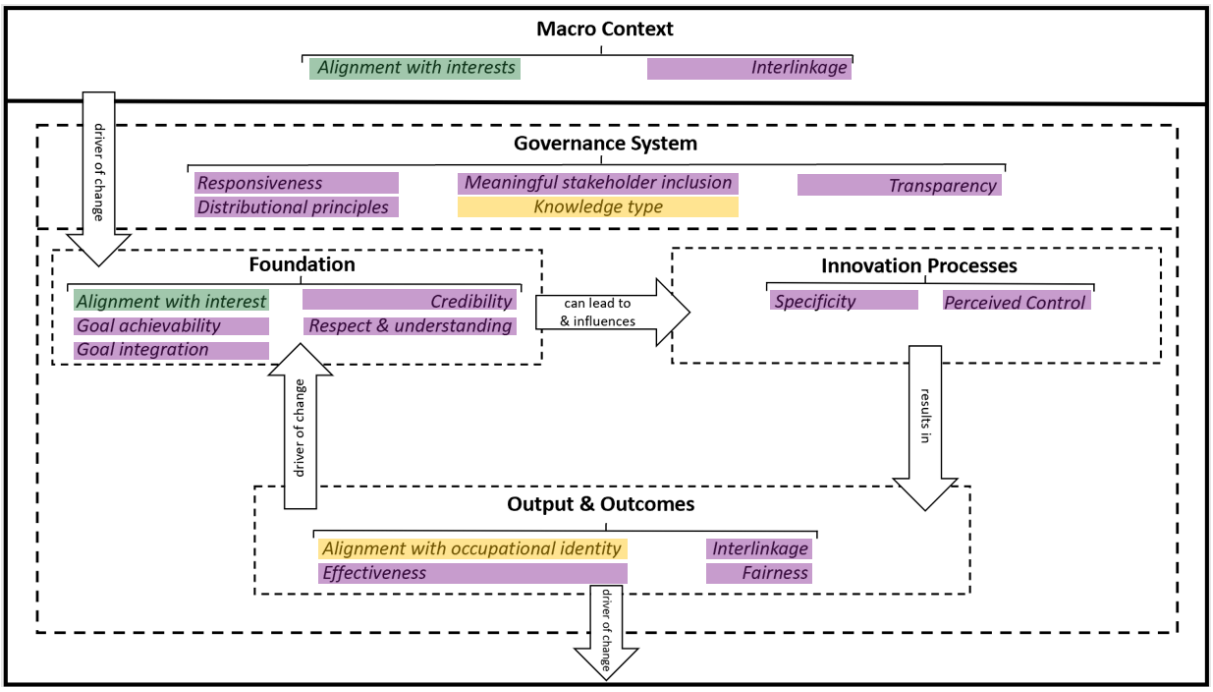

Figure 5. Example of application of the Sustainability Transition Governance framework in the analysis of social acceptability perceptions of the English agricultural sustainability transition.

Aspects marked in green indicates aspects that currently primarily positively influence perceived social acceptability of the English agricultural sustainability transition. Aspects marked in purple indicate aspects that currently primarily negatively influence perceived social acceptability of the English agricultural sustainability transition. Aspects marked in orange indicate aspects that play a mixed role in the perceived social acceptability of the English agricultural sustainability transition. Note that this is a simplified representation of how these different aspects influence social acceptability perceptions of the English agricultural sustainability transition. More nuanced descriptions are presented in papers II-IV.

6. Shaping governance to enhance the social acceptability of sustainability transitions: general lessons for governance and policy recommendations

In this chapter, I turn to the cross-cutting findings in relation to my third research question: How can governance be shaped to enhance the social acceptability of a sustainability transition?; and fulfil my aim of providing practical lessons for the governance of sustainability transitions. So far, I have shown that sustainability transitions are complex, multi-faceted processes and the ways in which people form their perceptions of social acceptability around these processes are equally multi-dimensional. The Sustainability Transition Governance framework that I have presented shows not only this complexity, but also re-emphasises the underlying disruptive, normative, and political dynamics. As the aspects that influence social acceptability perceptions are so diverse and personal and interact with each other, it is evident that it is not possible to create a sustainability transition that will be perceived as socially acceptable by all. However, the combined empirical results from papers II-IV and the Sustainable Transition Governance framework show that there are several things that can be done in the way in which the governance of sustainability transitions is shaped that can increase the likelihood that a sustainability transition is perceived to be socially acceptable. In relation to the English agricultural sustainability transition, the way in which this sustainability transition is currently governed contributes to negative perceived social acceptability of this sustainability transition. However, the basic idea behind the sustainability transition problem- and goal formulation is regarded as socially acceptable by stakeholders of all interest categories, which provides a basis on which governance arrangements can build to enhance social acceptability perceptions of this sustainability transition moving forward. Here I present general lessons for governance that I draw out from the Sustainability Transition Governance framework and the empirical material. In addition, in relation to each general lesson, I provide specific policy recommendations for the governance of the English agricultural sustainability transition, which has been the empirical focus of this thesis.

The first general lesson is that, in order for governance to be able to take into account normative perceptions of legitimacy, justice, and adaptive capacity and willingness to adapt that lie at the base of social acceptability, these perceptions need to be assessed in the society within which a sustainability transition is set to take place. Whilst the Sustainability Transition Governance framework that I presented gives insight into what aspects should be included in these kinds of assessments, only

after an assessment is completed can it be stated what their exact shape and relative importance is in a specific society and thus how the governance of a sustainability transition could be designed to reflect these perceptions. In addition, as a sustainability transition is a process that happens across a longer period of time with multiple different stages, perceptions of what is socially acceptable can change over the course of a sustainability transition, for example when consequences of earlier decisions become visible that were not anticipated beforehand. Decision-making processes that are perceived as socially acceptable for one stage of a sustainability transition may be perceived as unacceptable for another stage. It is therefore important that an assessment of perceptions is not only carried out once at the beginning of a sustainability transition, but that these perceptions are monitored throughout the entire transition process and that the governance of a sustainability transition is flexible and adaptable enough to change course when perceptions change. The analytical frameworks that I presented in papers II and IV and the survey that I developed in paper III can be used in support of these kinds of assessment and monitoring efforts. In relation to the English agricultural sustainability transition, this first general lesson in combination with the current social acceptability perceptions of this sustainability transition, lead me to provide the following policy recommendation: DEFRA could set up an assessment and monitoring system that regularly examines social acceptability perceptions in relation to the English agricultural sustainability transition across all stakeholder interest categories and the general English society. The assessment tools provided in papers II-IV as well as the presented Sustainability Transition Governance framework can be used in support of these assessment and monitoring activities. The empirical results from this thesis can function as a baseline. When the outcomes of these assessment and monitoring activities show that there are changes in perceptions, DEFRA could engage with these and make further changes to the governance of this sustainability transition when needed.

The second general lesson is that, in order to take account of the complexity of sustainability transitions and the ways in which people form their social acceptability perceptions around them, it is essential that the decision-making and implementation processes are not closed down or compartmentalised into sub-aspects that are considered in isolation of each other. A decision and the way this decision comes about at one point in a sustainability transition process related to one sub-aspect will have implications for all the components of a sustainability transition and can influence perceptions of social acceptability not only in that moment but also further down the line. It is therefore key that decision-making does not happen in siloes and that potential consequences of the decision, and the way the decision is made, are explored across all components of a sustainability transition. Based on this second general lesson and the current social acceptability perceptions of the English agricultural sustainability transition, I provide the following policy recommendation. To

enhance social acceptability perceptions in relation to the aspect of interlinkage in the component of the Macro Context, DEFRA could more actively interact with other governmental departments such as for example the Department for Science, Innovation and Technology, the Department for Business and Trade, the Department for Energy Security and Net Zero, the Department for Culture, Media and Sport, and the Department of Health and Social Care, to reduce the compartmentalisation in the current policy making process and to streamline the different strategies and policies that these departments produce, thereby creating synergies rather than contradictions in what is asked of the agricultural sector and clarifying how this sustainability transition sits alongside other governmental activities. This could also contribute to reduce the perceived siloed approach to nature, production, and culture. In addition, within DEFRA, different teams that are responsible for different sections of this sustainability transition could also work closer together to ensure that there is a clear understanding of how decisions made in relation to one aspect of this sustainability transition might impact other aspects of this sustainability transition.

The third general lesson is that, because perceptions of social acceptability are so diverse and heterogenous even within a single society, governance needs to allow this diversity to exist within a sustainability transition. Whilst it is necessary to set some priorities to move a sustainability transition forward (Meadowcroft, 2011), where possible, governance should take a comprehensive approach and aim to include and recognise diverse framings of the problem(s) that a sustainability transition is trying to address, allow for multiple transition pathways to occur, and examine where there is room for multiple goals for a sustainability transition to coexist. Allowing this diversity of multiple transition pathways can also reduce the risk of creating lock-ins and can mitigate the negative consequences of the disruptiveness of a sustainability transition by providing a broader range of adaptation options. Where there is no room for multiple goals to coexist, an assessment of trade-offs between goals needs to be undertaken and win-win alternatives should be sought in a collaborative manner. In relation to the English agricultural sustainability transition, this third general lesson in combination with the current social acceptability perceptions of this sustainability transition, can be translated to the following policy recommendation. To strengthen the base of social acceptability perceptions in relation to the English agricultural sustainability transition, DEFRA could widen the problem- and goal formulation of this sustainability transition to also include the perceived market failures around food pricing and acknowledge the importance of food production as a goal in and of itself and with the same importance as the environmental goals within this sustainability transition. This can contribute to enhance social acceptability perceptions of this sustainability transition through better alignment with interests both in relation to the Macro Context and the Foundation within which this sustainability transition is taking place (see also Figure 5). When incorporating these additional aspects, DEFRA could

focus on collaboratively (i.e. with stakeholders from all interest categories) identifying where win-win approaches can be found that can strengthen food production and enhance environmental conditions simultaneously. In addition, DEFRA could focus on diversifying the policy mix that they are planning to use to bring about this sustainability transition and creating more flexibility within it. For example, the provision of information, advice, and guidance can be diversified beyond online communication to e.g. communication by regular mail, information hotlines, and a service desk. Flexibility could be created by focusing incentive payments on goals achieved rather than on actions taken (i.e. outcome based payments), which would contribute to enhance social acceptability perceptions in relation to perceived control in the component of Innovation Processes as it allows farmers to choose their own pathways toward reaching specific goals. However, if DEFRA chooses to follow this path, more clarity is needed on how outcomes will be measured and how time-lags between actions and outcomes and external impacts that negatively influence the outcomes will be taken into consideration.

The fourth general lesson is that governance of sustainability transitions needs to focus on integration. Regardless of the specifics of the problem- and goal formulation and the measures chosen to bring about a sustainability transition, governance efforts need to be focused on ensuring that there is a clear connection between the problem- and goal formulation and the measures, as well as interlinkage between various sub-goals and measures internally. Conflicting goals or measures that work against each other should be avoided. Equally, the goals and measures related to a sustainability transition should also be in line with wider governmental activities. Applying this fourth general lesson to the English agricultural sustainability transition leads me to provide the following policy recommendation: DEFRA could enhance social acceptability perceptions in relation to goal integration and goal achievability in relation to the Foundation component and interlinkage and effectiveness in the component of Output and Outcomes by clarifying how all aspects of this sustainability transition link together and strengthen each other, for example by creating a graphical map that highlights which sub-goals relate to which end goals, which end goals link to which problem formulations, and which policy measures contribute to achieving which goals. In doing so, attention could be paid to which goals or policy measures might be conflicting with each other once implemented on the ground, and where possible, conflicting measures could then be adapted to mitigate this. In addition to this, social acceptability perceptions in relation to the aspects of goal achievability and effectiveness could also be enhanced by providing more clarity on the central policy approach that is currently chosen (i.e. public money for the provisioning of public goods). DEFRA could provide more clarity on how the monetary value of public goods will be assessed and how this instrument relates to the private market to ensure that it will not push out the private market from investing in public goods, which would

perpetuate the underlying problems that this sustainability transition is trying to address by further institutionalising market failures.

The fifth general lesson is that the short- and long-term goals of a sustainability transition should be clearly worded. They should be specific, measurable, and set on a specific timescale so that there cannot be any misunderstanding on their content. In addition, they should be stable and long-term enough to accommodate for the long-term planning cycles of the businesses in the sector at which a sustainability transition is aimed. This stability in the direction of a sustainability transition stands in conflict with the need for flexibility and adaptability. It is therefore important that a right balance is found between the two. In relation to the English agricultural sustainability transition, this fifth general lesson can be translated to the following policy recommendation. To enhance social acceptability perceptions in relation to the aspects of goal achievability and credibility in the Foundation component and specificity in the Innovation Processes component, DEFRA could rephrase the wording of the various (sub) goals of the transition to reduce the room for diverse interpretations. In addition, they could develop specific, measurable targets for each of the (sub)goals and link these to a specific timescale that provides both clarity and long-term stability that reflects the long-term planning cycles of the agricultural sector. For example, sub-goals such as 'enhanced beauty' or 'thriving plants and wildlife' could be specified by defining what is meant with 'enhanced', 'beauty', and 'thriving', being clear on which specific plants and wildlife this relates to, when beauty and plants and wildlife are deemed to be sufficiently enhanced and thriving, and within which timescale this should be achieved. Progress in relation to these specific targets could then be monitored to ensure that the specific timescale is adhered to and the (sub)goals of the sustainability transition are achieved.

The sixth general lesson is that, given the diversity in views on how a sustainability transition should be shaped, the widescale impact a sustainability transition has, and the diversity of interests that compete over the power to influence a sustainability transition, it is essential for the social acceptability of a sustainability transition that the decision-making and implementation processes are transparent and clearly communicated. Governance should thus ensure that it is clear what information decisions are based on, whose input was used in what way, and who is responsible for the decision and/or the way it is implemented. This sixth general lesson, in combination with the current social acceptability perceptions of the English agricultural sustainability transition, leads me to provide the following policy recommendation. To enhance social acceptability perceptions around the aspects of credibility in the Foundation component and meaningful stakeholder inclusion, knowledge type, and transparency in the Governance System component, DEFRA could work on improving transparency and communication around the decision-making and implementation processes and

what knowledge is used within them. They could communicate more clearly how input of which stakeholders has been used in the process of decision-making and implementation and be transparent in why the input was used in this specific way and how that led to the decisions that were made. They could also be more transparent and communicate more clearly as to what decisions are not open for debate and input by stakeholders and why this is the case. In addition, DEFRA could raise transparency and equal inclusion by creating more engagement activities that are open for all rather than by invitation only, stating more explicitly what stakeholders can expect from their engagement, and communicating the same information to all stakeholders at the same time. This could also contribute to addressing differences in power between the different stakeholders throughout the sustainability transition process.

The seventh general lesson is that governance efforts should be directed towards building trust and showing the credibility of a sustainability transition. This links partially to ensuring that all aspects of a sustainability transition are integrated internally and with governmental activities more broadly and transparency in all transition processes, but it goes beyond that by also ensuring to follow through on promises made and ensuring that measures to bring about a sustainability transition run smoothly. In relation to the English agricultural sustainability transition, this seventh general lesson can be translated into the following policy recommendation. To enhance social acceptability perceptions around the aspects of credibility and respect and understanding in the Foundation component, DEFRA could pay more attention to following through on the promises they make, providing coherent and stable messages around this sustainability transition, and acting in line with those messages. In addition, they could strengthen the regulatory baseline underpinning the sustainability transition and be very clear on what it is they expect from farmers and, if farmers fulfil these expectations, reward them accordingly within stated timelines. Part of this is ensuring that all the technical (IT) systems set up to handle the administrative side of the sustainability transition are easy to use and work smoothly. Another part of this is the tone in which DEFRA communicates both with and about farmers.

The eight, and final, general lesson is that, because all components of a sustainability transition are so highly interconnected both internally and with other societal processes, when governance efforts are directed toward creating more favourable conditions for a specific sustainability transition to take place, it is essential that a holistic approach is taken in order to avoid creating lock-ins or unintended consequences through interactions between various components of a sustainability transition. In relation to the English agricultural sustainability transition, this eight general lesson in combination with the current social acceptability perceptions of this sustainability transition, lead me to provide the following policy recommendation. To enhance social acceptability perceptions around the aspect

of fairness in the Output and Outcomes component and the aspects of responsiveness and distributional principles in the Governance System component, DEFRA could take a more holistic approach in how they design this sustainability transition and work on creating more favourable conditions for its success. This includes giving more attention to potential consequences of this sustainability transition at a geographical scale beyond England. It also includes being more alert to differences between different farmers and farm types to ensure that no farmers are excluded by design and that all have an equal opportunity to benefit from this sustainability transition. In addition, it includes taking a more holistic view on the possible costs, both monetary and otherwise, that stakeholders may incur as a result of the sustainability transition efforts within the context of wider environmental, economic, and societal processes (both at the meso and macro level). For the farmers specifically, this means that DEFRA could pay more attention to how the impacts of this sustainability transition on farmers link to, and are exacerbated or mitigated by, impacts from other societal and environmental processes including changes in climate, natural disaster, the outbreak of war, and market changes. For a holistic understanding and approach to these kinds of impact assessments, consideration could be given not only to economic costs, but also to mental health implications and ways in which these could be mitigated.

7. Concluding remarks

Sustainability transitions are assumed to be one of the key solutions to society's grand challenges and great hope is placed upon them. The global community has, consequently, committed itself in multiple international conventions and agreements (European Commission, 2019; UN, 1992a, 1992b, 2015a, 2015b, 2021) to bring about these kinds of transitions. However, in practice, efforts to set in motion sustainability transitions are often confronted with a lack of social acceptability and protest (Bhatia and Katakam, 2021; Gijs, 2022; Markard et al., 2020; Martin and Islar, 2020; Sæþórsdóttir and Ólafsdóttir, 2020), and especially those actors who have a vested interest in the current system tend to be resistant to change (Geels, 2011). As a result, we are increasingly becoming aware that sustainability transitions are inherently disruptive, normative, and political processes (Avelino and Wittmayer, 2016; Fielke et al., 2022; Markard et al., 2012; Turner et al., 2020) and that we therefore need to consider how we can take account of this through the ways in which we govern sustainability transition processes (Köhler et al., 2019). This realization has been enshrined in international agreements and declarations that call for sustainability transitions to be conducted in a 'just' manner (European Commission, 2019; International Labour Organisation, 2015; UN, 2015b, 2021; UN Climate Change Conference, 2018). Yet, to date there is no clarity on how this looks in practice nor does there exist a blueprint on how to achieve this. Policy makers therefore currently lack a clear framework that can help them design sustainability transitions in a way that increases their social acceptability. If we are, however, unable to find ways to govern sustainability transitions in a way that takes account of their disruptive, normative, and political characteristics, we risk losing their potential to address society's grand challenges and disappointing the hope that is placed upon them. Hence, in this thesis, I set out to explore how sustainability transitions could be governed to enhance the social acceptability of both the sustainability transition process and its outcomes. I developed a Sustainability Transition Governance framework and provided practical lessons for the governance of sustainability transitions.

The Sustainability Transition Governance framework and related lessons for governance can be used either diagnostically to assess and monitor past and current sustainability transition governance efforts, or prescriptively to support policy makers in the design of ongoing and future sustainability transitions. When applying the framework diagnostically, it is possible to focus only on certain sub-sections of the framework, but due to the interconnectedness and interactions between the different sections, it is important to bring back any findings of such an analysis into the broader context of the overall framework. It is further important to bear in mind, as highlighted in the lessons for governance, that the different sections of the Sustainability Transition Governance framework do not provide

absolutes, or detailed prescriptions on the specific content of sustainability transition processes. In addition, for reasons of parsimony, the current Sustainability Transition Governance framework only includes key aspects that were dominant either in the previous literature and/or in my empirical findings. The framework should therefore not be used as a panacea (see also Ostrom, 2007). Rather, the aspects presented in the framework provide anchoring points for examinations of social acceptability perceptions of a sustainability transition, which then can provide detailed and more content focused insights for the specific society and sector under consideration. In doing so, the framework can be used as a tool to explore how the disruptive, normative, and political dynamics of a sustainability transition manifest themselves in a specific context and how they are perceived in terms of social acceptability by the society concerned. The lessons for governance, on the other hand, can be treated as more general guidelines on how to structure and organise the governance of sustainability transitions in a way that acknowledges their disruptive, normative, and political characteristics to increase the likelihood that a sustainability transition will be regarded as socially acceptable.

In the remainder of this concluding chapter, I will discuss my empirical and scientific contributions and present areas for future research.

7.1. Empirical contributions

In this thesis I have made an empirical contribution by providing insights into how stakeholders representing diverse interest categories form their social acceptability perceptions around the different components of the English agricultural sustainability transition. I have shown that whilst there currently exists a general basis of social acceptability in terms of the overall focus of this sustainability transition, the way in which this sustainability transition is currently governed negatively impacts its perceived social acceptability. By identifying the aspects of governance that currently negatively contribute to social acceptability perceptions, I found potential avenues through which DEFRA can change their governance practices and increase the likelihood that the implementation of this sustainability transition will be perceived as socially acceptable. I described these avenues in the form of specific policy recommendations. In doing so, overall, I provided an in-depth case study that not only England might be able to benefit from, but that other countries can draw inspiration from for their own agricultural sustainability transition processes.

7.2. Scientific contributions

The Sustainability Transition Governance framework that I introduced in this thesis synthesises the cross-cutting empirical and theoretical findings from the four individual appended papers.

7.2.1. Reducing fragmentation by linking structural components of sustainability transitions

The section of the framework that addresses my first research question by describing the structural components of sustainability transitions integrates insights from multiple theoretical approaches that have their focus on sub-aspects of (agricultural) sustainability transitions. It thereby re-emphasises and strengthens previous findings, but also adds on to them and shows how these interact. It contributes to the literature on the governance of sustainability transitions by combining my empirical material with theoretical developments and insights from different approaches, connecting 1) the micro level: individual human behaviour and individual innovation processes, building on the Theory of Planned Behaviour (Ajzen, 1991; Ajzen and Fishbein, 2005; Burton, 2014; Maye and Chan, 2020), Innovation Management (Du Preez and Louw, 2008; Kline and Rosenberg, 2010; Tidd et al., 2005), and Responsible Research and Innovation (Asveld et al., 2015; Bronson, 2019; Eastwood et al., 2019; Klerkx and Rose, 2020; Regan, 2019; Rose and Chilvers, 2018); 2) the meso level: interactions between innovation processes and the contextual factors that impact upon them, building on the Multi-Level Perspective (Geels, 2019; Geels and Schot, 2007; Smith et al., 2010), Agricultural Innovation Systems (Klerkx et al., 2010; Klerkx et al., 2012; Rajalahti et al., 2008), and Responsible Research and Innovation (Asveld et al., 2015; Bronson, 2019; Eastwood et al., 2019; Klerkx and Rose, 2020; Regan, 2019; Rose and Chilvers, 2018); 3) the macro level: the broader system within which the innovation processes take place, building on the Multi-Level Perspective (Geels, 2019; Geels and Schot, 2007; Smith et al., 2010); and 4) the way in which 1, 2, and to a certain extent 3 are shaped through governance whilst simultaneously feeding back into the governance process themselves, building on literature on the governance of socio-ecological systems (Emerson et al., 2012; Emerson and Nabatchi, 2015). The importance of the seven described structural components of sustainability transitions in the framework have individually been highlighted in previous research (e.g. Eastwood et al., 2019; Geels, 2019; Klerkx et al., 2010; Klerkx et al., 2012; Smith et al., 2010). What the Sustainability Transition Governance framework adds is showing how these components interact and how each of them links to the disruptive, normative, and political characteristics of sustainability transitions. In doing so, it demonstrates overlaps and interactions between the sub-aspects that are raised in these different theoretical approaches, which provides a more holistic understanding of these kinds of processes that comes closer to the real-world complexity of sustainability transition processes than each of these

approaches can do individually. For example, the Sustainability Transition Governance framework contributes to the Multi-Level Perspective by adding in a level below the classical niches, i.e. individuals and individual innovation processes, whilst it contributes to the Responsible Research and Innovation literature by providing a framework including the different structural components of sustainability transitions and the way in which disruptiveness, normativity, and political dynamics manifest within them, alongst which efforts for anticipation, stakeholder inclusion, reflexivity, and responsiveness can be structured. Overall, the Sustainability Transition Governance framework thereby contributes to address the fragmentation in the literature on the governance of (agricultural) sustainability transitions (Allen et al., 2023; El Bilali, 2020; Melchior and Newig, 2021) and provides a more comprehensive, systemic approach to the governance of sustainability transitions which can take into account the different phases through which sustainability transitions pass (Oliver et al., 2021). As the framework focuses on sustainability transitions as a whole, rather than a specific type of innovation within a sustainability transition (e.g. technological innovation), a single innovation project, or a specific innovation niche, it also adds to our generic understanding of sustainability transitions that is not linked to one specific type of innovation. In addition, by explicitly incorporating questions of power dynamics and the disruptiveness and normativity of sustainability transitions, this paper enables us to take a step back and reflect on the disruptive, normative, and political underpinnings of such processes. It thereby further contributes to the growing literature around power and politics in the governance of sustainability transitions (Avelino and Wittemayer, 2016; Avelino et al., 2016; Meadowcroft, 2011) and helps address the limited focus on social acceptability considerations in sustainability transition governance research (de Geus et al., 2022; Köhler et al., 2019; Wironen et al., 2019). The Sustainability Transition Governance framework highlights for each structural component of sustainability transitions in what way political dynamics manifest themselves, i.e. what the central questions are around which power contestations evolve in relation to each structural component. This is an important addition to the literature around power and politics in the governance of sustainability transitions as it can help to set up governance structures and processes for sustainability transition processes in a more targeted way around these key questions of power contestation.

7.2.2. Deepening insights on social acceptability perceptions of sustainability transitions

The section of the Sustainability Transition Governance framework that addresses my second research question by describing how people form their perceptions of social acceptability around the structural components of a sustainability transition, extends the basic framework of structural components of sustainability transitions by providing more depth to how the disruptive, normative, and political

dynamics related to each of these components link to perceptions of social acceptability of sustainability transition processes and outcomes. It contributes to the literature on the governance of sustainability transitions by addressing the limited attention given to social acceptability perceptions of sustainability transition processes and their outcomes in relation to the interaction of their disruptive, normative, and political nature (Köhler et al., 2019). The Sustainability Transition Governance framework integrates the three key aspects that constitute social acceptability, i.e. perceived legitimacy, perceived justice, and perceived adaptive capacity and willingness to adapt (Busse and Siebert, 2018; Lucke, 1995), which are generally studied in isolation of each other in the sustainability transition literature, and links them to the structural components of sustainability transitions. This section of the framework draws on additional strands of literature (e.g. political philosophy, social psychology, environmental justice, food justice, social justice, and sociology) and empirical material beyond the ones used to identify the structural components of sustainability transitions as these have specialized on the various aspects of social acceptability which have been underdeveloped in the Multi-Level Perspective, Agricultural Innovation Systems approach, Responsible Research and Innovation, Innovation Management, and the Theory of Planned Behaviour. The Sustainability Transition Governance framework thereby gives deeper insight into how these social acceptability aspects, and their previously known respective sub-aspects including interlinkage, credibility, and effectiveness come together in perceptions of social acceptability and how they relate to the different structural components of a sustainability transition. To the best of my knowledge, this has not been done in the wider literature on the governance of sustainability transitions before. It adds on to all the previous approaches in the sustainability transition literature, including the ones I used to draw out the structural components of sustainability transitions, but also e.g. Transition Management and Strategic Niche Management, by providing more details on how perceptions of social acceptability could be addressed through governance in a comprehensive and systemic way at different stages of a sustainability transition (Oliver et al., 2021). In addition, the Sustainability Transition Governance framework brings in more nuance to previously identified sub-aspects of social acceptability perceptions of sustainability transitions by highlighting that many of these, such as alignment with interests, meaningful stakeholder inclusion, fairness, and knowledge type (e.g. Bennett et al., 2019; Gupta et al., 2010; Lockwood et al., 2015; Martin et al., 2016; Mills et al., 2021; Vringer and Carabain, 2020; Wironen et al., 2019), are not absolutes. Rather, the ways in which these aspects are perceived and play out in relation to social acceptability perceptions of sustainability transition processes and outcomes highly depend on individual normative values, experiences, and circumstances. Being aware of this, and being able to assess how these look in the specific society within which a sustainability

transition is set to take place, can enable taking better account of these normative views throughout the governance processes.

In terms of the sections of the Sustainability Transition Governance framework that relate to perceived legitimacy of sustainability transition processes and outcomes, findings from previous studies around perceived legitimacy (e.g. Boedeltje and Cornips, 2004; Jaber and Oftedal, 2020; Johansson, 2014; Scharpf, 1999; Suchman, 1995; Upham et al., 2015; Vringer and Carabain, 2020) are confirmed, but the framework also adds on to the literature by identifying new aspects that have not yet been prominent in the legitimacy literature, including the specific phrasing of (sub)goals of a sustainability transition and the importance of diversity in policy instruments used to bring about a sustainability transition, and by showing how the different dimensions of perceived legitimacy interact with each other in practice. Especially the aspect of diversity in policy instruments is an important additional finding as it does not only play a role in relation to perceived legitimacy but also provides a way through which the negative consequences of the disruptive nature of sustainability transitions can be mitigated through governance.

The sections of the Sustainability Transition Governance framework that relate to perceived justice of sustainability transition processes and outcomes, adds to the previous literature on just transitions by stepping away from the prescriptive approach taken in the just transition literature (e.g. Bennet et al., 2019; Blattner, 2020; Droubi et al., 2022; Heffron, 2022; Heyen et al., 2021; Knox et al., 2022; Sunio, 2021; Tribaldos and Kortetmäki, 2022; Wieliczko et al., 2021), thereby incorporating the normative nature of the concept of justice (Smaal et al., 2020; Wang and Lo, 2021; Wijsman and Berbés-Blázquez, 2022; Wolff, 2008). In addition, it contributes to the just transition literature by collating underlying dimensions and subdimensions based on which people make normative justice evaluations of a sustainability transition.

Together, the sections on perceived justice and perceived legitimacy provide structure to anyone who is interested in conducting an analysis of social acceptability perceptions of sustainability transition processes and outcomes, but rather than predefining what just or legitimate, and by extension socially acceptable, sustainability transitions should look like, they leave room to incorporate individual and societal normative perceptions on this. In doing so, this aspect of the Sustainable Transition Governance framework allows for reflections on one's own underlying normative starting points; something which is currently often lacking in the sustainability transition literature (Blok and Lemmens, 2015; Klerkx et al., 2012; Schlaile et al., 2017; Wigboldus et al., 2021). It thereby contributes to the literature on sustainability transitions by providing a framework that can make explicit what, and whose, normative views are catered to in a specific sustainability transition and what, and whose,

views are left out. Having an understanding of this is a prerequisite for governance to address the normative and political nature of sustainability transitions.

In terms of the sections of the Sustainability Transition Governance framework that relate to perceived adaptive capacity and willingness to adapt, the framework contributes to the exiting literature on sustainability transitions and the literature on adaptive capacity by linking the adaptive capacity and willingness to adapt concepts to (agricultural) sustainability transitions in specific. The Sustainability Transition Governance framework incorporates and confirms that many previous findings on adaptive capacity and willingness to adapt in relation to climate change or specific innovations, such as for example social capability, attitude to innovation, and learning capacity (e.g. Cinner et al., 2018; Hurley et al., 2020; Makate, 2019; Rust et al., 2020; Schut et al., 2018; Shah et al., 2019; Zeweld et al., 2019), also apply in the context of sustainability transitions. However, it also highlights aspects that have not yet been prominent in the previous literature on adaptive capacity in relation to climate change and innovation, including the dual role that access to finances and information can play, feeling respected and understood, and perceived level of control. These sections of the Sustainability Transition Governance framework contribute to the sustainability transition literature by highlighting what aspects governance of sustainability transitions could focus on strengthening to minimise and mitigate the negative consequences of the disruptiveness of sustainability transitions for stakeholders on the ground. It showcases the complexity of farmers' agency in deciding if and how to engage with an ongoing sustainability transition and the impact that institutional structures and processes have on these decisions, and it thereby takes a step in addressing the lack of attention to individual agency in sustainability transitions research (Huttunen et al., 2021; Rauschmayer et al., 2015) and re-emphasises the mutual responsiveness between individuals and the structures around them (Giddens, 1984).

7.2.3. Providing deeper insights into the dynamics between governance, social acceptability perceptions, and sustainability transition dynamics

The overarching lessons for governance and policy recommendations that I draw out from the Sustainability Transition Governance framework as an answer to my third research question regarding how governance can be shaped to enhance the social acceptability of a sustainability transition contribute to the sustainability transition literature by providing deeper insights into the dynamics between sustainability transitions and public opinion (Truffer et al., 2022) and how governance can play a role in influencing social acceptability perceptions. The overarching lessons for governance that I draw out reflect insights on governance as presented in literature related to adaptive governance (e.g. Allen et al., 2023; Chaffin et al., 2014; Sharma-Wallace et al., 2018), reflexive governance (e.g.

Feindt and Weiland, 2018; Hendriks and Grin, 2007; Pickering, 2019; Voss and Bornemann, 2011; Voss and Kemp, 2006), and collaborative governance (e.g. Ansell and Gash, 2008; Emerson et al., 2012). Neither of these lessons in and of themselves are therefore new. However, my contribution to the literature on the governance of sustainability transitions lies in connecting these lessons with each other, linking them to perceived social acceptability, and showing how they apply to the governance of sustainability transitions in particular.

The lessons for governance and the Sustainability Transition Governance framework as a whole add to the dominant approaches in the sustainability transition governance literature, including the Multi-Level Perspective, Transition Management, Strategic Niche Management, Responsible Research and Innovation, and literature on just and legitimate sustainability transitions, by placing social acceptability perceptions front and centre in the governance of sustainability transitions without adding in a predefined, normative, stance as to what a socially acceptable sustainability transition should look like and by providing concrete tools and policy recommendations on how governance can address the disruptive, normative, and political nature of sustainability transitions and take account of diverse social acceptability perceptions. Overall, I contribute to the sustainability transition literature by showing that governance can address the disruptive, normative, and political nature of sustainability transitions by taking a deliberative and reflexive approach, allowing diversity in sustainability transition goals and pathways, creating flexibility in the measures designed to bring about a sustainability transition, and by creating accountability through specificity in goal formulations and transparency of all governance processes. There is no panacea that can ensure that sustainability transitions are regarded as socially acceptable by all, but following the lessons for governance that I described and engaging with the Sustainability Transition Governance framework that I introduced can form a starting point to increase the likelihood that they will be perceived as such by larger sections of the specific society within which a sustainability transition is set to take place.

7.3. Areas for future research

Because the Sustainability Transition Governance framework is in the early stages of its development, it provides ample opportunities for future research. First, whilst the framework is anchored in previous literature, it currently only builds on one specific empirical case. Future research could therefore focus on testing and further developing the framework empirically, with different stakeholders, in different societal sectors, and/or in different geographical areas. Special attention could thereby be paid to normative cultural differences in perceptions of social acceptability, especially in relation to non-European cultural contexts, as well as to sector-specific characteristics. In addition, further nuance

could be provided to the Sustainability Transition Governance framework and the lessons for governance by exploring if and how perceptions of the social acceptability of sustainability transitions differ depending on people's socio-economic backgrounds such as educational level, income, and age. Gaining deeper understanding of if, and in what way, such differences exist could help policy makers target and adapt specific sustainability transition processes and policy measures to specific target groups and take a more focused approach in addressing the disruptiveness, normativity, and political nature of sustainability transitions. Future research could also focus on further developing the framework theoretically, by adding on insights from additional disciplines and theoretical approaches that have not been included in this study. A second area for future research could focus around the role of timescales, the social (in)acceptability of taking certain decisions or actions versus the social (in)acceptability of not taking them, and questions around trade-offs and either-or decisions. In relation to timescales, future research could provide insight into how a proposed timescale of a sustainability transition process influences its perceived social acceptability. In relation to the social acceptability of taking certain decisions or actions versus not taking them (e.g. embarking on a specific kind of sustainability transition pathway versus another or none at all) as well as in relation to potential trade-offs and either-or decisions, for example when desired sustainability transition goals cannot be achieved simultaneously, future research could examine the relativity of social acceptability perceptions in different contexts and when there are more than one acceptability objects to relate to. In addition, future research is needed to examine how governance can address and account for conflict in sustainability transitions and irreconcilable normative views on the aimed for goal(s) of a sustainability transition and how to achieve them. A third area for future research could focus on providing more detail on the social acceptability of specific, detailed sustainability transition policies, rather than their general direction. This could provide insights into where perceptions of the social acceptability of a sustainability transition might change depending on the specific costs and benefits (both monetary and otherwise) that it would provide. Additional research is also needed to examine how specific policy instruments used to bring about a sustainability transition can be designed to take account of the disruptive and normative nature of sustainability transitions by increasing their flexibility whilst maintaining or increasing their effectiveness. Fourth, as the Sustainability Transition Governance framework and the lessons for governance as they stand now only take account of the social acceptability perceptions of a sustainability transition of the specific society at which a sustainability transition is aimed even though a sustainability transition may likely have implications for others beyond that specific society (Tschersich and Kok, 2022), another area for future research could be centred around the question of how to incorporate social acceptability perceptions of a sustainability transition outside of the specific society within which a sustainability transition is set to

take place. Examining this could broaden the geographical scope of the disruptive, normative, and political dynamics that can be considered in the governance processes of a sustainability transition. This also relates to a deeper philosophical question that future research could focus on, namely whether it is ethically and morally appropriate to aim to design a sustainability transition around societal perceptions on what is socially acceptable, or whether there should be certain critical boundaries to the design of sustainability transitions? And if so, who should decide on these boundaries and in what way?

Overall, this thesis gives policy- and decision-makers, and researchers alike, a tool through which they can better understand, conceptualise, and take into account social acceptability perceptions of sustainability transitions. Future research can build on to, and further develop, the Sustainability Transition Governance framework and lessons for governance. It is encouraging to see that sections of the framework are already being referred to (e.g. Farstad et al., 2022; Fielke et al., 2022; Jakku et al., 2023; van der Velden et al., 2022; Vilas-Boas et al., 2022) and picked up by other researchers (e.g. Akimowicz et al., 2022; Olvermann et al., (2023).

Data availability statement

The survey data that support the findings of this thesis are openly available from the University of Reading Research Data Archive at https://doi.org/10.17864/1947.000413. The qualitative interview data are not openly available for confidentiality reasons.

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Appendix

Paper I

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Governing agricultural innovation: A comprehensive framework to underpin sustainable transitions

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ABSTRACT

Innovations have the potential to help us address and overcome many of the challenges that agriculture is facing today. Yet, at the same time, they have the potential to create new, sometimes even more challenging, problems, especially when they are not governed in a sustainable way. Governing agricultural innovation sustainably requires understanding of all components that influence, and are influenced by, innovation processes, interactions across societal levels, and the normative and power dynamics that come together to shape the direction and outcomes of innovation processes. Hitherto, approaches to (agricultural) innovation and transition tend to specialize on a specific societal scale or sub-aspect of innovation or transition processes. In this article we aim to bring the strengths of some of the main approaches (Multi-Level Perspective, Agricultural Innovation Systems, Responsible Innovation, Innovation Management, Theory of Planned Behaviour) and insights from environmental governance literature together into a comprehensive framework. The framework describes seven key components and their interactions: macro context, governance system, immediate context, innovative and adaptive capacity of the actors, psychosocial factors, and the innovation process itself. Based on these, we present a subset of guiding questions that can be used diagnostically or for design purposes to support the sustainable governance of agricultural innovation processes.

1. Introduction

The world is facing many large scale challenges such as climate change, demographic change, biodiversity loss, and land degradation that act as drivers of socio-ecological change (Burkett et al., 2014; IPBES et al., 2019). Among other things, they challenge the current ways of practising agriculture and change the dominant requirements that society asks agriculture to fulfil. In order to address these challenges there is a need for a transition[1] toward more sustainable forms of agriculture (El Bilali, 2020; Martin et al., 2018). Both in scientific literature, media, and new agricultural policies, innovation is highlighted as the mean to achieve this (Herrero et al., 2020; Lubberink et al., 2017). Yet at the same time, the call for more careful reflection on the potential (social) consequences of especially technological innovations in the agricultural sector is becoming louder (Eastwood et al., 2019; Klerkx and Rose, 2020; Stilgoe et al., 2013). However, socio-ecological systems such as agriculture are highly complex and unpredictable due to non-linear interactions and feedback loops that cross temporal and spatial scales (Thompson et al., 2007). Potential consequences are therefore often difficult to anticipate and arduous to counteract once an innovation is implemented (Klerkx and Rose, 2020; Sveiby et al., 2009). This is especially problematic because innovations have the potential capacity to create large scale, systemic changes beyond their intended reach (Loorbach et al., 2017; Voss and Bornemann, 2011).

Even when potential consequences can be foreseen, multiple pathways of change to address the above challenges toward a subset of alternative futures are possible (Blok and Lemmens, 2015; Foran et al., 2014). Each of these will have the potential to either contribute to sustainability or to undermine socio-ecological systems and consequently peoples' wellbeing. However, different people experience and value these pathways differently. What is perceived as a positive pathway for one might mean a loss of livelihood for another (Leach et al., 2007). The desirability of a certain innovation or transition pathway is therefore a value based, normative judgement.

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[1] We are speaking of transition rather than transformation because the focus here is on one societal sub-system (i.e. agriculture) rather than on society as a whole. For a discussion on the difference between these two concepts see Hölscher et al. (2018).

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Acknowledging the normativity underlying potential innovations and strived-for-futures as well as being aware that potential consequences of innovations will likely be distributed unevenly across society and might result in systemic change (Leach et al., 2007) moves innovations and their development out of a 'neutral, a-political sphere' where discussions evolve around technical aspects of innovation development and the (challenges to) uptake. Instead, innovation processes become political, contested arenas where differing interests compete over influence on the direction and manner in which the agricultural sector develops (Turner et al., 2020). With political, we refer here to processes of power contestation and the impact of uneven power distribution on how resources, life chances, and well-being are distributed in society (Stoker and Marsh, 2010). Whereas power broadly refers to "the capacity to effect outcomes" (Morriss, [1987] 2002, 299). This can include both having *power over* and having *power to* and can manifest itself in the form of *domination* or *empowerment* (Haugaard, 2012).

In order to create sustainable, socially just, and legitimate innovation processes and outcomes there is thus an urgent need to govern innovation in a way that takes account of these normative and political dynamics and the interconnectedness between individual innovation processes and societal processes and vice versa. This need has received recognition in international agreements and declarations that strive toward a more sustainable world, including the Paris Agreement (2015), the Solidarity and Just Transition Silesia Declaration (2018), the 2030 Agenda (United Nations, 2015), and the European Green Deal (European Commission, 2019). Yet, how exactly this needs to be brought about is still unclear.

Hitherto, approaches to (agricultural) innovation and transition tend to specialize on a specific societal scale or sub-aspect of innovation or transition processes (Foran et al., 2014; Poole and Van de Ven, 1989; see also Table 1) or one type of innovation, i.e. technological innovation. Individually, these approaches give valuable insights into their respective focus area but they do not provide the comprehensive understanding of innovation processes that is required to govern agricultural innovation sustainably. To enable this kind of governance in the complex socio-ecological system of agriculture, we need to connect our understanding of all societal levels related to innovation processes. We therefore need to combine theoretical developments from multiple disciplines related to 1) the micro level: individual human behaviour and individual innovation processes, 2) the meso level: interactions between innovation processes and the contextual factors that impact upon them, 3) the macro level: the broader system within which the innovation processes take place, and 4) the way in which 1, 2, and to a certain extent 3 are shaped through governance whilst simultaneously feeding back into the governance process themselves (Folke et al., 2010; Leach et al., 2007; Ostrom, 2009; Poole and Van de Ven, 1989; Poteete et al., 2010, p. 215). With governance we mean the practices and procedures of how decisions related to public affairs are made and implemented and how responsibilities are exercised (Baker, 2009; Lockwood et al., 2010). The objective of this paper is therefore to bring the strengths of multiple theoretical approaches together in a comprehensive framework that can give insights into how to govern agricultural innovation processes in a more holistic, sustainable way. Throughout this paper, when we use the term 'sustainability' we mean both its environmental, economic, and social aspects, as we argue that an agricultural innovation cannot truly be sustainable unless it takes each of these aspects into account. However, as the social component of sustainability is least developed in the agricultural innovation literature, this aspect has our main focus.

The research questions that are guiding the development of the framework is '*What components need to be considered in the governance of agricultural innovation processes, how do these components interact, and what lessons can be drawn from this to help guide the governance of agricultural innovation processes?*'. This paper thereby provides a first step on the way of developing a generic comprehensive framework for the sustainable governance of agricultural innovation and we hope to inspire other researchers to further add on to this framework over time.

Underlying the framework is a broad definition of innovation, i.e. innovation is taken to mean a change from a previous state of doing things through the application of new or existing knowledge in novel ways (McKenzie, 2013; Spielman et al., 2008). This can include anything from the use of new technology or other objects and (management) practices, to policy instruments, market mechanisms, products, etc. (Saint Ville et al., 2016) and always entails a change in behaviour (Duru et al., 2015). Innovation can be of technological, social, economic, or institutional nature (Klerkx et al., 2012; Schut et al., 2018). Furthermore, an innovation does not have to be completely novel in order to be considered innovative, it is sufficient if it is new for the person, community, or sector who is applying it, and is therefore not always synonymous with invention (McKenzie, 2013; van der Veen, 2010). Generally, innovations are a reaction to a change in needs and/or a change in the external context (Rodima-Taylor et al., 2012).

The remainder of this paper is structured as follows. First, we present the methods that we used to develop the framework and give a brief overview of the theoretical approaches that we build on. This overview focusses on the main strengths and weaknesses of these approaches in relation to the aim of this paper. Second, we present the various components of the framework. Whilst we have to draw distinct lines between the components for analytical clarity, it is important to keep in mind that they are closely intertwined and influence each other in a multi-directional way. Third, we describe how looking at the components of the framework through the parameters of legitimacy, social justice, and sustainability enables us to create a set of guiding questions that can highlight the normative and power dynamics of the agricultural innovation process. We propose that this set of guiding questions can support the sustainable governance of agricultural innovation. We end the paper with a discussion and conclusion on the potential uses of this framework and opportunities for further research.

2. Methods

In order to identify key system components that have been acknowledged as relevant to agricultural innovation across societal levels, we began with a literature review of research articles with a focus on the governance or management of agricultural innovation. The search terms (see Annex A) were generated with this aim in mind, based on an initial scanning of literature on agricultural innovation processes and the governance of socio-ecological systems, and adapted based on several trial searches. Web of Science's (WoS) core collection database was used as the backbone of this review. We used the broadest timespan possible in WoS (1945–2020, with March 10th 2020 being the cut-off date). The returned results (N = 742) were narrowed down to filter out non-relevant articles through a manual assessment of the titles and abstracts and in a second round through screening of the full-texts. This was done based on the criteria that an article would need to have its central focus on agricultural innovation processes and their management or governance or the capacity to undertake such processes. This resulted in the inclusion of 284 articles. A further 35 articles were added through snowballing (based on the reference lists of articles that were included) and expert (i.e. university based researchers specializing in agricultural innovation) feedback on the initial list, resulting in a total of 319 articles being included in this study. These consisted of both peer-reviewed papers, contributions to conferences, and academic book chapters. Through the analysis of these articles we identified that we reached data saturation and therefore did not extend the review to other databases.

The selected articles were coded according to their main topic and theoretical approach in order to identify research gaps. In an iterative process of reading and re-reading the material, discussions between the authors, and through feedback on conference- and departmental presentations, we identified 5 key components: the adaptive and innovative capacity of the actors (i.e. any kind of entity that can take active part in

an innovation process, e.g. an individual farmer, a group, an organisation, a company, etc.), the context within which the innovation process takes place, the innovation process itself, and the governance system. To develop the theoretical understanding of these components and potentially identify additional components, their role, and their connection to each other we combined the insights from the more empirically oriented articles in the literature review with various theoretical approaches that have specialized on these individual components or the connection between some of them: Multi-Level Perspective, Agricultural Innovation Systems, Innovation Management, Responsible Innovation, and Theory of Planned Behaviour. The choice of using these approaches was based on their strengths in relation to the identified components and complementarity to each other's weaknesses as is shown in Table 1 as well as their dominance in the literature that was included in our review. We acknowledge that this is not an exhaustive list of theories that elaborate on the components included in this framework. This is a limitation of this study, but one that had to be made given the scope of this article. We therefore encourage future research to further build on and expand this framework. Potential literatures that could be drawn on for this purpose include but are not limited to political economy, political ecology, literature on the diffusion of innovations, philosophical approaches to (ethics in) innovation, and psychology of innovation. In addition to these theoretical frameworks, we build on insights from the literature on the governance of socio-ecological systems in order to highlight and operationalize the normative and political dimension and strengthen our understanding of the role of the governance component within the framework. While this strand of literature did not come up in our review (as it is not explicitly focussed on agriculture), we argue that it makes a valuable contribution to this framework because the agricultural sector is a prime example of a socio-ecological system. To bring all the different components and their interactions together, we were inspired by the work of Emerson and Nabatchi (Emerson et al., 2012; Emerson and Nabatchi, 2015). Whilst their work is concerned with a different topic (collaborative governance regimes) and different components, it proved helpful to graphically structure the components that we have identified in relation to the governance of agricultural innovation.

3. Toward a comprehensive framework

The framework consists of four nested dimensions, each of which can be further broken down into smaller components: the macro context, the governance system, the foundation on which innovation processes build, and the innovation processes themselves. They are depicted as boxes

Table 1
Overview of theoretical approaches used in this study.

Characteristics of the approach	Type of approach				
	Multi-Level Perspective	Agricultural Innovation Systems	Responsible Innovation	Innovation Management	Theory of Planned Behaviour
Main focus	Macro & Meso level[a]: dynamics between niche-innovations, regimes (currently dominant & institutionalised way of delivering societal functions), & the landscape (macro level societal & environmental processes)	Meso level: networks of actors & the (institutional) structures that influence how these actors interact with the aim of optimizing the system for the specific innovation that is under study	Meso & Micro level: social and ethical aspects of innovation with the underlying aim to improve the societal uptake of innovations (Asveld et al., 2015)	Micro level: Individual innovation processes with specific attention toward the different stages that comprise an innovation process	Micro level: Individual actors' behavioural intent and behaviour (Maye and Chan 2020)
Strengths (in relation to the aim of this study)	Systemic scale, generalizability, & understanding of interaction of processes across levels (Geels, 2019; Geels and Schot, 2007; Smith et al., 2010)	Systemic scale, capacity to identify how the network configuration of actors & their socio-institutional context either hampers or supports the innovation under study (Klerkx et al., 2010; Klerkx et al., 2012; Rajalahti et al., 2008), & specialized to agricultural innovation processes	Thematizing the need for anticipation of consequences, inclusion of stakeholders, reflexivity, & responsiveness (Eastwood et al., 2019; Rose and Chilvers, 2018), & raising the issue of normativity (Bronson, 2019; Klerkx and Rose, 2020; Regan, 2019)	Breaking down the innovation process, concretizing the steps that are required to develop an innovation, & clarifying different management needs depending on the stage of the process (Du Preez and Louw, 2008; Kline and Rosenberg, 2010; Tidd et al., 2005, p. 65–75)	Identifying factors that influence actors' behavioural intent to take part in innovation processes, highlights the importance of normative dynamics for behavioural intent (Ajzen, 1991; Ajzen and Fishbein, 2005), & supports anticipation of farmers' behaviour toward innovations (Burton, 2014)
Weaknesses (in relation to the aim of this study)	Limited attention to agency of actors, political & normative dynamics, & the role of governance (El Bilali, 2019a; 2019b; Lachman, 2013), & lack of attention to dynamics within individual innovation processes	Limited attention to political & normative dynamics (Klerkx et al., 2012; Schlaile et al., 2017), focus to optimise the specific system under study without attention to how this may affect alternative innovation pathways (Pigford et al., 2018), & lack of attention to how different socio-institutional context factors may be more or less important depending on the stage of the innovation process	Lack of reflection on own underlying normative starting points (Blok and Lemmens, 2015), limited attention to political dynamics & the influence of the meso & macro level on the actions of micro level actors, & lack of clear operationalisation within the agricultural context	Risks simplification of the innovation process (Kline and Rosenberg, 2010; Kowalski et al., 2016), no detailed insights into the meso & macro level processes or how these might be affected by the individual innovation process (Michaëlli et al., 2014), & no focus on the normative & political dynamics	Gap between behavioural intent and actual behaviour (Ajzen, 2011) & does not directly address the potential consequences of that behaviour for the actors themselves, nor how the behaviour influences the meso & macro level
What the approach is used for in this paper	Distinguishing between the 'macro context' & the 'immediate context' & how these influence the innovation process	Gaining detailed insights into the elements that make up the immediate context & its functional role for innovation processes	Developing insights into normative dynamics	Clarifying the different stages of an innovation process & their function	Identifying how contextual components & normative dynamics have to come together in order to enable innovation-related behaviour

[a] Note: the MLP literature refers to niches as being at the micro level. We argue here that they are part of the meso level, as we use the term 'micro level' to refer to an individual innovation process and individual actors.

within boxes in Fig. 1 and elaborated on individually below. The governance system is placed between the macro context and the foundation and innovation processes because it is the mediating structure between them. Solid lines in the figure indicate the outermost structure whereas dotted lines show that there are interactions between the various dimensions. The arrows show the direction of those interactions. Together they show that the framework is characterized by 'duality of structure' or 'mutual embeddedness' (Klerkx et al., 2010; Markard and Truffer, 2008). This means that whilst the structure within which the actors of innovation processes are embedded influences their actions, at the same time the structure is a result of those actions (Giddens, 1984).

3.1. Macro context as driver of change

The macro context is the setting within which the other dimensions take shape. It takes its name from its characteristics and closely relates to the landscape level in Multi-Level Perspective approaches. It consists of grand macro structures such as climate, biodiversity, demography, macro-economics, and macro-political developments. Aspirations for societal transitions are also part of the macro context dynamics; they form the background and create opportunities for individual innovation processes and require input from society at large. The macro context generally changes slowly due to natural or anthropogenic processes (Pichs-Madruga et al., 2016) but rapid, shock-like alterations also occur. The average individual actor has only very limited to no influence over the structures that make up the macro context (Geels and Schot, 2007; Klerkx et al., 2012). However, innovations do have the potential to influence these structures over longer time scales.

Changes in the macro context function as direct or indirect drivers (Nelson et al., 2005; Pichs-Madruga et al., 2016) of agricultural change and can therefore be regarded as key driving motivational forces behind innovation efforts. They alter either directly or indirectly the demands that society puts on agriculture (e.g. increase in population eventually leads to higher output demands on agriculture) or the natural conditions within which agriculture has to function (e.g. climate change increases variability of weather patterns and extreme weather events which alter the conditions that crops and livestock need to be able to withstand) (Hazell and Wood, 2008; van Vliet et al., 2015).

Being aware of the interactions between the macro context and innovations and vice versa is important for the sustainable governance of agricultural innovation because it can support understanding the underlying issue that the innovation is attempting to address and the anticipation of potential long-term consequences of the innovation. Both of these are central questions in the innovation process.

3.2. Governance system

The governance system describes how societies make and implement decisions related to public affairs, in this case agricultural innovations. It includes both structures and processes of decision making and implementation and determines how power is exercised and responsibilities are carried out (Baker, 2009; Lockwood et al., 2010). It comprises the patterns that result from governing activities and interactions between public and private actors who actively and purposefully aim at steering (sectors of) society into a certain direction (Jordan, 2008; Kemp et al., 2005). It is distinct from, and more encompassing than, government due to the inclusion of non-state actors as relevant and active entities in governing processes (Lemos and Agrawal, 2006). The governance system reaches across the macro, meso, and micro level as it can operate at, and influence, each of these levels and its specific form can change over time and differ per innovation process. Because this framework is built around the question of how the governance of agricultural innovation processes can take into account the normative and political dynamics of innovation in order to create more sustainable, socially just, and legitimate processes and outcomes, we use governance in a normative sense.

We use 'legitimacy' to refer to "the acceptance and justification of authority" (Biermann and Gupta, 2011, p. 1858) and it therefore relates to the perceptions people have about the procedural characteristics and

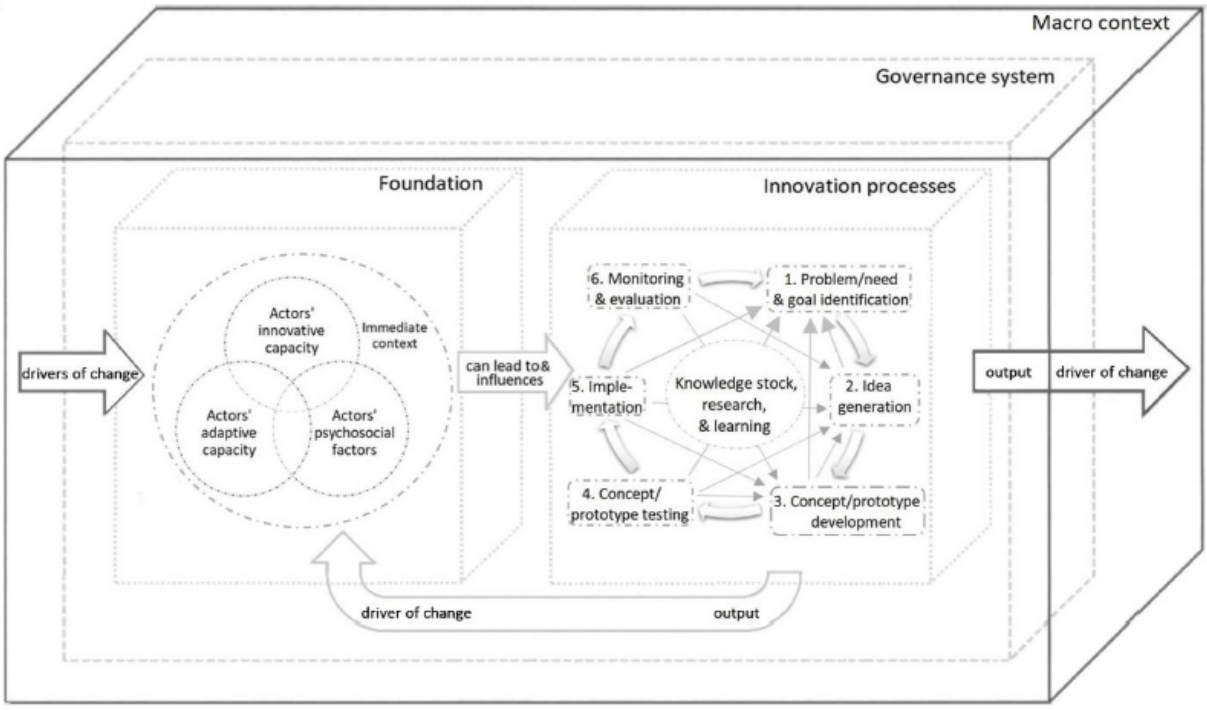

Fig. 1. Comprehensive framework for the governance of agricultural innovation. Inspired by Emerson et al. (2012), Du Preez and Louw (2008), and Kline and Rosenberg (2010).

outcomes of governance processes. It addresses the perceived validity of decision-making authority and how this authority itself is established (Bernstein, 2004) and is thus one parameter through which power dynamics can be made explicit. Perceived legitimacy is important in relation to the sustainability of agricultural innovation because it increases the acceptability of, and support for, the innovation processes and outcomes (Biermann and Gupta, 2011; Lockwood et al., 2010).

With 'socially just' we point to the distribution of positive and negative consequences of the innovation process and its outcome(s) both for current and future generations (Miller, 1999, p. 6) and the consideration and respect given to the views and opinions of those who are (potentially) affected by the innovation process and its outcomes (Lockwood et al., 2010). We use it here as a parameter for both normative and power dynamics. Like with legitimacy, we highlight the importance for sustainability of how these aspects are being perceived.

We use the term 'sustainable' as a functional condition, meaning that it refers to "a process that can be sustained over time without eroding its own foundations" (Voss and Kemp, 2006, p. 14). The process that we are interested in sustaining is agriculture and, in extension, agricultural innovation, but we recognize that it can be contested what kind of agriculture and innovations should be able to be sustained, how this should be achieved (Leach et al., 2007), and over what time-scale. Even when there exists some agreement about desirable end goals and/or pathways, when these cannot be achieved simultaneously, value trade-offs have to be made (Voss and Kemp, 2006). This raises the questions of which values are deemed more important than others and who has the power to manifest their views on this as the standard for decision-making. In addition, the desirability of contested goals and pathways can change over time. This happens for example when cultures and broader contexts change or when more knowledge becomes available. Thus, what kind of agriculture and agricultural innovation processes the foundation needs to be able to sustain can also differ over time. Furthermore, due to the complexity and non-linearity of socio-ecological interactions and the long time-scale that needs to be considered, the governance of agricultural innovation has to take place under conditions of uncertainty (Baker, 2009; Feindt and Weiland, 2018; Voss and Kemp, 2006). It is therefore important that the processes remain flexible and adaptable to incorporate changing values and new knowledge, to address unforeseen positive and negative consequences of made decisions (Hartley et al., 2016; Stilgoe et al., 2013; Tricarico et al., 2020), and to ensure that the decisions that are made now do not unduly hamper or foreclose alternative pathways and goals for the future (Baker, 2009). Creating room for diversity through the governance system can be useful to this end as it increases the range of potential response options (Underdal, 2010).

Due to the above described characteristics and normative orientation, and in line with insights from Responsible Innovation approaches and literature on the governance of socio-ecological systems, we argue that the governance processes of agricultural innovation should be grounded in reflexive practices. Actors involved in the governing process should deliberately reflect on the potential (unintended) consequences of their decisions and on how the way that decisions are made, and the values that underly these decisions, reproduce the structures that can undermine sustainability and erode the foundation on which they are built (Dryzek and Pickering, 2017; Hendriks and Grin, 2007; Voss and Kemp, 2006). This includes recognizing the (potential) impacts of governance actions throughout the socio-ecological system, monitoring of past and present impacts, and anticipating future impacts (Lubberink et al., 2017; Rose and Chilvers, 2018; Stilgoe et al., 2013). In order to know what these reflections should focus on specifically we need an understanding of the components and their interactions that are relevant to agricultural innovation processes. We will therefore first continue to explore the other dimensions of this framework before we turn to how this kind of governance could practically take shape.

3.3. Foundation

The foundation stands in a bidirectional relation with the governance system and consists of components that have been identified by the articles in our literature review as either supporting and sustaining or hampering agricultural innovation processes. It includes the adaptive and innovative capacity of the actors and their psychosocial factors as well as the immediate context within which the actors are embedded. The psychosocial factors have been generally addressed as part of the adaptive or innovative capacity in the articles in our literature review, but for reasons that will be described below we treat them as a component in its own right. We have brought these components together under the heading 'foundation' because together they form the foundation on which agricultural innovation processes build.

As Table 2 shows, there is considerable overlap, interaction, and dependency between the elements and determinants that make up these components. This may partially be a result of the fact that the literature on agricultural innovation uses multiple definitions of these concepts (for examples see below), uses them interchangeably (e.g. Aase et al., 2013; Rockenbauch et al., 2019), or does not define what they mean altogether (e.g. Morton et al., 2017; Röling et al., 2004). Here we make an attempt to create clearer distinctions between these components both in regard to how they are defined and what their differing functions are in relation to the innovation process. We then build on this to develop initial hypotheses of how these components come together to either enable or disenable innovation processes.

3.3.1. Immediate context

The immediate context comprises the structures within which the actors are embedded. Insights from the Agricultural Innovation Systems approach show that these include the physical infrastructure, formal and informal institutions, formal and informal organisations, the market, the local natural environment, and the adaptive and innovative capacity of the aforementioned components (Hekkert et al., 2007; Pigford et al., 2018; Rajalahti et al., 2008). These structures are located at the meso level but can be analysed at various scales; in the terminology of Multi-Level Perspective approaches, they can be analysed both in relation to the regime, an individual niche, or a combination of the two.

We posit that the extent to which the immediate context is aligned with the kind of innovation that is strived for determines the degree of innovative or adaptive capacity that the actors need to be able to initiate and bring an innovation process to a close. I.e. if the immediate context is structured in a way that is supportive to the specific innovation, the degree of innovative and adaptive capacity that is required for this specific innovation process will be lower than in the case where the immediate context is not supportive of the innovation that is strived for. While innovative and adaptive capacity are partially dependent on the immediate context, they are distinct enough (as presented in Table 2) to be able to potentially fill each other's gaps. In addition, the immediate contextual factors that influence the adaptive and innovative capacity of actors can be different than the contextual factors that support or hamper a specific innovation. Understanding this interaction between the immediate context and the innovative and adaptive capacity of the actors is important for the governance of agricultural innovation and the understanding of power dynamics because it reveals how the immediate context empowers certain actors whilst putting others out of the power to adapt or innovate.

3.3.2. Actors' innovative and adaptive capacity

Innovative capacity is defined in the agricultural innovation literature in multiple ways. For example, it is referred to as the capacity or ability to adapt to change by developing or implementing and mastering new processes, products, and services (Aase et al., 2013; Schut et al., 2018; Spielman et al., 2008), the conditions and capacity to drive change and create and implement innovations (Cohen et al., 2016), or the sum of human resources, scientific and technological services,

Table 2
Components of the foundation.

Immediate context		Innovative capacity		Adaptive capacity		Psychosocial factors	
Element	*Determinant*	Element	*Determinant*	Element	*Determinant*	Element	*Determinant*
Physical infrastructure	*roads; internet; phone lines*	Social capital (bridging, bonding, & linking)	*social networks; knowledge networks; network of organisations*	Social capital (bridging, bonding, & linking)	*social networks/relationships; community services; communication networks*	Willingness to adapt or innovate	*attitude to innovation; risk attitude, (social) norms & values; self-identity*
Formal institutions	*laws; regulations; company policy*	Access to resources	*natural; financial*	Access to resources	*natural; financial; human*		
Informal institutions	*social norms; shared societal values; implicit rules of the game*	Innovative capabilities	*innovativeness*	Innovative capacity	*innovativeness*		
Formal organisations	*farmer organisations; NGOs; extension services*	(Flexibility of) institutional context/ structure	*regulations; policies*	(Flexibility of) institutional context/ structure	*regulations; policies; laws; market arrangements; political advocacy*		
Informal organisations	*non-official social networks*	Psychosocial factors	*social norms; risk attitude; culture; trust; vision; agency; attitudes; openness to new ideas & actions*	Psychosocial factors	*community/group norms; risk attitude & perception; culture; trust; social imagination; agency; will/intention; beliefs; motivation; goals; self-identity; reflexivity; values; habits & expectations; leadership*		
The market	*consumers; (international) commodity market*	Knowledge/education	*education; information flow; absorptive capabilities*	Knowledge/ education	*education level; access to information; local knowledge & awareness; knowledge attuned to the specific situation; learning opportunities; skills*		
Direct natural environment		Collaboration	*interaction between government, industry, & university*	Local embeddedness	*stakeholder involvement & participatory research*		
		(Space for handling) power dynamics, conflict, & negotiation		Perceived adaptive capacity (self-efficacy)			
		Adaptive capabilities		Ability for collective action			
		Exposure to external & internal shocks		Degree of diversity	*farm's diversification; livelihood diversification; flexibility in solutions*		
References: Hekkert et al. (2007); Pigford et al. (2018); Rajalahti et al. (2008)		**References:** Aase et al. (2013); Cohen et al. (2016); Demissie and Muchie, 2014; Fielke and Bardsley (2014); Govoeyi et al. (2019); Lowitt et al. (2015); McKenzie (2013); Olajide-Taiwo et al. (2011); Rockenbauch et al. (2019); Röling et al. (2004); Saint Ville et al., 2016; Schut et al. (2018); Song et al. (2017); Spielman et al. (2008); Struik et al. (2014); Turner et al. (2017); Zhou and Wang (2018)		**References:** Aase et al. (2013); Akkari and Bryant (2017); Asfaw et al. (2016); Bitterman et al. (2019); Bussey et al. (2012); **Chelleri et al., 2016**; Chhetri et al. (2012); Cohen et al. (2016); Darnhofer (2010); Darnhofer et al. (2010); Dennis et al. (2016); Duru et al., (2015); Eakin et al., 2016; Fielke and Bardsley, 2014; Grundmann et al. (2012); Guido et al. (2018); Heijne et al., (2014); Knox et al. (2010); Leitgeb et al. (2014); Li et al. (2019); Lin (2011); Lowitt et al. (2015); Lyle and Ostendorf (2005); Makate (2020); Mase et al. (2017); McDowell and Hess (2012); Morton et al. (2017); Patnaik et al. (2019); Rossi et al. (2014); Saint Ville et al., 2016; Shah et al. (2019); Snyder and Cullen (2014); Turner et al. (2017); Urruty et al. (2016); Weiss and Bonvillian (2013); Wigboldus et al. (2016); Wilk et al. (2013); Zeweld et al. (2019)		**References:** Eakin et al. (2016); Morton et al., 2017; van der Veen (2010); Zeweld et al. (2019)	

Note: full reference details can be found in Annex B.

support to research and development, business climate, capital markets, and connections and infrastructure (Weiss and Bonvillian, 2013). We take innovative capacity to refer specifically to the ability to create or generate innovations. This encompasses both the ability to create an innovative idea and the ability to turn that idea, or someone else's idea, into something that could be implemented. It does not include the actual implementation. We posit that it is especially important in the initial stages of an innovation process.

Adaptive capacity on the other hand is referred to, for example, as the ability or capacity of an entity, to prepare for, respond, and adapt to change in the (social and/or natural) environment through a change in behaviour (Asfaw et al., 2016; Bitterman et al., 2019; Cohen et al., 2016), having the resources and ability to use those resources that are required for adaptation (McDowell and Hess, 2012), or a combination of farmers' experiences and perceptions of stressors, opportunities, environmental change, their associated risks, and the decision-making context (Eakin et al., 2016). We take adaptive capacity to be linked to the implementation of innovations, as the implementation requires adaptation to the existence of the innovation. Therefore, we define adaptive capacity as the capacity to adapt to (anticipated) change through the implementation of innovative or old practices. It includes having the relevant resources (financial and natural) and knowing how to apply them appropriately (skills and knowledge) and/or having a network through which one can access relevant resources, skills and knowledge. In addition, it includes the perception of the actor of the sufficiency of his or her (access to) relevant resources, skills, and knowledge (i.e. perceived adaptive capacity). We expect that adaptive capacity is especially important in the later stages of the innovation process.

The degree of innovative and adaptive capacity always stands in relation to what the actor is adapting to (i.e. the stressors/type of change) or what kind of innovation the actor is striving for (Akkari and Bryant, 2017; van der Veen, 2010). The capacity to innovate or adapt in a given situation therefore depends on having (access to) the relevant kind of resources, skills, and knowledge specific to that given situation. Generic adaptive or innovative capacity then refers to the overall capacity to react to or generate any kind of change (Cohen et al., 2016).

We posit that both innovative and adaptive capacity are directly linked to power dynamics as they influence in how far an actor has the capacity to affect the innovation process and its outcomes. At the same time, making decisions during an innovation process on factors that can affect the future innovative and adaptive capacity of actors includes deciding on who will have more or less power in the future. These are thus important aspects that need to be reflected on during the governance of agricultural innovation processes.

In addition, it needs to be recognized that the innovative and adaptive capacity of individuals stand in relation to the innovative and adaptive capacity of the other societal levels. They can reciprocally influence each other both positively and negatively. For example, a farmer with high perceived technical adaptive capacity to climate change and environmental degradation might not be willing to support measures that would mitigate these challenges (Gardezi and Arbuckle, 2020), thereby potentially undermining the adaptive capacity of the community around them.

3.3.3. Actors' psychosocial factors

Because adapting or innovating always entails a change in behaviour, regardless of the type of adaptation or innovation (Duru et al., 2015), having a supporting immediate context and an adequate degree of adaptive and innovative capacity on its own is not sufficient to ensure that an innovation process will be initiated and brought to a conclusion (Lyle and Ostendorf, 2005; Morton et al., 2017). Because of this, and in line with the Theory of Planned Behaviour, the intention or willingness to change certain behaviour, here the willingness to adapt or innovate, is regarded in this framework as a component in its own right (Ajzen, 1991; 2011). Elements that have been identified as making up this willingness include attitude to innovation (in general and to this specific issue), risk attitude, (social) norms and values, self-identity, and trust (see Table 2). We expect that depending on the type of innovation, how much the innovation deviates from current practices, and the societal level at which the innovation process takes place, some of these elements may be more or less important. Further empirical research is needed in order to clarify this.

Understanding these elements and how they take shape can give insights into the normative orientation of actors involved in, or affected by, the innovation process and is therefore important when addressing normative dynamics within agricultural innovation processes through governance.

3.3.4. Link between the components of the foundation: foundational failure or functioning

As described above, the components of the foundation interact and depend on one another. The way they fit together either enables or hampers innovation-related behaviour. We hypothesize that the immediate context and innovative and adaptive capacity together determine how much behavioural control the actors have to initiate and go through an innovation process. Likewise, we posit that they influence, together with the psychosocial factors, the perceived innovative and adaptive capacity. These in turn are expected to influence the control beliefs. The psychosocial factors are also expected to influence the behavioural and normative beliefs of the actors. Following the Theory of Planned Behaviour, the behavioural, normative, and control beliefs shape the actors' attitudes toward a behaviour, subjective norms, and perceived behavioural control, which in turn determine behavioural intention. Behavioural intention and actual behavioural control are the determinants of behaviour (Ajzen, 2011; Armitage and Christian, 2003) (see Fig. 2).

We hypothesize that when all components of the foundation work together favourably for the innovation that is strived for, i.e. when the actors have 1) sufficient (perceived) innovative capacity to develop an innovative idea and/or to make an innovative idea (of themselves or someone else) implementable regardless of the immediate context, 2) sufficient (perceived) adaptive capacity to implement the required action regardless of the immediate context, and 3) when they are willing to change their behaviour in line with the strived for innovation, the foundation forms enabling conditions that sustain the innovation process. However, if this process and its outcome marginalizes certain groups, it will reduce their innovative and adaptive capacity and can therefore not be regarded as sustainable over the long term as it erodes the foundation for future innovations.

The Agricultural Innovation Systems approach refers to multiple types of 'innovation system failure' when a certain element of the context forms a constrain on innovation efforts in a way that makes successful innovation and adaptation unlikely (Klerkx et al., 2012; van Mierlo et al., 2010). In our framework we highlight that the foundation will function as a hampering factor only when there is a mismatch between any of the components of the foundation and the innovation that is strived for. It is also important to be aware that system failures are primarily identified in relation to a specific (type of) innovation even though the foundation generally has to be able to support more than one (type of) innovation simultaneously. Attempting to intervene in the foundation through governance to make it more favourable for a certain (type of) innovation can therefore result in trade-offs for other innovations and even lock-ins (Pigford et al., 2018). This should thus only be done based on thorough reflection on the (potential) consequences of the intervention not only for the specific desired innovation but for the system at large.

3.4. Innovation processes

The innovation processes section of the framework relates to the structures and processes of agricultural innovation. Combining insights

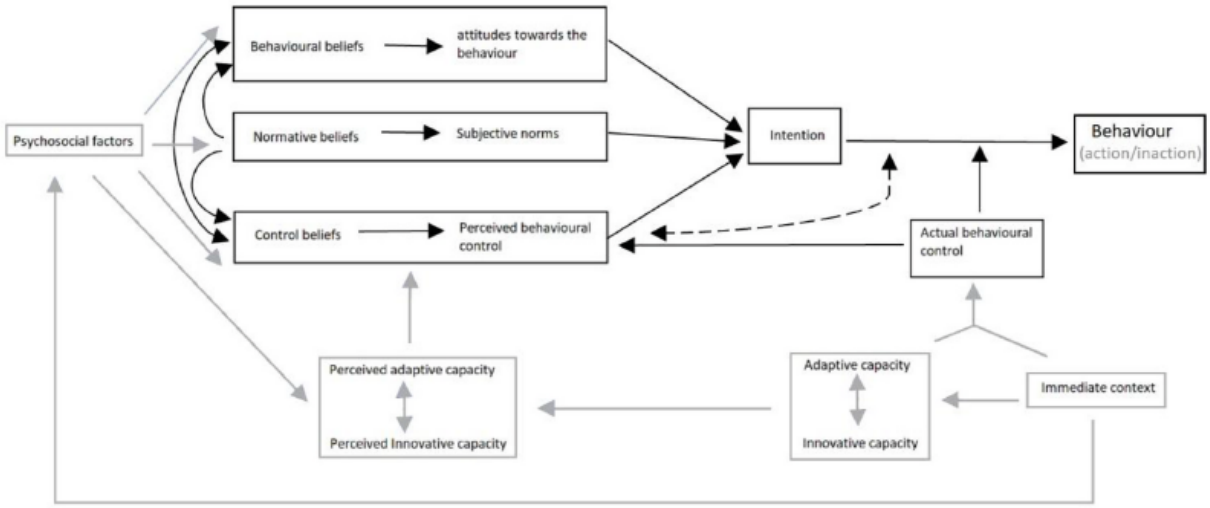

Fig. 2. Interactions between the foundational components. Adapted from Ajzen and Fishbein (2005). Aspects marked in grey are our propositions.

from literature on innovation processes in agriculture and literature with an Innovation Management approach reveals that each innovation process, regardless of the extent of change that is brought forward through the innovation, the type of innovation, the type of actor that is driving the process, and the societal level at which the innovation takes place goes through the same set of structural stages. How these stages are shaped, who is involved, how long they last, etc. will differ from case to case, but the underlying structure is generic to all innovation processes (Du Preez and Louw, 2008; Sutherland et al., 2012; van der Veen, 2010).

The first stage is identifying, or recognizing that there is a problem that needs to be solved or a (new) need that wants to be fulfilled. These generally stem from a change in external conditions in the landscape or immediate context or a change in internal objectives of the actor(s) (Sutherland et al., 2012; van der Veen, 2010). Being clear about what exactly the problem or need is, and consequently what the goal of the innovation is, is essential because it will set the direction of, and boundaries to, the entire innovation process. It can help to address the problem or need by its roots and in some instances reframing what the problem or need is can open up or close down opportunities for innovation (Tidd et al., 2005, p. 11; Schot and Steinmueller, 2018). Thus, whoever is in a position to decide on the problem and goal formulation has considerable power over the direction of the innovation process. It is important here to acknowledge the significance of how a need or problem and goal is framed and that different actors can have differing frames around the same situation (Beland Lindahl, 2008). This is likely to be especially relevant if the innovation process is aiming to satisfy a need or solve a problem for multiple stakeholders simultaneously. The second stage is the stage of idea generation on how the problem potentially can be solved or the need fulfilled. Available options are identified, evaluated, and assessed (Pignatti et al., 2015; Sutherland et al., 2012). At the end of this stage one or several ideas are chosen for further development (Du Preez and Louw, 2008). Both the first and the second stage function to set the strategic orientation of the innovation process and are thus highly political undertakings (Lindner et al., 2016). We therefore argue that these stages should be explicitly internalized into the innovation process rather than taken for granted at the outset and be given explicit consideration in the governance process. The third stage is concerned with the development of a concept or prototype of the idea(s). Here the idea(s) are turned into something tangible (Du Preez and Louw, 2008). We posit that stage one to three build on the innovative capacity of the actors.

The fourth stage is concerned with testing the concept/prototype in practice (Kline and Rosenberg, 2010). The fifth stage is the implementation stage. This can include marketing efforts if it is the aim that the innovation becomes (widely) dispersed (Tidd et al., 2005, p. 95) or only the actual full-scale application of the innovation in its intended context (van der Veen, 2010). The final stage, monitoring and evaluation, is not always included, but nonetheless highly important to increase learning (Tidd et al., 2005, 96). It is often integrated in all the aforementioned stages. Whilst monitoring and evaluation can seem like an objective undertaking, we want to highlight its normative underpinning. What is deemed as an important evaluation criteria, what kind of knowledge is perceived as legitimate to base evaluations on, and when set criteria are deemed to be satisfactorily met may differ from person to person. Therefore, whoever has the power to make decisions on these aspects, also has the power about what kind of lessons are drawn from such monitoring and evaluation practices. After the final stage, one can return back to stage one (Du Preez and Louw, 2008). We hypothesize that the fourth, fifth, and sixth stage rely on the adaptive capacity of the actors.

As innovation processes are generally messy, these stages should be seen as an abstract conceptualisation of the innovation process. The stages are likely to overlap and it is possible that at the end of progressing through a stage, the actor will loop back one or several stages rather than move forward to the next stage (Du Preez and Louw, 2008; Meynard and Casabianca, 2009). Because innovation is dependent on new or existing knowledge (both explicit and tacit), at the centre of the innovation process and each stage lies the existing knowledge stock, research and learning, and processes of knowledge exchange among actors. These feed into the stages of the innovation process, but the stages can likewise feed back into the knowledge stock through new insights (Kline and Rosenberg, 2010; Tidd et al., 2005, p. 15). Fig. 1 displays this.

3.5. Output and outcomes

The innovation process generally produces both outputs and outcomes. With output we refer to the actual innovation, e.g. a new technology, management practice, policy, etc. The output and the dynamics of the innovation process can function as direct and indirect drivers of change to all the components of the foundation, the governance system, and (over time) the macro context. Outcomes, on the other hand, describe how this change takes shape both over the short- and long-term; they are the combination of the intended and unintended consequences of the innovation process and its output. They can be of social,

Table 3
Guiding questions for the governance of agricultural innovation.

Stage of the innovation process	Guiding questions	Methods that could be used to examine these questions (non-exhaustive), inspired by Dryzek and Pickering (2017), Eastwood et al. (2019), Muiderman et al. (2020), Reed et al. (2009), & STEPS Centre (n.d.)
Questions that should be reflected on repeatedly at each stage	Who is (not) involved? Why? Is it a result of limited *innovative* and/or *adaptive capacity*? If stakeholders are involved, how are they involved? What is their role in this stage? Why? What types of knowledge are relied on? Why? Who has (no) decision-making power (in all aspects that are raised in the other questions)? Why? What are the structures of decision-making (e.g. consensus, voting)? Why? What are the structures for accountability for those that make decisions? Are there mechanisms in place to ensure that all relevant voices are heard and treated with respect? What are the (potential) consequences of the answers to the above and stage-specific questions in terms of perceived *social justice*, perceived *legitimacy*, and *sustainability*? Are these acceptable or is adjustment needed?	Stakeholder analysis Creation of codes of conduct Stage-gating Impact assessment Forecasting (Participatory) scenario analysis
1. Problem/need & goal identification	What is the underlying *driver* that is causing the problem/change in needs perceived to be? Is this the same for all stakeholders or are there different views? What is the goal of the innovation? Does it aim to adapt to, mitigate, reverse, or alter the direction of change of the *driver* that is causing the problem? What *values* underly the different framings of the problem and the goal? Whose *values* are they? Who is affected by the identified problem and goal? What alternative problem and goal framings could there be? Do they open up or close down possible solutions?	Participatory workshops Stakeholder analysis Evaluation H Deliberative mapping Deliberative polling Q method Participatory impact pathway analysis (Participatory) scenario analysis
2. Idea generation	What *values* underly suggested ideas? Whose *values* are they? What kind of future would this idea contribute to creating: what could be potential short- and long-term consequences of the suggested idea(s) for *all the components and elements of the foundation and the macro context*? What would the potential consequences mean for the future *capacity of the stakeholders to innovate and adapt*? Is this similar for all stakeholders or does it put some into a more or less favourable position than others for future innovation efforts? Does this idea impact the *immediate context* in a way that gives some stakeholders more power to act than others? Does this idea close off alternative innovation pathways in the future through its potential impact on the *immediate context* and *innovative* and *adaptive capacity*? Are these potential consequences acceptable or would they require correction? From who's perspective is this assessed? What trade-offs (regarding *values, goals, use of resources, etc.*) have to be made when this idea would be pursued? Are these acceptable? How does this idea relate to the *psychosocial factors* of the stakeholders? What alternative ideas could there be and how do they look like in terms of the above questions?	Value sensitive design User-centred design Participatory workshops Focus groups Deliberative polling Deliberative mapping Deliberative valuation Evaluation H (Participatory) backcasting Citizens' juries Multi criteria mapping (Participatory) scenario analysis Forecasting Participatory impact pathway analysis Impact assessment
3. Concept/prototype development	For whom is the concept developed (i.e. for who should it work)? Why is the idea turned into this specific concept? Are there alternatives? What are the advantages and disadvantages of this (and alternative) concepts and for who? What resources and structures would be required to implement this concept? How does this relate to the current *adaptive and innovative capacity* of the stakeholders and their *immediate context*? What would this mean for the future *adaptive and innovative capacity* of the stakeholders and potential future innovations? Are these potential consequences acceptable?	User-centred design Value-sensitive design (Participatory) scenario analysis (Participatory) backcasting Participatory workshops Focus groups Deliberative mapping Deliberative polling Deliberative valuation Multi criteria mapping Impact assessment Participatory impact pathway analysis
4. Concept/prototype testing	What are the criteria used for testing? What alternative criteria could be considered? What are the underlying *values* that have guided the selection of the criteria and whose *values* are they? Do these criteria take into account the *psychosocial factors* of the stakeholders and the (potential) impact on the *immediate and macro context*? What are potential consequences of using these specific criteria rather than others? Are these acceptable?	Value-sensitive design User-centred design Participatory workshop Focus groups (Participatory) scenario analysis Impact assessment Participatory impact pathway analysis Citizens' juries
5. Implementation		

(continued on next page)

Table 3 (*continued*)

Stage of the innovation process	Guiding questions	Methods that could be used to examine these questions (non-exhaustive), inspired by Dryzek and Pickering (2017), Eastwood et al. (2019), Muiderman et al. (2020), Reed et al. (2009), & STEPS Centre (n.d.)
	In case of marketing: what underlying *values* are targeted with marketing? How do they relate to the *values* underlying this innovation? What resources are needed for the implementation? How does this relate to the current *adaptive capacity* of the stakeholders and their *immediate context*? What would this mean for the future *adaptive capacity* of the stakeholders and potential future innovations? Are those with currently insufficient *adaptive capacity* somehow supported to still be able to benefit from the innovation? What are direct/immediate and long-term consequences of the implementation across *all components and elements of the foundation* and *macro context*? What are the trade-offs that those implementing this innovation have to make?	Value-sensitive design User-centred design (Participatory) backcasting Stakeholder analysis (Participatory) scenario analysis Forecasting Impact assessment
6. Monitoring & evaluation	What are the criteria used for monitoring and evaluation? What alternative criteria could be considered? What are the underlying *values* that have guided the selection of the criteria and whose values are they? Do these criteria take into account impacts on *all components and elements of the foundation* and *macro context*? What are potential consequences of using these specific criteria rather than others? Are there mechanisms in place to learn from the monitoring and evaluation results? Why (not)? Are lessons learned used to alter the innovation and innovation process? Why (not)?	Participatory workshops Value-sensitive design User-centred design Deliberative valuation (Participatory) scenario analysis Innovation histories Participatory impact pathway analysis Impact assessment

economic, natural, and/or political nature (Emerson and Nabatchi, 2015). The output and resulting outcomes of an innovation process can create lock-ins, or path dependency, i.e. they have the potential to determine the direction of, and room for, future innovation pathways (Voss and Kemp, 2006) and therefore have the potential to influence agricultural transition. Whether or not these (unintended) outcomes are positive or negative depends on the perspective from which they are being evaluated (Emerson and Nabatchi, 2015). The shape of the output and outcomes depends on the decisions that are being made at each stage of the innovation process and the way that these decisions are being made.

4. Governing for sustainable agricultural innovation

Now that we have a general understanding of the foundation and structure of agricultural innovation processes we can return to the question of how to govern these processes in a way that creates sustainable, socially just, and legitimate processes and outcomes. We have raised the importance of reflexivity both on the decisions that have to be made and the way in which they are made and described the components that need to be taken into account in these reflections. Based on the three parameters legitimacy, social justice, and sustainability as described under section 3.2. and the insights into the key components, how they relate to each other, and their role in the innovation process, we propose a set of guiding questions (see Table 3) for reflection that can support the governance process. These questions were developed by looking at the potential disruptive, normative, and power dynamics present within each stage of the innovation process in relation to the components of the framework and by linking this to the parameters of sustainability, legitimacy, and social justice. Reflecting on these questions should help in making explicit the specific normative and political underpinnings of a certain innovation process and aid the anticipation of potential consequences. It can help to enable dialogue between stakeholders with differing opinions, create awareness of the potential broader consequences of an innovation beyond the immediate self-interests of the innovator, and help to come closer to a balance between conflicting interests and perceptions of risk. However, it is not the goal to reach consensus on these questions or on final decisions because that would disregard that some values, viewpoints, and interests simply cannot be united (Johansson et al., 2018; Voss and Bornemann, 2011). These questions do therefore not prescribe certain specific decisions that should be made. Rather, they should be used to open up room for learning, create understanding of underlying values, interests, and power relations, and form a base for the re-articulation and reconfiguration of aims, values, and practices when the reflections show that current processes are unsustainable or perceived as illegitimate or socially unjust. Ultimately, they should lead to more informed, deliberate decision making both by the stakeholders and the actor who is in charge of the innovation process (Gregory et al., 2011; Pickering, 2019). The questions in Table 3 can thus serve as a guideline or tool for anyone who is interested in making agricultural innovation processes and outcomes more sustainable.

5. Discussion

The framework that we have presented here integrates insights from multiple theoretical approaches that have their focus on sub-aspects of innovation processes into a comprehensive framework and starts to build new theory on the interactions between the components and their role and how these insights can be used to support the sustainable governance of agricultural innovation. We posit that it improves existing approaches to agricultural innovation in two main ways. First, due to its comprehensiveness, this framework can better account for the interconnectedness and interdependence of the components and the various societal levels. Through the inclusion of all the components and attention to how they interact, this framework comes closer to the real-world complexity of innovation processes than approaches that only focus on one or a few of the components and societal levels. Therefore, it can better support reflections on potential consequences of certain decisions and contributes to a more holistic, sustainable governance approach. Secondly, where other frameworks seem to take the direction of innovation as a given and give only limited attention to power dynamics, this framework enables to take a step back and reflect on the normative and political underpinnings of such processes.

We suggest that this framework can be used either diagnostically to assess past or current innovation processes or prescriptively to support the design of current and future innovation processes. When the framework is applied in practice there are several aspects that need to be considered. Because the framework presents a generic description of components that need consideration in the governance of agricultural innovation processes, when the framework is applied it will need to be adapted to the specific case. Whilst the guiding questions we propose here can be used as a basis for any kind of innovation process, additional questions that target the unique challenges of the specific innovation under consideration might be required. Another important part of adapting the framework to a specific case is deciding on the boundaries of the system that is under consideration. This decision will depend on the specific issue at hand and the time and other resources that are available. It might often not be possible to take a complete holistic perspective (Verschuren, 2001). Generally, it can be stated that the larger the scope, the more complex and time consuming the application of this framework will become. However, the smaller the scope, the more likely it is to lose sight of the complexity and interconnectedness of socio-ecological systems and thus to overlook potential interactions and consequences. We therefore argue that it is important to be explicit about the artificiality of system boundaries and the consequences this has on the claims and proposed solutions that are made based on such analyses. It is possible to focus on certain sections of the framework, but when discussing the results of such an analysis, they should be brought back into the wider context of the overarching framework. At first sight, needing to reflect on all the guiding questions and taking all the components and their respective elements into account might look as a daunting and time consuming task. However, we argue that spending additional time on these reflections during each stage of the innovation process will result in more informed decisions and therefore likely streamline the innovation process, improve the sustainability, perceived legitimacy, and perceived social justness of both the process and its output and outcomes, which will result in time saved on having to correct consequences of less informed and less deliberate decision-making.

Besides the possibility for practical application of this framework to gain insight into and support specific empirical cases to improve their sustainability, as the framework is in the early stages of its development, it provides also numerous research opportunities for further theory development. First, the propositions that we have brought forward based on our understanding of the various theoretical approaches would benefit from empirical testing. The framework could be applied to analyse past and current agricultural innovation processes related to multiple types of innovations to examine the validity of our theory-based assumptions. This could, secondly, also help in examining if there are any additional components that we have missed. Third, further empirical research would be useful to identify the relative importance of the components and their elements. This kind of research could also examine if certain components and elements are more important for certain types of innovations or in specific kind of situations and if there are any generalizable patterns related to this. Fourth, future research could focus on operationalizing the components of the foundation by further unravelling the elements and possibly even sub-elements that constitute them. Finally, regarding the proposed guiding questions, application of the framework could help to identify which questions are especially important and whether or not there are important questions missing.

6. Conclusion

Innovations can help us address and overcome many of the challenges that agriculture is facing today. Yet at the same time, they have the potential to create new, sometimes even more challenging, problems (Voss and Kemp, 2006). In addition, perceptions on the desirability of certain innovations and the futures they might lead to are rooted in normative judgement that may differ from one person to the next. Governing agricultural innovation processes in a way that takes account of these characteristics requires a comprehensive understanding of all components that interact during innovation processes across societal scales. Hitherto, research has focussed on unravelling certain sub-aspects of agricultural innovation processes; creating in depth understanding of these sub-aspects but losing sight of the complex whole. In this paper we have strived to bring this knowledge together in a comprehensive framework. We hope that this framework will generate more critical and comprehensive debates in research on agricultural innovation and help policy makers and innovators alike to guide the design of new innovation processes, to understand and assess underlying values and power relations in current innovation processes, and support the assessment of innovation processes in terms of their sustainability, (perceived) social justice, and (perceived) legitimacy.

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Declaration of interest

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Ethics approval statement

No ethical approval was necessary for this work.

Submission declaration and verification.

We confirm that our work is original. Our manuscript has not been published, nor is it currently under consideration for publication, elsewhere.

Author contributions

Auvikki de Boon: Conceptualisation, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization, Camilla Sandström: Resources, Writing – review & editing, Supervision, David Christian Rose: Resources, Writing – review & editing, Supervision, Funding acquisition.

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Annex A. Details to the literature review

Table A.1
Search criteria.

	Search Criteria
Indexes	SCI-EXPANDED, SSCI, A&HCI, CPCI–S, CPCI-SSH, ESCI
Timespan	1945–2020 (as the search was conducted on March 10, articles published after that date were not included)
Search string	TS=(agri* OR farm* OR horticultur*) AND (innovat* OR "socio-technical transition" OR pathway OR future OR vision*) AND TS=("reflexive governance" OR "adaptive governance" OR "transition governance" OR "deliberative governance" OR "participatory governance" OR "transformative governance" OR "reflexive governance" OR "responsible governance" OR "adaptive management" OR "transition management" OR "deliberate transformation" OR "reflective deliberation" OR "responsible innovation" OR "responsible research and innovation" OR "responsible research & innovation" OR "co-innovation" OR "participatory innovation" OR "collaborative innovation" OR "inclusive innovation") OR ("adaptive capacity" OR "transformative capacity" OR "innovative capacity" OR "responsive capacity") Note: "sustainable governance", "governing sustainably", "sustainable management", and "managing sustainably" were not included in the final search string because trial searches showed that these terms lead primarily to literature that looks at the sustainability of specific practices rather than at the governance of innovation
Inclusion criteria	Have a central focus on agricultural innovation processes and the management or governance of these processes or the capacity to undertake such processes

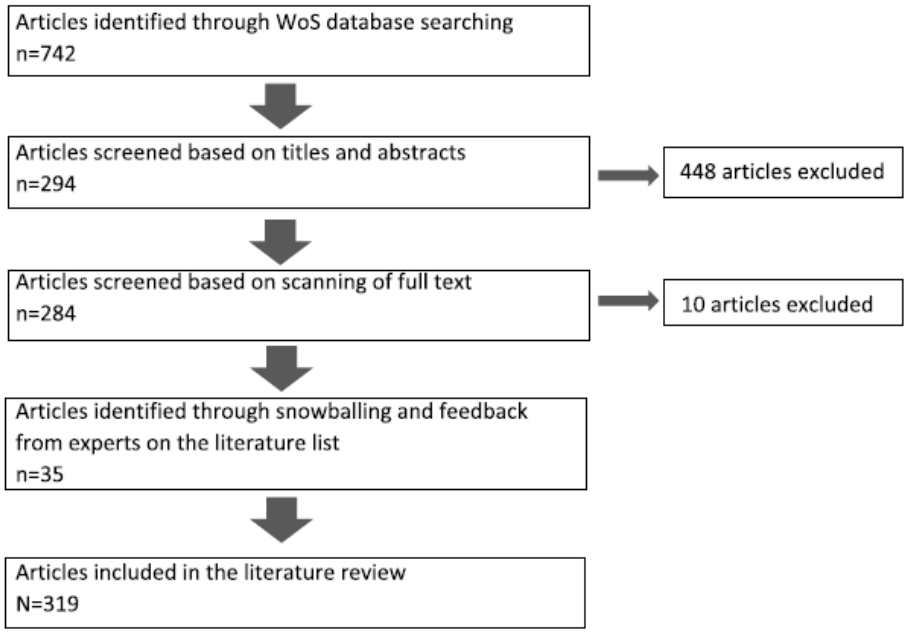

Fig. A.1. Selection process of articles that were included.

Annex B. Bibliographical details for articles referred to in Table 2. Components of the foundation

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Perceived legitimacy of agricultural transitions and implications for governance. Lessons learned from England's post-Brexit agricultural transition

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ABSTRACT

It is widely recognized that there is a global need for a transition towards more sustainable forms of agriculture. In order for such a transition to be socially sustainable, its input (problem and goal formulation), output (policy instruments), and throughput (processes) need to be perceived as legitimate. However, we currently know relatively little on how to legitimize normatively shaped transition processes and their outcomes. We aim to address this knowledge gap by examining how the governance of agricultural transitions can be shaped to improve the perceived legitimacy of the transition. Through a combined lens of normative and sociological approaches to legitimacy we investigate the English post-Brexit agricultural transition as a crucial case-study. Building on a policy analysis and semi-structured interviews we find that in order to create perceived legitimacy of agricultural transitions, both in the English case and for agricultural transitions generally, clarity and diversity in design is essential. In addition, in order to take account of the normative and political nature of agricultural transitions, our study highlights the importance of a broad problem formulation, a diverse mix of instruments, and a process that is transparent and includes stakeholders in a meaningful and equal way. We conclude that a combined lens of normative and sociological legitimacy forms a useful framework for future research to critically evaluate the normative and power dimensions of transition processes. In addition, it can support governments in their efforts to develop policies for agricultural sustainability transitions that will be accepted by society.

1. Introduction

Agricultural systems are increasingly under pressure due to large scale drivers of socio-ecological change such as climate change, biodiversity loss, environmental degradation, and demographic change (IPBES, 2019). Simultaneously, currently dominant agricultural practices contribute to and exacerbate these challenges (Awuchi et al., 2020). In order to reduce the negative impact of agricultural practices and adapt to an increasingly unstable and unpredictable environment, it is widely recognized that there is a need for a transition toward more sustainable forms of agriculture across the globe (El Bilali, 2020; Herrero et al., 2020; Martin et al., 2018). However, what sustainable agriculture looks like and what pathways should be taken to create this transition is contested. Different people will experience the consequences of a transition in different ways and will have different perceptions on what we should be transitioning to (Leach et al., 2007; Markard et al., 2012; Meadowcroft, 2011); especially actors with vested interests in the existing system will likely be resistant to change (Geels, 2011). The perceived legitimacy of a transition pathway is therefore dependent on value based, normative, and political judgements of those who are affected by it (the stakeholders) (de Boon et al., 2022).

Ensuring that stakeholders and wider society perceive a transition as legitimate is essential for the success and social sustainability of a transition (Boedeltje and Cornips, 2004; Jaber and Oftedal, 2020;

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Vringer and Carabain, 2020). A lack of perceived legitimacy can be a hurdle to the implementation of the transition, stand in the way of compliance with the required measures, and result in societal unrest (Dehens and Fanning, 2018; Martin and Islar, 2020; Vringer and Carabain, 2020). Recent examples of this within the agricultural sector come from France (Chiarello and Libert, 2019), the Netherlands (Schaart, 2019), and India (Bhatia and Katakam, 2021). It is therefore problematic that we currently only have a limited understanding of how we can take the normative and political nature of transitions into account in governance processes. Köhler et al., (2019, p. 16) in their review of literature on sustainability transitions speak of "a moral vacuum in transition research". Consequently, questions concerning how to take account of heterogenous public opinions and how to legitimize normative sustainability transitions through governance remain largely unanswered (Hendriks, 2009; Markard et al., 2012; Upham et al., 2015; Wironen et al., 2019). In addition, while sustainability transition literature has primarily been focussed on the energy and transport sector, sustainability transitions in agriculture have only recently become a topic of scientific inquiry and insights into their workings and governance are fragmented and limited (El Bilali, 2020; Melchior and Newig, 2021). There has been considerable attention in the literature to the agricultural transition that took place in New Zealand in the mid 1980s (e.g. Gouin et al., 1994; Johnsen, 2003; Turner et al., 2020). However, the reforms leading to this transition did not come forth out of environmental concerns and were limited to a removal of subsidy programs (Vitalis, 2007). Therefore, the lessons that can be drawn from that case can only be applied to agricultural sustainability transitions to a limited extent, as sustainability transitions have specific characteristics that are different from other types of transitions (Geels, 2011).

We address this knowledge gap by examining how the governance of agricultural sustainability transitions can be shaped to improve the perceived legitimacy of the transition process and its outcomes. Developing a deeper understanding of how perceptions of legitimacy are formed in relation to agricultural transitions can support governance to navigate the transition and resistance against it. In order to do so, we investigate the English[4] post-Brexit agricultural transition from the Common Agricultural Policy (CAP) to an Environmental Land Management scheme (ELM) as a crucial case-study.

The Department of Environment, Food, and Rural Affairs (DEFRA) is using the window of opportunity created by Brexit to structurally revise agricultural policy. Instead of giving farmers subsidies based on the amount of land that they manage, as was the case with the Basic Payment Scheme under CAP (European Parliament, 2020), they propose a system where farmers are paid public money for the provisioning of public goods (DEFRA, 2020a). While the CAP has been widely critiqued for not properly addressing environmental degradation (Pe'er et al., 2020), DEFRA is hopeful that this new system will create a sustainability transition and has made it the cornerstone of English agricultural policy, replacing the Basic Payment Scheme fully by 2028 (DEFRA, 2018a, 2020a, b). This example can be regarded as a crucial case because while policy change generally happens through incremental processes (Kern and Howlett, 2009), the complete break with old policy in a relatively short timeframe in this case makes it most likely that the normative and political dynamics that are always present within transition policy processes will be amplified. Thus, if certain normative and political dynamics inherent to agricultural transitions do not come forward in this case, it is unlikely that they will be present in other (or only few) cases of agricultural transitions. In addition, because the English culture and agricultural sector have similarities with other (especially European Union) countries, it can be expected that lessons learned from this case can be relevant for other countries. We therefore contribute both to the understanding of this specific case, to the wider literature on the governance of sustainable agricultural transitions, and to our theoretical understanding of legitimacy perceptions.

[4] Agriculture is devolved in the United Kingdom, we focus on the agricultural transition in England only.

2. Three dimensions of legitimacy

Legitimacy is a contested concept with a myriad of interpretations and operationalizations (Deephouse and Suchman, 2008; Johansson, 2014; Suchman, 1995; Vringer and Carabain, 2020). Nevertheless, these interpretations can be narrowed down into two overarching ways of approaching legitimacy: a normative approach that addresses legitimacy as originating in the fulfillment of normative criteria and a sociological approach that addresses legitimacy as originating in subjective beliefs and perceptions (Bernstein, 2011; Johansson, 2012). In the sociological approach, legitimacy is broadly taken to mean the acceptance of power (Weber, 1978) or a "*generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions*" (Suchman, 1995, p. 574). It relates therefore to the willingness to comply with or support a source of power and stems from subjective evaluations (Montenegro de Wit and Iles, 2016). As such, it has been critiqued for the infinite number of criteria that people can use to subjectively define whether or not something is legitimate and the resulting difficulty to measure it (Suddaby et al., 2017). The normative approach instead starts out with a predefined set of criteria that need to be complied with in order to achieve legitimacy. Whilst the criteria themselves rest on normative ideals, whether they are fulfilled can be evaluated empirically and objectively. Examples of such criteria include compliance with the law, accountability, equality, inclusiveness, effectiveness, efficacy, and responsiveness (Boedeltje and Cornips, 2004; Schmidt, 2013; Steffek, 2019; Vringer and Carabain, 2020). However, due to the normative nature of these criteria, their fulfillment can only inform us on whether something should theoretically be regarded as legitimate by those prescribing to these normative standards, not on whether people actually perceive it to be legitimate in practice (Bernstein, 2011; Johansson, 2012; Schmidt, 2013). In order to take into account the critique to both of these approaches, this study combines them; taking the assessment of the fulfillment of normative criteria as a starting point and asking what the fulfillment or neglect of these criteria does to the perceived legitimacy of the proposed transition policy.

Both normative and sociological approaches to legitimacy have in common that they generally distinguish between different dimensions of legitimacy: input- and output legitimacy and more recently also throughput legitimacy. Based on the theoretical work of Suchman (1995), Scharpf (1999), and Schmidt (2013) and recent empirical studies on the legitimacy of transition policies, we apply these dimensions of legitimacy in the following way.

2.1. Input legitimacy

The input legitimacy of a policy rests on the extent to which it reflects "the will of the people" (Scharpf, 1999, p. 6) and relates to the problem- and goal formulation in the policy (Vringer and Carabain, 2020). If the policy goals reflect the interests of the stakeholders, they will lend the policy *normative input legitimacy*. Because policy goals generally stem from a prioritization of problems that should be addressed, agreement with the problem formulation also falls under this type of legitimacy (i.e. does the policy address the correct problems) (Suchman, 1995). The normative criteria for input legitimacy in this sense would be the consensus or alignment of the problem- and goal formulation of the policy with the problem-and goal formulation of the stakeholders (Wironen et al., 2019). Subjectively however, it is plausible that stakeholders do lend a policy input legitimacy even if the problems and goals do not reflect their self-interests. Stakeholders may also lend legitimacy to problem- and goal- formulations based on moral considerations, if they perceive them to be in the wider interest of society or "the right thing to do" (Suchman, 1995, p. 579). We refer to this as *sociological*

input legitimacy.

2.2. Output legitimacy

Output legitimacy relates to the capacity to effectively solve societal problems (Scharpf, 1999). This can be derived from indications that the policy contributes to reaching the goals that it set out to achieve (*normative output legitimacy*) and the societal acceptability of the policy interventions that are used to achieve the goals (*sociological output legitimacy*) (Suchman, 1995). The former translates into the normative criteria of goal achievement, whilst the later translates into the subjective perception of acceptability of the policy instruments (Upham et al., 2015; Vringer and Carabain, 2020). Because this study examines the legitimacy of a transition policy that is not jet fully implemented, we focus here on the perceptions of the effectiveness and acceptability of the proposed policy instruments to solve the identified problems and reach the policy goals.

2.3. Throughput legitimacy

Throughput legitimacy refers to the processes that are used to develop the content of the policy and to achieve the outcomes (Schmidt, 2013; Suchman, 1995). The normative criteria that need to be satisfied in order to obtain throughput legitimacy can be very diverse (Steffek, 2019). Because DEFRA has stressed their desire to develop ELM in an inclusive way through co-design (DEFRA, 2020b,c), we focus on inclusivity as the central normative criterion for throughput legitimacy. Objectively, this can be assessed based on the presence or absence of procedural mechanisms of stakeholder inclusion throughout the policy process and equality in inclusion (*normative throughput legitimacy*). Subjectively, throughput legitimacy here depends on the perceptions of the stakeholders on whether or not they were meaningfully included. This also encompasses having an understanding of how engagement in the process influences the final result (*sociological throughput legitimacy*).

Finally, the three dimensions of legitimacy are interlinked. Input-and output have legitimizing power of their own and can balance each other out to a certain degree in the overall legitimacy of a policy. However, they are only meaningful in relation to each other: having acceptable goals but no means to achieve them or having effective and acceptable instruments that are not linked to preferred goals will not be regarded as meaningful and thus won't create overall perceived legitimacy for a transition (Boedeltje and Cornips, 2004). Throughput legitimacy is complementary to input- and output legitimacy. A good process on its own cannot completely counterbalance illegitimate input and output, but a bad process can undermine legitimate input- and output. Therefore, throughput only becomes salient when it is perceived as illegitimate (Schmidt, 2013; Steffek, 2019; Suchman, 1995).

3. Methods

To examine the perceived legitimacy of the English agricultural transition we build on a policy document analysis and semi-structured stakeholder interviews. For the policy analysis, documents were selected in a bottom-up manner, starting from the policy domain (Ossenbrink et al., 2019). Initial documents were selected through systematic searches for agriculture related policy documents that have been published after 29.03.2017 (the date Brexit became official) on the official websites of the UK government and UK parliament. This resulted in a list of 28 documents. We sent a list of these documents to civil servants within DEFRA and the Department of Business, Energy, and Industrial Strategy[5] to reassure that there were no relevant documents missing. After this, all the documents were scanned and assessed based on their relevance to ELM, which narrowed the list down to 9 documents. In order to examine the opportunities for stakeholders to participate in the design process of ELM we also added official reports related to engagement opportunities for that section of the analysis (5 documents). As we used the policy analysis as input into the interviews, any documents that have been published after the 25th of March 2021 are not included in the analysis.[6] The selected documents are briefly described in Table 1.

We conducted the analysis of these documents in NVivo 12 along the lines of the analytical frame as shown in Table 2. While the structure of what we were looking for in the material was guided by the theoretical

Table 1
Selected documents for the policy analysis.

Date of publication	Title of document	Relation to ELM
Jan. 2018	A green future: Our 25 year plan to improve the environment (inc. Annex 1–3)	Sets out the goals that ELM is striving to fulfill
Feb. 2018	Health and Harmony: the future for food, farming and the environment in a green Brexit	Consultation document that described DEFRA's initial thinking on agricultural policy after Brexit
Sept. 2018	Health and Harmony: the future for food, farming and the environment in a green Brexit. Summary of responses	Summarizes the input that DEFRA received on the Health and Harmony consultation
Mai 2019	At a glance: summary of targets in our 25 year environment plan	Sets out goals that ELM is striving to fulfill
June 2019	National Audit Office Early review of the new farming program	A review by the National Audit Office of DEFRA's progress to date with the development of new agricultural policy
Feb. 2020	Farming for the future. Policy and progress update	Describes the current plans related to ELM & how the transition from CAP to ELM will gradually take place
July 2020	Environmental Land Management tests and trials. Quarterly evidence report. July 2020	Summarizes key findings so far from ELM Tests & Trials
Sept. 2020	Environmental Land Management tests and trials. Quarterly evidence report. September 2020	Summarizes key findings so far from ELM Tests & Trials
Nov. 2020	Agriculture Act	Provides the legal basis for ELM
Nov. 2020	The path to sustainable farming - an agricultural transition plan 2021–2024	Describes the schemes that will be available in the transition period from CAP to ELM & how the reforms link to other policies
Nov. 2020	Multi annual financial assistance plan for the plan period 2021–2027	Describes the objectives for the transition period from CAP to ELM
Jan. 2021	Test and trials – Phase 3 'Landscape Recovery'	Notifies of a next phase in the Test & Trial project under ELM
Feb. 2021	Environmental Land Management. Policy discussion document	Describes the current design of ELM
March 2021	Sustainable Farming Incentive: Defra's plans for piloting and launching the scheme	Sets out in more detail the plans for the piloting of this component of the ELM scheme

[5] All documents that we initially selected were (co-)authored by either of these departments.

[6] Since the conclusion of our policy analysis and interviews, DEFRA has started to move away from considering the ELM scheme as one coherent scheme and instead approaches it now as multiple separate environmental land management schemes, as shown for example in DEFRA (2021a). However, for the purpose of this article we hold on to the terminology of ELM and components under ELM to refer to all the schemes combined as this reflects the terminology that was used by DEFRA while we were conducting this study.

Table 2
Operationalisation of perceived legitimacy and analytical frame.

Operationalization		Empirical questions		Questions asked to the material	
		Normative legitimacy	*Sociological legitimacy*	*Question*	*Empirical expression*
Input legitimacy	Problem formulation	Do the problem formulations in the policy align with the problem formulations of the stakeholders?	Does the stakeholder find the problem formulations acceptable (even if they may not be aligned with their own)?	What problems are stated? Are there any problems mentioned as missing or out of place?	Risk/challenge/problem/needs to change/needs to be tackled/threat/ danger/harm/action needed/ pressure/concern/cannot continue
	Goal formulation	Do the goal formulations in the policy align with the goal formulations of the stakeholders?	Does the stakeholder find the goal formulations acceptable (even if they may not be aligned with their own)?	What goals are stated? Are there any goals mentioned as missing or out of place? Are the goals perceived as being achievable?	Goal/target/aim/objective/seek to/ ambition/vision/achieve/we will or want to reach/sets out (to deliver)/to build/strive to/to make sure/we must (ensure)/work toward/commitment to/determination to/pledge/outcome
Output legitimacy	(perceived) Efficacy	Are the policy instruments (perceived to be) capable and effective in reaching the policy goals?	Does the stakeholder think that these policy instruments are acceptable?	What solutions are offered to overcome the problems/reach the goals? What do the stakeholders think of the design of the scheme and the different instruments?	References to types of policy instruments, e.g., financial (dis) incentives, regulations, information sharing, collaboration
Throughput legitimacy	Inclusiveness	Are there mechanisms in place that allow for stakeholder inclusion?	Does the stakeholder feel like they had the opportunity to meaningfully contribute to the development of the policy?	What opportunities are there to be included in the policy processes? Do the stakeholders feel like they had an equal chance to contribute?What do they think of the role of other stakeholders in the process? Do they feel like they had influence in the process? Do they understand how their input is being used?	References to possibilities to be involved/how stakeholders have been included in the process/expressions of experiences of participation

framework, the codes that we used within this structure were generated inductively to reflect the content of the policy.

To identify potential stakeholders for the semi-structured interviews, we focussed on self-proclaimed stakeholders who are publicly listed as such: those who gave input to DEFRA's 2018 consultation related to ELM or sent in evidence to the process leading up to the Agriculture Act. This resulted in a list of 589 self-proclaimed stakeholders. We grouped these into four overarching categories based on primary interest type: social interests (soc.; including food security, historical heritage, human health, recreation, rural life, and other social charities), environmental interests (env.; including environmental organizations and trusts and farm-animal welfare organizations), economic interests (econ.; including consultants, fertilizer/pesticide/insecticide industry, food processing industry, food standards, grant providers, organizations and companies focussing on increasing farm productivity, supermarkets, seed and crop industry, and trade), and farmer, forestry, and land-owner interest (ffl; including farmer associations, unions, and collaboration groups between farmers, forestry organizations, churches, and educational institutes with an agricultural focus). The farmer, forestry, and land-owner interests received their own category because they are the central stakeholders who have to actively adapt to ELM. For the interviews we focussed on stakeholder groups rather than on individual stakeholders as these groups are representative for a wider array of stakeholder interests and speak on behalf of all their members. To select which stakeholder groups to invite for interviews in each category we created a purposive sample by focussing on the organizations' reach across England, aimed to include a wide range of different interests to capture the diversity within each interest category, and included stakeholder groups with different degrees of engagement with the process. We continued contacting stakeholder groups until we fulfilled these criteria and reached data saturation in the responses of the interviewees. This strategy of stakeholder selection meant that we contacted a total of 54 stakeholder groups and conducted 14 interviews (two in the economic interest category, four in all other categories). Those who did not take part in the interviews either did not respond to our repeated requests (24), stated that ELM was not their main priority (6), or did not have the capacity to participate (10).

The interviews received ethical clearance, took place between the 8th of April and the 1st of June 2021, lasted between 55 and 90 minutes and were all conducted, transcribed, and analysed by the first author. An overview of which interview covered which interest category is provided in Annex A. All the interviewees work directly with ELM for their organization and have therefore first-hand experience and knowledge of their organization's views on the content of ELM and the process by which it is being designed. Prior to the interviews we sent them a summary of our findings from the policy analysis so that they had the opportunity to reflect on their organization's views on these specific aspects of ELM. This summary was also used during the interview as an anchor point for the conversation. The handout and a list of the main questions that were used to structure the interviews is presented in Annex B and C. The transcripts of the interviews were analysed by summarizing the main arguments of each interviewee in an excel table along the lines of the analytical frame of this article.

4. Results

4.1. Input legitimacy

4.1.1. Problem formulation

The problem formulation used in the policy documents as the argumentative base for why ELM is needed sets out multiple interlinked challenges. The majority of them can be grouped under an environmental banner: biodiversity loss, climate change (including drought, extreme weather, flooding, and rising sea levels), invasive species, land use change, over exploitation of resources, pests and diseases, all forms of pollution, and soil degradation. They are presented as requiring action and current agricultural practices are identified as one of the underlying causes. Besides the environmental problems, the documents raise two overarching social problems: social inequality and demographic change. Social inequality is raised in the context of disadvantaged people in society having less access to nature and being more exposed to pollution. Demographic change is primarily mentioned as a factor that will put more pressure on natural resources and food security (DEFRA, 2019, 2020a, b, c, d; HM Government, 2018).

All the interviewed stakeholders stated that the problems identified by DEFRA largely reflect their own problem formulation. However, they raised additional challenges, of which the systemic problems of market failure and a siloed approach were most prominent. Market failure was

mentioned by at least one stakeholder of each interest category, but in different ways. One of the farming, forestry, and landowner stakeholders (interview 2) and economic stakeholders (interview 1) and two of the environmental stakeholders (interview 9 and 13) see it as a market failure that farmers are pressured into producing cheaper food without reflecting the cost of higher environmental standards or the environmental clean-up costs related to food production:

> "it's about market failure in some respects. The market doesn't tend to pay higher for higher environmental standards. [.] and that's where ELM should step in, is to be that bit of the market that would not get paid by consumers." (interview 2).

One of the social stakeholders (interview 14), however, pointed out that it is a market failure that the public is paying multiple times for farming: through subsidies to farmers, food prices, and measures to repair the environmental damage caused by food production.

The challenge of a siloed approach was identified by all but the economic interest stakeholders and discussed in three different ways: production versus nature (interview 2, 5, 6, 7, 8, and 13), nature versus culture (interview 4 and 12), and a disconnect between multiple policies (interview 4 and 12). For example:

> "So it's absolutely fundamental that those first two [biodiversity loss and climate change] are done together. And then within ELM that needs to be done with being able to continue to produce food and fuel. And so you can't separate them out and mustn't silo them" (interview 13).

Taking into account the stakeholders' general recognition of DEFRA's problem formulation and these additional challenges, the stakeholders largely perceive DEFRA's problem formulation as normatively legitimate, but see some room for improvement. In addition, all stakeholders stated that they find DEFRA's problem formulation acceptable regardless of the challenges that are currently not included, because they recognize the importance of addressing these challenges. They therefore lend the problem formulation sociological legitimacy.

4.1.2. Goal formulation

The overarching goal of ELM is to improve the environment within one generation. It is underpinned by its core aim

> "to deliver environmental benefits, paying farmers, foresters and other land managers for interventions and actions that improve and enhance our environment, or for maintaining current land management practices that secure environmental public goods" (DEFRA, 2020a, p. 7)

and two strategic objectives:

> "1. To secure a range of positive environmental benefits, prioritising between environmental outcomes where necessary 2. To help tackle some of the environmental challenges associated with agriculture, focusing on how to address these in the shorter term" (DEFRA, 2020a, p. 8).

This overarching goal is further broken down into nine sub-goals, as displayed in Table 3.

All the stakeholders were supportive of the overarching goal formulation. However, all the farming, forestry, and landowner stakeholders would like to see it turned into a dual goal that also covers viable farm businesses:

> "we want to see that generational change, but can we add on to that, that we also want to see thriving sustainable farm businesses as part of that solution." (interview 8)

When it comes to the sub-goals, all stakeholders agreed that they are at least partially reflective of their own goals. However, one main sub-goal that was stated as currently missing in ELM was a separate goal

Table 3
Sub-goals of the ELM scheme in alphabetical order. Based on Agriculture Act (2020), DEFRA (2019, 2020a,b,c,d) and HM Government (2018).

Sub-goal	Additional details
Clean & plentiful water	
Clean air	
Enhanced beauty of the natural environment & heritage	Connecting more people (from all backgrounds) with the environment
Enhance biosecurity	
Minimizing waste/pollution	Effectively manage noise & light pollution; Eliminate all avoidable plastic waste; Eliminate waste crime; Minimize (chemical) pollution; Reducing food waste
Mitigating & adapting to climate change	Improving resilience of nature & society; Reduce greenhouse gas emission
Reduced risk of harm from environmental hazards	
Sustainable & efficient use of resources	Sustainable growth; Increased productivity; Increased resource efficiency; More dynamic, self-reliant agriculture industry
Thriving plants & wildlife	Improved (species) biodiversity (incl. soil); Improved health & welfare of livestock; More trees; New/restored habitats for wildlife (incl. increasing protected areas)

on productivity (interview 5, 8, and 11), as expressed by one of the economic stakeholders:

> "There's still a polarity shown in ELM. It is the polarity of environment over production. And farmers want to know how to manage the environment and productivity hand in hand, and ELM is not helping them do that entirely" (interview 11).

Apart from the missing sub-goal, the stakeholders felt that their own goals aligned with DEFRA's goal formulation and it can thus be stated that the overarching goal and sub-goals largely fulfill the criteria to be normatively legitimate.

However, regardless of this, the stakeholders found the goals only conditionally acceptable. Their main concerns were not so much related to the type of goals, but to their emphasis, phrasing, lack of interlinkages, and their credibility. Regarding the emphasis of the goals, some stakeholders are concerned that the goals focus too much on iconic landscapes and species and therefore will not create ecosystem wide environmental improvements (interview 8 and 9) and that there is not enough emphasis on access to nature and cultural heritage (interview 2 and 4). When it comes to the phrasing of the goals, stakeholders from all interest categories (interview 1, 2, 7, 9, 10, 12, 13, and 14) are concerned about the way that the goals are formulated. They state that for these goals to be useful they need to be broken down into specific measurable targets, with specific timelines, and with further clarifications on some of the wording. As expressed by one of the environmental stakeholders:

> "it's pointless having a goal that's called thriving plants and wildlife. Unless you know how many, what kinds of plants, and what kind of wildlife, and how much, what's the improvement that you want to see, what's the goal? Actually, these aren't goals. In my mind, they are not meaningful because they need fleshing out." (interview 7).

Closely related to this, half of the stakeholders (interview 4, 7, 10, 11, 12, 13, and 14) had concerns about a lack of clarity on how the goals fit alongside each other, how they relate to the problem formulation, how they are linked to specific actions and measures within ELM, and how the goals relate to other activities of the government:

> "we support the goal of an improved environment in a generation. It's just not clear to us how the steps set out in policy so far will achieve that. They will obviously play a roll, but there's no big guiding vision that we can see that will deliver that." (interview 4)

In addition, one of the environmental stakeholders (interview 10) and one of the social stakeholders (interview 14) question the credibility of the goals:

> "I think the problem with any target like that is you're aware that when government is used as these kind of targets is that they can never really mean what they say on the tin" (interview 14).

Because these concerns negatively influence the stakeholders' perceptions on the acceptability of the goals, the sociological legitimacy of DEFRA's goal formulation is also negatively affected. Thus, whilst there is the potential for these goals to be sociologically legitimate due to their content, this is currently not adequately fulfilled.

4.2. Output legitimacy

As ELM is currently under development, there is still considerable uncertainty over the exact shape of the policy instruments that will be used. However, the overarching mechanisms are set. The scheme currently consist of three components: (1) Sustainable Farming Incentive (SFI), where farmers will be paid for specific environmentally-sustainable land management actions, (2) Local Nature Recovery, where farmers and other land managers are paid to support targeted nature recovery that is adapted to the local circumstances, and (3) Landscape Recovery, where farmers and land owners are paid for the delivery of large scale, long-term, land use change projects. The first component will initially be open to those who received Basic Payments under CAP and is envisaged to be open to all farmers once the scheme is fully expanded in 2024 (DEFRA, 2021d). Eligibility to the second and third component are currently envisioned to be dependent on the project, the characteristics of the landscape, and potentially be competition based. Central to all components is the use of the policy instrument of financial incentives in the form of 'public money for public goods' (DEFRA, 2020b, c). An overview of the instruments currently under consideration is provided in Table 4.

All the stakeholders thought that the three component design of ELM is a useful way of structuring the scheme, but several (interview 3, 4, 7, 8, 9, 10, 11, 12, 13, and 14) raised concerns in relation to the lack of interlinkages between the components and a proper and enforceable regulatory baseline: *"I think there should be a level of regulation beneath the Sustainable Farming Incentive"* (interview 12); especially the environmental stakeholders saw this as a crucial requirement. In relation to the SFI, the stakeholders were concerned about a lack of ambition (interview 10, 11, and 13) and incompatibility with some types of farming, e.g. small scale farming and organic farming (interview 1, 3, and 14).

In regard to the specific instruments, all stakeholders agreed that a mixture of the different instrument types could potentially be effective in reaching the goals, with financial incentives and information sharing being the most crucial. However, they were all skeptical about the effectiveness of the current design of the individual instruments, as shown in Table 5.

More general concerns regarding the overall effectiveness of the scheme were a lack of a sufficient, long term budget and unclarity about how that budget will be distributed across the three components (interview 2, 8, 10, 13, and 14), a lack of clarity in what happens after the end of an agreement under ELM (interview 10, 11, and 12), the complexity of the scheme (interview 9 and 12), and a lack of a systemic approach (interview 3, 7, 9, 11, and 14):

> "all we've got is a notion towards collaboration and a notion towards an incentive to do specific things, but not a plan towards transition to more sustainable farming. We've still got a very linear, not a systems approach to achieving end goals. Sustainable farming and the delivery of the environment plan goals requires a change to systems. Using money to fund aspects of farming or land management that don't link together, don't achieve the end goal." (interview 11).

Table 4
Overview of policy instruments under consideration for ELM. Based on DEFRA (2019, 2020a,b, c,d) and HM Government (2018).

Instrument type	Component		
	Sustainable Farming Incentive	*Local Nature Recovery*	*Landscape Recovery*
Financial incentives	Payments will only be made for actions or targets that are not required through domestic regulations & that are not already supported through other public funds The duration of agreements will be flexible, dependent on what the agreements set out to deliver & the individual circumstances of the farmers		
Payments for:	Specific actions	Initially actions, over time outcomes	Specific projects (grants for upfront costs + payments for ongoing maintenance)
Payment rate:	Income foregone + costs, or adjusted over time based on uptake of the actions	Income foregone + costs, based on the degree of environmental benefits, or marked-based	Negation based & set on an individual basis or through reverse auctions
Financial disincentives	Penalties for regulation breaches or non-compliance with ELM But: main emphasis on support to achieve & maintain compliance		
Regulations	Should sit alongside ELM (e.g. bans, legally binding targets, zoning)Compliance with regulations as entry requirement into the scheme		
	Use of land management plans to support applications & agreements & to support and check progress and compliance	Applicants might need to demonstrate that they fulfill SFI standards	
Collaboration		Stimulating farmers & land managers to work together Including local residents, local workers, & farmers in local planning & decision making	
Information sharing (guidance & advice)	Written (online) information Self-declared information from farmers to support applications, agreements, & compliance checks	One-on-one advice to land managers, group based training & advice, facilitating peer-to-peer learning, online & telephone support, & (primarily online) written information	

All these concerns, together with the concerns over the lack of clarity in the goal formulation, negatively influenced the stakeholders' perceptions on the achievability of the overarching goal. The economic, environmental, and social stakeholders were particularly skeptical about the capability of the current plans to fulfill the goals:

> "So at the moment, I think we have no policies in place to deliver it at all. Absolutely none. And therefore I think it's highly unlikely that we're going to succeed, unless there is a massive intervention and turn around. […] the goal is brilliant, but we have absolutely no means of meeting it at the moment." (interview 9).

Thus, although the stakeholders recognize a potential for the proposed instrument types to be effective, they do not consider their currently proposed design to be effective and, therefore, there is a lack of perceived normative output legitimacy.

In regard to the perceived acceptability of the instruments, all the stakeholders thought that the instruments are going into the right direction. However, some raised concerns regarding the transition management (interview 2, 7, and 10), the fairness of the scheme (interview

Table 5
Overview of the stakeholders' main concerns regarding the proposed instruments.

Financial incentives: public money for public goods	Information sharing: advice & guidance	Regulations: minimum environmental standards	Financial disincentives: penalties	Collaboration: between farmers & local communities
Can potentially address market failure (all)	Is essential to help change attitudes & make farmers use the scheme in the best possible way (all)	Essential as a basis underneath the scheme; which is currently not sufficient (all)	A necessary instrument, as a final resource, to give the scheme teeth (all)	Effective to create integrated landscape scale change and shifts in attitudes (all)
Income foregone + cost too low of an incentive to be effective; payment rates have to be fair (all)	Need for multiple methods of information sharing to be effective, online advice alone won't be effective (all)	Need to be enforceable and understandable to be effective, which is currently not the case (ffl; env.; soc.)	Needs to take account of external impacts that influence results on the ground to be fair (ffl)	Needs to be voluntary, facilitated, & funded (all)
Mix of payments for actions & outcomes would be most effective, if time lags and external impacts on outcomes are taken into account (all)	Different types of advice is required for different public goods to be effective (all)	Changing attitudes will be more effective in the long term (as no need for enforceability) (env.; soc.)	Only effective if compliance can be monitored, which is currently difficult (ffl; econ.)	Needs to be clarified how financial incentives will be distributed within a collaborative project (ffl; env.)
Won't be effective if it pushes out the public market to invest in public goods (all)	Needs to be (partially) funded through ELM to be fair and effective (all)	Need for an understanding how ELM relates to regulations from other sectors as well to be effective (e.g. forestry), which is currently not the case (ffl; env.)		
→ Current design is not effective	→ Current design is not effective	→ Current design is not effective	→ Current design can be effective, if properly monitored	→ Current design can be effective, if funded

1, 2, 3, 5, 7, and 14), and worried that the instruments will not deliver on the promises that were made (interview 4, 5, 7, 8, 9, 11, 12, 13, and 14). The concerns in regard to the transition management related to unnecessary pressure on farm businesses and rural communities due to strong cuts to basic payments while ELM is not yet fully operating and unclarity about how the previous environmental schemes will be carried over into this new scheme. The concerns regarding the fairness of ELM were identified in relation to the scheme currently being too narrow, creating a loss of income for some farmers, excluding certain farmers, and not properly incorporating non-farmed land and forestry: "*at some point someone will say that it's not fair and it's not wide enough scaping.*" (interview 1). In addition, it was pointed out that ELM will only be fair to society if it will deliver on the goals. Yet, it is precisely this aspect where stakeholders from all interest categories were concerned that the scheme will fall short and why they thought that its current design is not acceptable. Nevertheless, there was a general optimism that with more clarity and changes to the design the scheme can still become acceptable:

> "But I think there is still time to put that right. If there's clarity on the goals and if there's clarity on the instruments and actually the detail of how they work. And I don't think we're there yet. But I think, it doesn't mean that all hope is lost." (interview 4).

Overall, it can therefore be stated that the instrument types per se are perceived as sociologically legitimate, but not their current design.

4.3. Throughput legitimacy

DEFRA has set up a number of engagement activities in order to include stakeholders in the development of ELM, as described in Table 6. Some of these were disrupted by the COVID-19 pandemic and there has been a renewed effort to attend farmer events since the lifting of lockdown restrictions from May 2021. Whilst several of these activities were open to all, most of them have been targeted towards specific stakeholders and were based on selection procedures. In addition, the majority of the interviewed stakeholders noted that the engagement process has not been equal for all. There was

disagreement over whether the farming organizations or the environmental organizations have had more influence, but the social stakeholders were unanimous in their opinion that they have had a more disadvantaged position in the process in comparison to both of these: "*I dread to think that others have had a similar experience. And actually, I would hope that they would have had a better one.*" (interview 4). It was

Table 6
Overview of activities to include stakeholders in the ELM design process. Based on Defra (2018a, b, 2020a, d, e, f, 2021b, c, d).

Engagement activity	Who can take part
Consultation (Feb.-May. 2018)	Anyone
Consultation (Feb.-July 2020 – paused between April 8-June 25 due to Covid-19)	Anyone
Policy roundtables, regional events, & interactive webinars accompanying the consultations	Targeted at farmers, land managers, landowners, agronomists, environmental specialists, & other 'interested stakeholders'
ELM stakeholder engagement group	Invited stakeholder organizations only
Test & Trials	Selected projects
National pilot focussing on SFI	Initially farmers who previously received basic payments & whose land has certain characteristics, the final phase should be open to all farmers
National pilot of other components of the scheme	Details are not yet available
Workshops & webinars on specific sections of the ELM scheme	Anyone
Submitting written evidence to the Agriculture Bill	Anyone
Submitting written evidence to the Environment, Food and Rural Affairs Committee (EFRA) inquiry into ELM	Anyone
Presenting oral evidence to the EFRA inquiry into ELM	Invited speakers only

also pointed out by several stakeholders (interview 2, 5, 11, and 14) that some stakeholders receive information earlier than others and that there are sometimes additional conversations, where not everyone gets included:

> "So if DEFRA want to get something from that meeting, then a lot of other thought might be closed down and picked up outside of the meeting, which can disadvantage people if you're not privy to the secondary conversation." (interview 11).

In addition, several of the stakeholders mentioned that they have been included only at a late stage. Additional stakeholders that were not sufficiently engaged with according to our interviewees included individual farmers (interview3, 9 and 13), minority interest groups and groups with limited resources for engagement (interview 2 and 14), the general public (interview 4 and 10), and local authorities (interview 4 and 12). Thus, whilst there are multiple opportunities to be involved in

the design of ELM, due to the multiple dimensions of inequality within these activities, the criteria for normative throughput legitimacy are only partially fulfilled.

When it comes to the stakeholders' perceptions on whether or not they have had an opportunity to meaningfully contribute to the design of ELM, we noticed a disparity. Whilst all stakeholders were happy that there have been possibilities to engage, they were critical about the effect of that engagement. One of the farming, forestry, and landowner stakeholders (interview 2) and one of the economic stakeholders (interview 11) stated that expectations of the engagement process have not been well-managed and all of the stakeholders expressed frustration and disappointment on the lack of action that has been taken on their input:

> "I think where it's not working is that clearly the group has sometimes reached a consensus on particular things and then doesn't feel that it's been actioned at all. […] Many people said don't use income forgone plus costs, and we're using income forgone plus costs. Most people said we need more advice to farmers in SFI particularly, and there isn't an advice stream set in place for SFI. […] So that's frustrating." (interview 14).

They further expressed frustration about a lack of transparency and communication regarding how decisions are made, which decisions are already made, and which are still open for debate:

> "And I think that is the crooks of the problem basically. You engage with them and you feed into them and then you don't often hear how they've assessed your engagement. But they decided against it anyway. So that pathway isn't clear" (interview 6).

They also stated that this lack of transparency negatively impacted the acceptability of the decisions that are being made. In addition, stakeholders from all interest categories (5, 11, 12, and 13) expressed concerns about the policy making process being too siloed. It can thus be stated that whilst there is a potential for sociological throughput legitimacy, at the moment the stakeholders have a largely negative perception of this.

4.4. Overall legitimacy

Overall, when considering both the problem formulation, goal formulation, instruments, and design process, all the stakeholders are supportive of the idea behind ELM and therefore perceive it to be normatively legitimate. However, the stakeholders differ in the degree of their overall support to the scheme in its current form. Two of the farming, forestry, and landowner stakeholders (interview 5 and 6) and one of the economic stakeholders (interview 1) support the scheme without hesitation and thus perceive it to be sociologically legitimate. The majority of the other stakeholders (interview 2, 4, 8, 10, 11, 12, and 13) give general support to the scheme but express a lack of support to (some of) the details and the proposed level of funding. They therefore see a potential for sociological legitimacy, but the potential is currently not adequately fulfilled:

> "we're a critical friend at the moment. We are trying hard to be supportive in the process and constructive in the process to some things we're hearing which we like. But as I said, details, timelines, we will take the government to task on that because that's not working at the moment." (interview 8).

The other stakeholders (interview 3, 7, 9, and 14) do not support the overall scheme in its current form due to a lack of confidence in its impact and concerns about a dissonance within government regarding what they really want to achieve and therefore do not perceive the scheme to be sociologically legitimate. Table 7 provides a simplified overview of the main perceptions of the stakeholders in each of the legitimacy dimensions.

Table 7
Simplified overview of the stakeholders' perceptions of the legitimacy of ELM and the process by which it is being designed.

		Normative legitimacy	Sociological legitimacy
Input legitimacy	Problem formulation	Largely overlap between DEFRA & stakeholders (all) Main problems missing: market failure (all) & siloed approach (ffl; env.; soc.) → ***largely normatively legitimate***	Recognize importance of DEFRA's problem formulation, regardless of missing problems (all) → ***sociologically legitimate***
	Goal formulation	Largely overlap between DEFRA & stakeholders (all) Main goal missing: productivity (ffl; econ.) → ***largely normatively legitimate***	Accept idea behind the goals, not how they are formulated (all) Concerns over emphasis (ffl; env.; soc.), phrasing (all), lack of interlinkage (econ.; env.; soc.), & credibility (all) → ***potential for sociological legitimacy, currently not adequately fulfilled***
Output legitimacy	(perceived) Efficacy	3 component design & mix of all instrument types could be effective (all) Concerns over insufficient regulatory baseline underneath the scheme (all), lack of interlinkage across components (env.; soc.), lack of ambition & exclusion of some under SFI (econ.; env.; soc.); no sufficient incentives & limited funding (all), lack of focus on information sharing (all), lack of clarity on long term plan (econ.; env.; soc.); complexity (env.; soc.), & no clear linkage between instruments, goals, actions, & problems (econ.; env.; soc.) → ***potential for normative legitimacy, but current design lacks normative legitimacy***	Instrument types are acceptable (all) Current design of instruments is not acceptable: bad transition management (ffl; env.), concerns over fairness (all), & will fall short of reaching goals (all) → ***sociological legitimacy of instrument types, lack of sociological legitimacy of their current design***
Throughput legitimacy	Inclusiveness	Multiple opportunities to be engaged in the process, but some only open for selected stakeholders Inequality in the process (all) Some stakeholders are not sufficiently included (all) → ***partially normatively legitimate***	Happy with opportunities for engagement (all), but: expectations were not well managed (ffl; econ.), frustration & disappointment on lack of action on input (all), lack of transparency & communication (all), siloed approach (all) → ***potential for sociological legitimacy, but currently not fulfilled***
Overall legitimacy		Agree with idea behind the scheme (all) → ***Normatively legitimate***	Different perceptions on acceptability: Three stakeholders (ffl; econ.) support it without hesitation → ***sociologically legitimate***
			Seven stakeholders (all) support it conditionally, based on changes to details & increased clarity → ***potential for sociological legitimacy, but not yet fulfilled***
			Four stakeholders (env.; soc.) do not support it due to structural concerns → ***lack of sociological legitimacy***

Note: the description in parenthesis indicates that at least one stakeholder of a certain interest category had this perception.

5. Discussion

The results of this study present deeper insights into aspects influencing perceived legitimacy and highlight that there are several critical points that need to be taken into account in the governance of agricultural sustainability transitions in order to improve their perceived legitimacy. We discuss theoretical insights, elucidate lessons for policymakers in general, and provide specific policy recommendations for the English transition.

5.1. Advancing understanding of perceived legitimacy

Combining normative and sociological approaches to legitimacy within one study allowed us to deepen our understanding of what things people consider when they build their perceptions of the legitimacy of an agricultural transition. In relation to perceived input legitimacy, our study shows that it is not only important to aim for alignment between the problem formulation of the policy and the stakeholders as generally highlighted in the legitimacy literature (Johansson, 2014; Vringer and Carabain, 2020), but also to recognize the structural, systemic underlying causes of the problems. Recognizing these is perceived as important because it enables to address a problem by its roots rather than by its symptoms. Our results thus reemphasize the point made by Suchman (1995) about the importance of addressing the correct problems in the eyes of the stakeholders. In addition, our results indicate that there is a stronger negative effect if certain problems are not included in the problem formulation than if there are additional problems included. As previous legitimacy literature has primarily been focussed on alignment of problem formulations, this result provides a more nuanced insight into the relative importance of problem formulation alignment for perceived input legitimacy.

In relation to the perceived legitimacy of the goal formulation, our analysis shows that where the legitimacy literature so far has put most emphasis on the importance of goal alignment and the recognition of the importance of the goals for society at large (Scharpf, 1999; Schmidt, 2013; Suchman, 1995; Wironen et al., 2019), these two criteria on their own are not sufficient to create perceived legitimacy of the goal formulation. When the content of the goals are perceived to be acceptable, perceived input legitimacy can still fall short due to the way the goals are phrased and their perceived credibility. Our results indicate that in order to gain perceived legitimacy, any goal that is part of an agricultural transition needs to be specific, measurable, set on a specific timescale, clearly linked to the problems that it aims to solve, and in line with wider governmental activities. As this presents new criteria for perceived input legitimacy that so far have not been highlighted in the legitimacy literature these aspects should be given more attention in future research on perceived legitimacy.

When it comes to perceived output legitimacy, our results reiterate the importance of perceived effectiveness of the design of the transition and the policy instruments (Scharpf, 1999; Suchman, 1995). For instruments to be perceived as effective, our results indicate that, at a minimum, it needs to be clear how they work in practice and how they will be enforced. In addition, in line with findings from Boedeltje and Cornips (2004), we found that for the instruments to be regarded as meaningfully contributing to the achievement of goals, they need to be clearly linked to each other and to the problem and goal formulation. Perceived output legitimacy is therefore in part dependent on the clarity of the problem and goal formulation. This result highlights the importance of assessing the perceived legitimacy of a transition as a whole, connecting problem and goal formulations with the proposed policy mix rather than evaluating individual policy instruments disconnected from their context and purpose (Rogge and Reichardt, 2016; Wanzenböck et al., 2020). We therefore argue that this should be a central focus in future research on the legitimacy of agricultural transitions.

Another point that we found to be important for the perceived effectiveness of the instruments is that the instruments need to be diverse enough to be able to speak to a wide variety of people who will have different behavioral motivations and learning styles. This point has to date received little attention in research focussing on the effectiveness of policy instruments (Pedersen et al., 2020), and is thus an interesting new indicator that increases our understanding of how people form their perceptions on output legitimacy. We therefore argue that this should receive more scrutiny in assessments of perceived output legitimacy. Beyond the perceived effectiveness of the instruments, our results show that fairness of the instruments and the transition design are additional factors that influence perceived output legitimacy. Fairness of the instruments has been previously highlighted as an important factor (e.g. Valkeapää et al., 2013; Vringer and Carabain, 2020), but fairness of the overall transition design has been less prominent in legitimacy literature.

Finally, in relation to perceived throughput legitimacy, our results reemphasize the importance of meaningful inclusion and transparent processes (Bierman and Gupta, 2011; Steffek, 2019; Upham et al., 2015) and function as a reminder that the legitimizing power of inclusion depends on how that inclusion is shaped (Braun and Busuioc, 2020). For inclusion to generate perceived throughput legitimacy, our results indicate that attention needs to be paid to differences in power, including differences in access to resources to invest in engagement activities, expectation management, and communication and transparency regarding how the input from the stakeholders is used in decision-making. Especially the latter point was highlighted as a factor that can contribute to improve the acceptance of decisions, even when they go against the interests of the stakeholders, indicating that creating transparency in the process can have a positive influence not only on perceived throughput legitimacy but also on perceived input- and output legitimacy.

5.2. Critical points for the governance of agricultural transitions

Generally, our results show that across all dimensions of perceived legitimacy, clarity and diversity in design and processes is essential. When stakeholders underwrite the spirit of a transition but do not have faith in the policies that should bring about that transition and do not understand how specific decisions have come about, the perceived legitimacy of the transition will be negatively affected.

In relation to perceived input legitimacy, the wider lessons that we can draw from these results for the governance of agricultural sustainability transitions more generally are the importance of identifying all underlying causes of the problems that the transition aims to address from the outset and developing a wide problem formulation. Whilst it is necessary to set priorities to move a sustainability transition forward (Meadowcroft, 2011), when there are heterogenous opinions about the main problems, incorporating these diverse views rather than setting a parsimonious problem formulation will be beneficial for the perceived input legitimacy of the transition. Furthermore, in relation to the goal formulation, specificity both in terms of formulation, timescale, and measurability are key in setting the direction of the transition and limiting contestation over what the goals entail. Besides improving the perceived input legitimacy this can also contribute to streamline the transition and ensure that all involved actors work to fulfill the same societal mission (Hekkert et al., 2020; Klerkx and Begemann, 2020).

In relation to perceived output legitimacy, our results highlight the importance of building the transition around instruments that are predictable and known to be effective. Using a voluntary scheme without a clear and enforceable regulatory baseline as the central mechanism to guide the transition will have difficulty in gaining perceived output legitimacy because it cannot guarantee that steps will be made toward goal achievement. Likewise, a transition that is built around a policy instrument that does not have a precedent will have more difficulties in obtaining perceived output legitimacy than a transition that is built on well-tested instruments, as new instruments come with many uncertainties regarding their functioning in practice. In addition, paying

attention to how the instruments interact with each other and clearly stating how they relate to the goal and problem formulation has the potential to considerably contribute to overall perceived legitimacy. Finally, creating a diverse mix of policy instruments that can appeal to a diverse range of people will likely be more effective in bringing the transition forward than building on a narrow set of inflexible instruments. This can also help to some extent in ensuring that the overall transition design does not explicitly excludes or disadvantages certain groups of people from the outset.

In regard to enhancing the perceived throughput legitimacy of the transition from the outset and throughout the transition period, the wider lessons that we can draw from these results for the governance of agricultural transitions are that clear communication and transparency on what stakeholders can expect from their involvement in the transition process, how input is used, and how decisions are made is of key importance. Furthermore, taking actions to mitigate power imbalances, for example by supporting stakeholders with limited resources to take part in the process, will also likely contribute to improve perceived throughput legitimacy.

5.3. *Improving perceived legitimacy of ELM*

Specifically related to ELM, our results show that the English agricultural transition in its current form risks insufficient support from its stakeholders to be sustainable in the long term. However, there is scope for improvement within the structures that DEFRA have laid out.

Perceived input legitimacy could be improved by recognizing and incorporating the market failures and the siloed approach to nature, production, and culture as underlying problems and clarifying unclear language in the goal formulation, such as 'enhanced beauty' or 'thriving plants and wildlife'. As part of this clarification the goals need to be broken down into measurable targets with a specific timescale that are directly linked to the problem formulation. In addition, it should be clarified how ELM sits alongside other government activities that might affect the environment or agricultural sector.

In relation to perceived output legitimacy, the proposed ELM design currently falls short on all the identified criteria. Especially the regulatory baseline underneath the scheme and the two instruments that the stakeholders regarded as most important in this transition, public money for public goods and information sharing, need considerable clarifications and alterations to be perceived as legitimate. The provision of information, advice, and guidance, needs to be diversified and be given a more prominent role within the transition. As the instrument of public money for public goods is a new approach that does not have a precedent in this context and at this scale, more research and clarity is required on how the monetary value of public goods can be assessed in order to set effective and fair payment rates, whether it is most effective to pay for specific actions or for outcomes and, in the case of the latter, how outcomes will be measured, and how time-lags between actions and outcomes and external impacts that negatively influence the outcomes will be taken into consideration. In addition, it needs to be clarified how this instrument relates to the private market. If it will push out the private market from investing in public goods, rather than helping to solve the underlying problems, it might perpetuate them by further institutionalizing market failures. In terms of the overall design and transition management, more attention should be given to how farmers that are currently excluded by design can be better supported throughout the transition and how it can be ensured that no-one, including nature, falls between the gaps when the old schemes are gradually replaced by the transition policy. It also needs to be clarified how all different aspects of ELM sit together and contribute to the overarching goal. It is therefore worrying for the perceived output legitimacy of the scheme that rather than clarifying how the different components of ELM are integrated, DEFRA has been moving to separating the components further by now regarding them as separate schemes (DEFRA, 2021a).

Finally, to maximize the positive potential that DEFRA has created through the multiple engagement activities, several changes to the ELM design process are required to enhance perceived throughput legitimacy. First, more efforts should be made to create equal inclusion, including providing support to those who wish to engage but do not have the resources to do so and creating more activities that are open for all rather than by invitation only. Whilst it will be difficult in practice to include everyone who wishes to be included equally (Boedeltje and Cornips, 2004), efforts should be made to come as close to this ideal as possible. Second, more attention should be given to power imbalances between stakeholders, for example by reducing the number of secondary conversations outside of the official meetings and communicating information to all stakeholders at the same time. Third, it should be clarified what the stakeholders can expect from their engagement. Fourth, and finally, communication and transparency regarding how input is used, how decisions are made, and which aspects of the scheme are still open for debate needs to be improved. This latter point has also been highlighted in written and oral evidence provided to the EFRA inquiry into ELM (EFRA, 2021).

6. Conclusion

Agricultural sustainability transitions promise to be one of the key solutions to society's grand challenges. However, in order to fulfill that promise, they need to be designed in a way that can ensure widespread societal support. In this article, we analysed the proposed English agricultural transition with the aim to examine how the governance of agricultural transitions can generate such support. We focussed specifically on how the normative and political nature of transitions can be taken into account in order to improve their perceived legitimacy. Whilst the analytical application of perceived legitimacy and its division in multiple dimensions tends to create artificial boundaries in an indivisible empirical phenomenon (Deephouse and Suchman, 2008), our operationalisation of the concept was able to show how the dimensions interact in practice. In addition, whilst the results of an analysis of normative legitimacy depends on pre-set indicators (Vringer and Carabain, 2020) and can only show if a certain transition should be regarded as legitimate in theory (Johansson, 2014; Schmidt, 2013), combining pre-set indicators with an assessment of perceived sociological legitimacy allowed us to examine the perceptions on the ground and capture additional factors that have so far received limited attention in the literature. Our operationalisation of perceived legitimacy therefore proved to be a fruitful tool in examining what aspects need to be considered in the governance of agricultural sustainability transitions to take account of their normative nature and increase their societal acceptability and support. It enabled us to gain deeper theoretical insights into what aspects people use to form their legitimacy perceptions in relation to agricultural transitions and to provide practical advice for the governance of agricultural transitions in general and for the English transition specifically. As countries around the globe start to think about how to transition their agricultural sectors toward more sustainable forms of agriculture, the framework that we applied in this study can be used in future research to critically evaluate the normative and power dimensions of transition processes and support governments in their efforts to develop policies for agricultural sustainability transitions that will be accepted by society.

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Author contributions

Auvikki de Boon: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Camilla Sandström:** Resources, Writing – review & editing, Supervision, **David Christian Rose:** Resources, Writing – review & editing, Supervision, Funding acquisition.

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Annex A. Interview key

Interview 1: Economic interest.
Interview 2: Farming, forestry, and landowner interest.
Interview 3: Social interest.
Interview 4: Social interest.
Interview 5: Farming, forestry, and landowner interest.
Interview 6: Farming, forestry, and landowner interest.
Interview 7: Environmental interest.
Interview 8: Farming, forestry, and landowner interest.
Interview 9: Environmental interest.
Interview 10: Environmental interest.
Interview 11: Economic interest.
Interview 12: Social interest.
Interview 13: Environmental interest.
Interview 14: Social interest.

Annex B. Interview handout

Summary of ELM scheme as currently proposed

This handout provides a summary of the ELM scheme as it is proposed at this moment. It contains the problem formulation, goals, and proposed instruments to achieve the goals. The interview will evolve around the views of your organisation on the acceptability of the ELM scheme in its current form and the processes through which it is being developed. Before the interview we would like to ask you to reflect on your organisation's views on these aspects. To help your reflection, for each theme, please consider what your organisation's stance is: are these proposals acceptable or are there aspects that your organisation would like to see changed? Please bring this handout with you to the interview.

Problem formulation

The main problems/challenges that are brought forward as reasons why the ELM scheme is needed are, in alphabetical order:

Overarching problem	Specification
Biodiversity loss	
Climate change	Incl. costal erosion, draught, extreme weather, flooding, ocean acidification, & rising sea levels
Demographic change	Putting pressure on food security and other resources and change in the age structure of the population
Invasive species	
Land use change	
Over exploitation	
Pests & diseases	Animal related, plant related, & human related
Pollution	Incl. plastic waste, air pollution, soil pollution, water pollution, light pollution, & noise pollution
Soil degradation	
Social inequality	Inequal access to nature & inequal exposure to pollution

Goals

The overarching goal that the ELM scheme is aiming to achieve is to improve the environment within one generation. This goal is supported by several smaller goals and sub-goals, shown here in alphabetical order:

Goal	Additional sub-goal
Clean & plentiful water	
Clean air	
Enhanced beauty of the natural environment & heritage	Connecting more people (from all backgrounds) with the environment
Enhance biosecurity	
Minimising waste/pollution	Effectively manage noise and light pollution; Eliminate all avoidable plastic waste; Eliminate waste crime; Minimise (chemical) pollution; Reducing food waste
Mitigating & adapting to climate change	Improving resilience of nature & society; Reduce greenhouse gas emission
Reduced risk of harm from environmental hazards	
Sustainable & efficient use of resources	Clean/green/sustainable growth; Increased productivity; Increased resource efficiency; More dynamic, self-reliant agriculture industry
Thriving plants & wildlife	Improved (species) biodiversity; Improved health & welfare of livestock; More trees; New/restored habitats for wildlife (incl. increasing protected areas)

Instruments

The overarching design of ELM is a three component system:

1) Sustainable Farming Incentive: targeted at individual farmers and their land management actions
2) Local Nature Recovery: targeted at farmers and other land managers to support targeted nature recovery that is adapted to the local circumstances
3) Landscape recovery: targeted at farmers and landowners, aiming for the delivery of large scale, long-term, land use change projects.

Across these components, the overarching instruments that are being considered to be used in the ELM scheme and the mechanisms behind them to reach the goals are, in alphabetical order:

Instrument type	Currently considered ways this instrument could take shape
Collaboration	Encouraging farmers and land managers to work together & submit group-applications (for component 2 & 3) Giving local areas, residents, workers, & farmers a role in deciding local priorities and local planning (primarily for component 2)
Financial disincentives	Monetary penalties in case of failure to comply with regulations or non-compliance with ELM scheme agreements
Information sharing	Providing advice and guidance to support compliance (e.g. how to navigate the scheme, how to carry out land management actions): • Group based training and advice • One-on-one advice • Online & telephone support • Peer to peer learning • (online) written information Using information supplied by farmers (self-declared information, e.g. self-assessments, photo & video evidence) to support applications, agreements, & compliance checks (especially for component 1)
Paying public money for public goods	Payments for concrete actions Payments for results Grants for upfront costs vs payments for ongoing maintenance Payment rates based on income forgone & incurred costs Payment rates flexible/market based Payment rate negotiation based Payment rates set through auctions (or reversed auctions)
Regulations	Compliance with regulations (incl. legally binding targets & bans) as minimum entry requirement into the scheme (for all components) Flexibility of agreement duration Fulfilment of component 1 standards as entry requirement for component 2 Using land management plans to map and record the baseline condition of the land, plan future management activities, & support applications to, & agreements under, the scheme (central to component 1) Increasing the proportion of protected sites & the use of conservation covenants (especially for component 3)

Annex C. Interview guide

Context

1. Can you give me a brief introduction to your organization and its purpose?
2. What is your role and position within the organization?

Main part

A. Problem formulation.

1. What does your organisation see as the main problems that need addressing in relation to agriculture?
2. The ELM scheme is brought forward as a means to address multiple problems. We summarized them for you in the handout that you received prior to the interview. Does your organisation think that there are any other problems that are currently not included in ELM that should be included or problems that are included that should not be?
3. Does your organisation find these problems an acceptable ground to argue for the need for an ELM scheme?

B. Goal formulation

1. Can you expand on what the goals of your organization are and in how far your organization feels like these goals are reflected in the ELM scheme?
2. In the current proposals for the ELM scheme, the overarching goal is to improve the environment within one generation. What does your organization think of this goal?
3. There are nine smaller goals that ELM is striving to achieve, which we summarized in the handout. Does your organization think that these goals are acceptable?

C. Policy instruments

1. What does your organization think of the three component design of the ELM scheme?
2. Out of the potential instruments that DEFRA is considering to use in the ELM scheme, is there any instrument type that your organization prefers over the others?
3. What does your organization think of the potential design options of these individual instruments? Can they be effective and capable in solving the problems and reaching the goals that the ELM scheme is aiming to achieve?

D. Process

1. Does your organization feel like it had the opportunity to contribute to shaping the ELM scheme?
2. Does your organization feel like you had an equal chance to influence the development of the scheme in comparison to other stakeholders?
3. What does your organization think about the role of other organizations that you align with or who represent other interests than your own in the development of the ELM scheme?
4. Did your organization feel like the right people were and are included in the development of the ELM scheme?

Overall

1. Does your organization support the ELM scheme in its current form?

Ending

1. Is there anything that we have not touched upon that you would like to bring forward?

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Paper III

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Research article

A psychometric approach to assess justice perceptions in support of the governance of agricultural sustainability transitions

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ABSTRACT

There is consensus that we need sustainability transitions and increasing acknowledgement that such transitions should be conducted in a just manner. However, what exactly a 'just transition' means and how this should be brought about is less clear. Attempts to examine the justice of transitions to date primarily rely on normative interpretations of what justice means. Using the English agricultural transition as a case, we develop an instrument that builds on the underlying dimensions of justice evaluations to provide a tool for decision-makers to gain insights into societal perceptions of what a just agricultural transition means to them. When adapted, this instrument is also valuable for sustainability transitions in other sectors. We establish adequate construct reliability and validity for a number of constructs such as Equality, Entitlement, and Merit as Principles of Procedural Justice, whilst others such as the different Topics of Distributional Justice will need further refinement.

1. Introduction

There is consensus that we need sustainability transitions across societal domains in order to address challenges of climate change, biodiversity loss, environmental degradation, and growing inequality. An expanding field of research examines how these kinds of transitions can be achieved, and increasingly attention is turned to their political nature (Köhler et al., 2019). It is acknowledged that transition processes are inherently disruptive, considerably altering or destructing old systems altogether (Kivimaa et al., 2021) and that not everyone will benefit from this (Leach et al., 2007; Meadowcroft, 2011). However, so far, this acknowledgement has not translated into a clear understanding of how to govern transitions in a way that takes account of the justice implications of this nature of transition (Avelino et al., 2016; Köhler et al., 2019).

The agricultural sector has been highlighted as one of the societal domains that requires a sustainability transition (El Bilali, 2020; FAO et al., 2021; Young Park et al., 2021), because currently dominant agricultural practices considerably contribute to climate change, biodiversity loss, environmental degradation, and social inequality (Awuchi et al., 2020; Cadieux and Slocum, 2015; IPCC, 2019; Mares and Peña, 2011). These practices are in part a result of the agricultural policies that incentivise particular ways of farming. Therefore, a change in the policies that shape agricultural practices is needed (FAO et al., 2021; Pe'er et al., 2020). Simultaneously,

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agriculture is under increasing pressure from multiple environmental and demographic changes (e.g. IPBES, 2019; IPCC, 2021; UNEP, 2021).

As early as the 1970s, labour organisations have highlighted that these kinds of transitions should be conducted in a socially just way (Cha, 2020; Galgóczi, 2020; Newell and Mulvaney, 2013; Sabato and Fronteddu, 2020). This call for a just transition has also been incorporated in multiple international agreements and declarations such as the Paris Agreement (UN, 2015), the International Labour Organization's Guidelines for a Just Transition (ILO, 2015), the Silesia Declaration on Solidarity and Just Transition (UNCCC, 2018), the European Green Deal (European Commission, 2019), and the draft text for the post-2020 global biodiversity framework (UNEP, 2020). This reflects the insight that transitions can only be sustainable if they are designed in a socially just way (Wang and Lo, 2021). However, none of these documents set out a clear definition of what is meant by a just transition (Jenkins et al., 2020; Velicu and Barca, 2020), nor do they provide a blueprint of how to achieve this. In addition, in these agreements, and in the scientific literature alike, the idea of just transitions has primarily been connected to climate change and energy transitions (Bennet et al., 2019; Cha, 2020; Kaljonen et al., 2021). Only recently have researchers highlighted the need to broaden the application of just transition thinking to agricultural transitions (Aubert et al., 2021; Blattner, 2020; Carlisle et al., 2019; Dale, 2020; Hebinck et al., 2021; Hedberg, 2021; Murphy et al., 2022; Stevis, 2021; Tschersich and Kok, 2022; Young Park et al., 2021). It remains unclear what a just agricultural transition looks like and how to achieve it.

Furthermore, these international agreements, and many scientific articles alike, do not recognize that justice has no universally agreed meaning. Perceptions of what is, or is not, just are entrenched in individual values and societal norms (Rasinski, 1987; Sikor et al., 2014) and views on how justice should be prioritized and enacted through policies vary (Burchardt and Craig, 2008). It is therefore a highly normative concept (Smaal et al., 2020; Wang and Lo, 2021; Wijsman and Berbés-Blázquez, 2022; Wolff, 2008). However, without having a clear idea of what is perceived as a just transition, it will be very difficult to achieve it (Cadieux and Slocum, 2015; Piachaud, 2008).

As societal perceptions of injustice are motivators for political protest (Rothmund et al., 2016; Wieliczko et al., 2021), and thus undermine the sustainability of any transition (Herrero et al., 2020; Markard et al., 2020; Martin and Islar, 2020; Meadowcroft, 2011), we argue that for the governance of transitions societal justice perceptions are of central importance. Efforts to create sustainability transitions have already resulted in societal unrest. In relation to agricultural policy changes, large scale protests in the Netherlands (Gijs, 2022), India (Bhatia and Katakam, 2021), and France (Chiarello and Libert, 2019) provide prime examples of the need for a better understanding of societal justice perceptions to underpin transition policy development. In order to be able to take societal justice perceptions into consideration in the governance of transitions, we need to know what these perceptions are (Schlosberg, 2013). Whilst there exist several tools to assess general justice perceptions (Harding et al., 2021; Heyen et al., 2021; Liebig et al., 2015, 2016; Rasinski, 1987) and environmental attitudes (Bernstein and Szuster, 2019; Bouman et al., 2018; Franzen and Vogl, 2013; Milfont and Duckitt, 2010), to the best of our knowledge there does not exist an instrument through which justice perceptions in the context of transitions can be assessed. Therefore, this study aims to develop such an instrument. The research questions that guide our development of this instrument are: what are the underlying dimensions that people base their normative justice evaluations on and can these be used to assess societal perceptions of what a just transition means to a specific society? To answer these questions, we take England as a case study as it is currently in the midst of designing a post-Brexit agricultural transition that moves away from the EU's Common Agricultural Policy (CAP) in which farmers receive subsidies based on the amount of land that they manage (European Parliament, 2020) toward a system that pays farmers public money for the provisioning of public goods (DEFRA, 2020a).

In doing so, this paper contributes to the transition literature by broadening the notion of just transitions to the agricultural context and by providing an operationalisation that can acknowledge the normative nature of justice. Beyond that, we provide policy makers with a tool that can inform the governance of sustainability transitions. Whilst individual perceptions of a just transition will ultimately vary, this tool gives insights into the general direction of the justice perceptions that are present in society, thereby helping governments to take account of the justice implications of transitions and minimize resistance to transition pathways.

2. Dimensions of justice perceptions

As justice and just transitions are normative concepts, it is not surprising that there are a myriad of theories and interpretations of these concepts. In this section, it is not our aim to review all normative conceptions of justice. Instead, we focus on the underlying dimensions and interconnected sub-dimensions that are generally used to make normative claims of justice. We draw on insights from political philosophy, social psychology, environmental justice, food justice, and social justice literature. Within these strands of literature, there are generally three overarching dimensions of justice that are brought forward: distributional justice, procedural justice, and recognitional justice (Bennett et al., 2019; Heffron and McCauley, 2018; Martin, 2017). These three dimensions are widely applied and recognized in the sustainability transition literature (Kaljonen et al., 2021). Several authors mention restorative justice (Hazrati and Heffron, 2021; Robinson and Carlson, 2021; Van Ness and Strong, 2010) and cosmopolitan justice (Jayapalan and Ganesh, 2019; McCauley et al., 2019; Sunio, 2021) as additional justice dimensions. We have decided to integrate the arguments used in these two additional justice dimensions into the dimensions of distributional and recognitional justice, as the underlying sub-dimensions and constructs of restorative and cosmopolitan justice arguments relate to who (and at what geographical scale) should be recognized and on what grounds costs and benefits should be distributed. Equally, the categorization of the sub-dimensions within the three justice dimensions as presented below is based on our understanding of whether a specific sub-dimension primarily relates to argumentations around the distribution of costs and benefits, procedural aspects, or who should receive moral consideration.

2.1. Distributional justice

Distributional justice encompasses perceptions of the justice of how costs and benefits of decisions are distributed within society (Martin, 2017; Rothmund et al., 2016). This includes four sub-dimension: a) *Topics of Distributional Justice* – i.e. whether people think that the right kinds of costs and benefits are considered (Kaljonen et al., 2021; Newell and Mulvaney, 2013; Schlossberg, 2013), b) *Mechanisms of Distributional justice* – i.e. whether the policy instruments used to distribute the costs and benefits are perceived as just (Sterner and Robinson, 2018; Wieliczko et al., 2021), c) *Principle of Distributional Justice* – i.e. whether the underlying principle that is used to decide who should receive what kind of costs and benefit is considered just (Bennett et al., 2019; Jasso et al., 2016; Picachaud, 2008), and d) *Viewpoint of Justice* – i.e. what is used as a vantage point to judge distributional impacts (Schuitema et al., 2011; Schuitema and Bergstad, 2019).

In relation to agricultural transitions, the potential *Topics of Distributional Justice* that have been brought forward can broadly be categorized through the constructs of environmental and socio-environmental costs and benefits such as environmental pollution and access to nature (Martin, 2017; Schlosberg, 2013), food costs and benefits such as food prices and nutritional quality (Cadieux and Slocum, 2015; Holt-Giménez and Shattuck, 2011; Smaal et al., 2020), and economic costs and benefits such as job loss and creation of new jobs (Carlisle et al., 2019; Hedberg, 2021; Newell and Mulvaney, 2013), all of which incorporate both monetary and non-monetary aspects. The *Mechanisms of Distributional Justice* can be categorized along constructs related to the type of policy instruments: financial incentives, financial disincentives, regulations, and guidance and information (Pacheco-Vega, 2020; Sterner and Robinson, 2018). The *Principles of Distributional Justice* can be classified through the constructs of Equality - i.e. distribution so that everyone receives an exactly equal share, Equity and Need - i.e. distribution according to means and need, Entitlement - i.e. distribution according to historic position or right, and Merit - i.e. distribution according to effort (Bennett et al., 2019; Liebig et al., 2016; Piachaud, 2008; Rasinski, 1987; Rothmund et al., 2016). Finally, the *Viewpoint of Justice* in this context can be categorized as Intrapersonal, where people base their perception of justice on how the transition affects them personally compared to how their own life was before the transition, and Interpersonal, where people base their perception of justice on how the transition affects themselves in comparison to how it affects others (Schuitema et al., 2011; Schuitema and Bergstad, 2019). Theoretically, an agricultural transition will thus be perceived as just in terms of distributional justice if it addresses the right selection of topics, through the right kind of policy instruments, with the right underlying principle of distribution, and if the individual is impacted by the change in the right way according to the person making the justice evaluation.

2.2. Procedural justice

Procedural justice encompasses two sub-dimensions: *Degree of Involvement* – i.e. conceptions of the degree of stakeholder involvement in decision making and implementation, and *Principles of Procedural Justice* – i.e. the underlying principles that are used to decide who should get how much influence in the process (Kaljonen et al., 2021; Sabato and Fronteddu, 2020; Vermunt and Steensma, 2016). The *Degree of Involvement* can range from no stakeholder involvement at all to joint government-stakeholder decision-making (Arnstein, 1969; Hurlbert and Gupta, 2015). The *Principles of Procedural Justice* are the same as the principles of distributional justice, but applied to the transition process: Equality – i.e. everyone has the same opportunity to be involved and the same degree of influence in the process, Equity and Need – i.e. those who need it receive support to take part and those who have most at stake receive most influence, Entitlement – i.e. those who have traditionally been most influential in the agricultural sector receive most influence in the transition process based on their historic role, and Merit – i.e. experts receive most influence in the process based on their expertise (Bennett et al., 2019; Liebig et al., 2016; Piachaud, 2008). Theoretically, an agricultural transition will thus be perceived as just in terms of procedural justice if it has the right degree of stakeholder involvement and uses the right underlying principle to decide who should have most influence in the process according to the person making the justice evaluation.

2.3. Recognitional justice

Recognitional justice relates to perceptions on who or what should receive moral consideration in the transition. This includes four sub-dimensions: a) *Stakeholder Inclusion* – i.e. what stakeholders should be considered, b) *Social Inclusion* – i.e. what societal vulnerable groups should be considered, c) *Geographical Scale of Justice* – i.e. what geographical scale should be taken into account, and d) *Knowledge Types* – i.e. what types of knowledge should be recognized as legitimate to build decisions on (Burchardt and Craig, 2008; Kaljonen et al., 2021; Martin et al., 2016; Stevis and Felli, 2020; Velicu and Barca, 2020). *Stakeholder Inclusion* relates to what interests of (potentially impacted) groups should be considered. This could also be extended to include interests of future generations and/or multi-species (Celermajer et al., 2021; Fitz-Henry, 2021; Schlosberg, 2013; Schuitema and Bergstad, 2019; Wieliczko et al., 2021). In the agricultural context, this can then be captured by the constructs of Agricultural, Forestry, and Landowner Interests, Environmental and Future Generations' Interests, Social Interests, and Economic Interests. *Social Inclusion* relates to what societal vulnerable groups should be considered, including the recognition of their cultural practices, pre-existing rights, and identities (Bennett et al., 2019; Crowe and Li, 2020; Smaal et al., 2020). Broadly speaking we can capture these through the constructs of Minorities, Children and Disabled People, and Women. The *Geographical Scale of Justice* can be seen as a scale ranging from local to global and describes the geographical breadth that should be recognized when considering potential costs and benefits and stakeholders to include (Sabato and Fronteddu, 2020; Smaal et al., 2020; Stevis and Felli, 2020; Wieliczko et al., 2021). Finally, *Knowledge Types* in the agricultural context can be broadly categorized as recognizing Scientific Knowledge and/or Local/Traditional Knowledge (Kaljonen et al., 2021; Martin et al., 2016). Theoretically, an agricultural transition will thus be perceived as just in terms of recognitional justice if it considers the

right kind of stakeholders at the right geographical scale, and if decisions are based on the right type of knowledge.

All three of the justice dimensions, as summarized in Fig. 1, are interlinked and influence each other. They can all be an end in and of themselves, but to create an overall just perception of an agricultural transition all three need to be perceived as just (Burchardt and Craig, 2008; Heffron and McCauley, 2018; Martin, 2017; Vermunt and Steensma, 2016).

3. Methods

We chose England as the context for the development of our instrument because an agricultural transition is currently taking place there. This transition has been described by some as "a massive field experiment for CAP reform" (Hill, 2020), indicating that it can function as an example of a transition pathway for other countries to learn from. The main pillar of this transition is a move away from direct payments to farmers based on the amount of land that they manage to payments for efforts undertaken to provide specific public goods such as clean water, clean air, and thriving wildlife (DEFRA, 2020a). This policy shift sits in a wider context of changes to the UK Agriculture Act, (environmental) regulations, available agricultural grants and schemes, and trade agreements (Agriculture Act, 2020; DEFRA2020b; DEFRA, 2021a; DIT, 2022; Environment Act, 2021).

3.1. Instrument development

The questionnaire was designed following broadly the steps as suggested by Robinson (2018). Initial questions and items were generated based on the above operationalisation of the just transition concept. We also aimed to make the items relevant to the English context. Two one-hour workshops were conducted by the lead author, one with six environmental governance researchers and one with five agricultural innovation researchers. These workshops were used to refine the preliminary items by discussing their clarity, whether they captured the various justice aspects, and to identify any missing relevant aspects. After these workshops, the question order and survey layout was designed in Qualtrics Survey Software based on the guidelines by Dillman et al. (2014). The preliminary items were piloted through five cognitive interviews with people from the general public (age range 39–68, three female, two male) and a quantitative pilot with 81 participants (staff and students at [blinded for peer review]). Based on the interview feedback and pilot results, we modified some of the items and shortened the overall questionnaire, resulting in the following instrument:

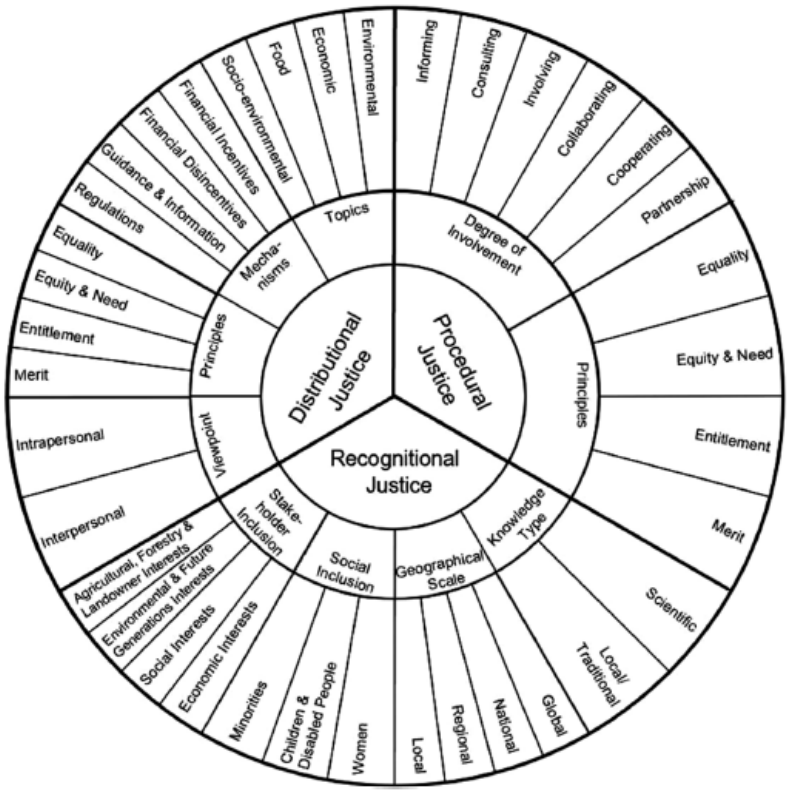

Fig. 1. Proposed underlying dimensions of perceptions of just agricultural transitions.
The inner circle presents the three overarching justice dimensions. Consequent outer circles represent sub-dimensions and their constructs.

3.1.1. Assessing perceptions of distributional justice

Perceptions on *Topics of Distributional Justice* were assessed using 12 items that respondents had to rank from most to least important. This was the only rank-order question; for all other items the respondents were asked to answer on a seven-point Likert Scale. We chose to have this question as rank-order because in the pilot stage we identified that all items were generally perceived as very important and we were not able to capture prioritization of the topics in case of trade-offs between them. By having this question as a rank-order question, we were able to assess relative importance of the topics to each other. Topics covered were based on aspects that are discussed in the agricultural transition, food justice, and environmental justice literature (e.g. Cadieux and Slocum, 2015; Carlisle et al., 2019; Holt-Giménez and Shattuck, 2011; Schlossberg, 2013) and that were identified in the workshops. Exact wording of these and all other items can be found in Appendix A Table A.1.

Perceptions on *Mechanisms of Distributional Justice* – i.e. Financial (dis)incentives, Regulations, and Guidance and Advice, were assessed with 25 items which were developed based on currently existing and proposed policy instruments. These were derived from policy documents (e.g. Agriculture Act, 2020; DEFRA, 2020a, 2020b, 2020c, 2021b; HM Government, 2018), public debates on how to potentially create change in the agricultural sector (e.g. UK Parliament, n.d.; DEFRA, 2018), and the workshops. For the wording of the items, we aimed to capture the mechanism behind the policy instrument, rather than exact details, to be able to cover as broad a range as possible in the types of policy instruments that could be deployed in support of agricultural transitions. For each of these items, respondents were asked to indicate to what extent they agreed or disagreed that the guidance of agricultural change by the government would be just if this policy instrument were to be implemented.

Perceptions on the *Principles of Distributional Justice* were assessed using 12 items, three for each principle. These items were inspired by the Basic Social Justice Orientation Scale (Liebig et al., 2016) and the work by Rasinski (1987) and Bennet et al. (2019) but adapted to agricultural transitions and our conceptualisation of the distributional principles. Here, respondents were asked to indicate the extent to which they agreed or disagreed that a certain way of distributing cost and benefits of agricultural change is just.

Perceptions on the *Viewpoint of Justice* were assessed with six items that were inspired by the work of Schuitema and Bergstad (2019) and Schuitema et al. (2011) and adapted to the context of agricultural transitions. Here, respondents were asked to indicate how important or unimportant they find it for the justice of agricultural transitions how they themselves are impacted by the consequences of the changes compared to how others are impacted.

3.1.2. Assessing perceptions of procedural justice

Perceptions on the *Degree of Involvement* were assessed using six items, inspired by Arnstein's (1969) classic typology of citizen participation. Respondents were asked for each of the items to indicate to what extent they agreed or disagreed that they were important for the justice of agricultural change.

Perceptions on the *Principles of Procedural Justice* were assessed similarly as the perceptions on the *Principles of distributional justice* with 12 items, but now applied to what principle is just in deciding who should have most influence in the process of designing agricultural transitions.

3.1.3. Assessing perceptions of recognitional justice

Perceptions on *Stakeholder Inclusion* were assessed with 24 items. Each item described a different potential type of stakeholder group and respondents were asked to indicate to what extent the interests of these specific stakeholders should be taken into account in order for the agricultural transition to be just. To reflect the English context, the type of stakeholders listed was based on self-proclaimed stakeholders who are publicly listed as having given input to the process leading up to the UK Agriculture Act (UK Parliament, 2020) and consultation on proposed post-Brexit agricultural policy (DEFRA, 2018). If this survey is to be used in a different context, this list should be revised to reflect the potential stakeholders in that specific setting. In addition, we added future-generations, nature, farm-animals, and wild-animals to this list to reflect the scientific debate of these stakeholders deserving moral consideration (Celermajer et al., 2021; Fitz-Henry, 2021) and we allowed respondents to add any additional stakeholders if they wished to do so. Following typical groupings of different stakeholder interests this approach meant that we included seven items for Agricultural, Forestry, and Landowner Interests, six items for social interests, five items for economic interests, and six items for environmental and future generations' interests.

Perceptions on *Social Inclusion* were assessed with eight items. Here, we focussed on specific societal groups that are generally considered to be vulnerable and therefore might require additional consideration. We included three items for Minorities, two items for Children and Disabled People and two items for Sexes. Initially we only included 'women' as an item, but following the pilot we also added an item for 'men' in this question as all participants in the cognitive interviews indicated that they found it strange that women were listed but not men.

Perceptions on the *Geographical Scale of Justice* were assessed with four items, one for each geographical scale ranging from local-regional-national-global. The wording of these items were specified for the English context and should be adapted if the survey is used in a different setting. The respondents were asked to indicate how important or unimportant they find it for the justice of agricultural transitions that potential consequences at each geographical scale are taken into account.

Perceptions on the recognition of *Knowledge Types* were assessed with two items: one for Scientific Knowledge and one for Local/Traditional Knowledge adapted from the Food and Agriculture Organization of the United Nations' (FAO, 2004) definition. Respondents also had the opportunity to add additional knowledge types if they wished to do so. The respondents were asked to indicate how much or little the government should take these types of knowledge into consideration for decision-making to be just.

For all questions, all items were shown in random order to minimize systemic bias resulting from item-ordering (Wilson and Lankton, 2012; Wilson et al., 2017). We further also included questions related to the respondents' background and we asked

respondents to indicate how important or unimportant they find it that agricultural transitions are just.

3.2. Data collection and sample

Data were collected using an online survey, which was distributed to a Qualtrics panel of adults (18+) living in England. We aimed to collect a representative sample with a sample size of 400, taking account of age, gender, education, income, and distribution across England. Attempted responses were terminated when a quota in a certain group was met ($n = 8023$), when the respondent was younger than 18 ($n = 62$), or when they were speeding through the survey ($n = 526$). Further responses were excluded based on duplication ($n = 176$), straight lining ($n = 183$), or partial response ($n = 3755$). The survey was live collecting responses between January – April 2022, until a representative sample of 400 was reached. See Appendix A Table A.2. for a breakdown of our sample distribution compared to the English population distribution and [blinded for peer review] for access to the full dataset and a representation of the full survey layout.

3.3. Data analysis

As this study represents the development of a new instrument, we took a combined explorative and confirmative approach, following broadly the steps as suggested by Boateng et al. (2018), Robinson (2018), and Spector (1992). All analyses were conducted in RStudio version 1.4.1717 (Rstudio Team, 2021) using the packages lavaan (Roseel, 2012) and psych (Revelle, 2022).

First, we examined mean values, standard deviations, Mardia's skewness and kurtosis, and the Henze-Zirkler multivariate normality test to determine whether the normality assumption was met, which was not the case. We also examined the suitability of the data for factor analysis with the Kaiser-Meyer-Olkin (KMO) test, where values above 0,70 indicate that the data are suitable (Worthington and Whittaker, 2006; Watkins, 2018).

Second, we assessed Cronbach alpha and conducted EFA. Cronbach alpha is a measure of scale reliability (internal consistency reliability), with values of 0,70 or above generally stated as the cut-off value, but with some room for leeway (Bagozzi and Yi, 2012; Taber, 2018). EFA can be used to empirically identify the factor structure, which is especially useful when aiming to examine the latent factors that account for shared variance between items. We used common factor analysis, MinRes as estimation method as this does not require the fulfilment of specific distributional assumptions, and oblimin as factor rotation method as the nature of the constructs makes it highly likely that the factors are correlated (Worthington and Whittaker, 2006; Watkins, 2018). Our goal with this part of the analysis was to identify whether the factors that we expected to be present in the data based on theoretical understanding of the dimensions, sub-dimensions, and constructs related to perceptions of justice would appear or whether the empirical data would suggest potentially alternative factors. As criteria for factor retention we used a combination of the Kaiser's criterion (where factors with an Eigenvalue of <1 are retained), examination of the scree plot, parallel analysis, and theoretical sense (Kahn, 2006). Criteria used to determine item deletion or retention were based on item loadings and cross-loadings, as well as Cronbach alpha if item is dropped (Worthington and Whittaker, 2006). This was an iterative process in which individual items were retained or deleted, followed by another EFA and examination of Cronbach alpha values, until a stable, satisfactory factor structure was identified.

Third, we conducted Confirmatory Factor Analysis (CFA) and examined the average variance extracted (AVE) to assess construct validity, with AVE values of 0,50 or higher considered being acceptable (Hair et al., 2019; Lockwood et al., 2015). We used a robust version of the maximum likelihood estimator with scaled test statistics (equal to Yuan Bentler) and robust standard errors (Huber--White) (Maydeu-Olivares, 2017; Rosseel, 2014). To assess construct reliability we examined Raykov's rho coefficient, where values should ideally be above 0,70 (Hair et al., 2014; Peterson and Kim, 2013; Raykov, 2001). To assess discriminant validity we examined the Fronell-Larcker Criterion, where the square root of AVE of a construct needs to exceed the correlation of the construct with the other constructs (Mat Roni and Djajadikerta, 2021).

In the instances where the EFA models differed from what we had expected based on theory, we compared CFA models following the factor structure as identified through the EFA with CFA models following the factor structure as proposed by prior theoretical assumptions. In the next step, we continued with the CFA model that performed best in terms of AVE and construct reliability.

For three of the sub-dimensions, *Topics of Distributional Justice*, *Geographical Scale of Justice*, and *Knowledge Types*, we did not conduct EFA and CFA as this was deemed inappropriate based on how the question and items related to these sub-dimensions were designed. Instead, for the items related to *Topics of Distributional Justice* and the items related to *Geographical Scale of Justice* we conducted the Friedman Test to determine whether there was a significant difference between the ranking or rating of the items (Pimentel et al., 2016), Kendall's W to assess the strength of the difference (Field, 2005), and the Wilcoxon Signed Rank Test to identify which items grouped together, i.e. did not have a significant difference between them (Smalheiser, 2017). For the items related to *Knowledge Types* we only conducted the Wilcoxon Signed Rank test as there were only two items to examine. For all three sub-dimensions we also examined mean values and standard deviations, and for the *Knowledge Types* items we examined a combined frequency table.

Finally, to illustrate the usefulness of this tool in a policy context and to give results on which justice constructs and sub-constructs are important in the English case, we created summated rating scales for the sub-constructs and constructs by calculating the weighted summated mean (DiStefano et al., 2009; Robinson, 2018).

4. Results

4.1. Reliability and validity of developed scales

We present here the results of the final EFA models that we took forward for further analysis followed by the CFA results.

4.1.1. Distributional justice constructs

Principles of Distributional Justice (KMO= 0,81). As the items related to the constructs of Equity and Need and Entitlement were unstable, the final EFA model that we took forward for further analysis only consisted of the Equality and Merit items. Including only these items resulted in a two-factor solution. Both factors together explained 43% of variance, with the Equality factor explaining 24% of variance and the Merit factor explaining 18% of variance. Cronbach alpha was 0,72 (95% CI= 0,68 – 0,77) for the Equality factor and 0,63 (95% CI= 0,57 – 0,69) for the Merit factor.

Mechanisms of Distributional Justice (KMO= 0,91). The EFA revealed a different structuring of the items than what we had anticipated based on the theory: rather than items grouping together based on policy instrument type, they grouped together based on their policy focus, with three main themes which make theoretically sense: a focus on the Environment and Animal Welfare, a focus on Social Support, and a focus on Reducing Agriculture. Three items were excluded based on their poor factor loadings and reliability scores. One of these items was a reversed item and the data indicated that the respondents did not realize this. The three factors together explained 44% of variance, with the Environment and Animal Welfare factor explaining 23% of variance, the Social Support factor explaining 12%, and the Reducing Agriculture factor explaining 9%. Cronbach alpha was 0,89 (95% CI= 0,88 – 0,91) for the Environment and Animal Welfare factor, 0,79 (95% CI= 0,76 – 0,82) for the Social Support factor, and 0,76 (95% CI= 0,72 – 0,79) for the Reducing Agriculture factor. Due to the alteration in what we are assessing, we will henceforward refer to this sub-dimension as *Policy Focus of Distributional Justice*.

Viewpoint of Distributional Justice (KMO= 0,80). As conducting EFA with MinRes as estimation method was not appropriate here, we used WLS as estimation method for this construct. The EFA revealed a different factor structure than we had anticipated based on the theory. On closer examination of the item wordings this structure was logical, but assesses a different aspect than we intended: instead of assessing intrapersonal versus interpersonal viewpoints, the factors as revealed by the EFA assess perceptions on personal impact: whether an agricultural transition results in improvement of the own situation (Self-Improvement) or whether it does not make one's own position worse (Not-Worsening). These two factors, which we took forward in further analysis, together explained 0,65% of variance, with the Self-Improvement factor explaining 21% of variance and the Not-Worsening factor explaining 43% of variance. Cronbach alpha was 0,73 (95% CI= 0,68 – 0,78) for the Self-Improvement factor and 0,86 (95% CI= 0,84 – 0,88) for the Not-Worsening factor. Due to the alteration in what we are assessing, we will henceforth refer to this sub-dimension as *Personal Impact*.

4.1.2. Procedural justice constructs

Principles of Procedural Justice (KMO= 0,82). The final EFA model that we took forward for further analysis was exactly as expected based on the theory. This four-factor solution together explained 56% of variance, with the Equality factor explaining 15%, the Equity and Need factor explaining 10%, the Entitlement factor explaining 17%, and the Merit factor explaining 15%. Cronbach alpha was 0,79 (95% CI= 0,75–0,82) for the Equality factor, 0,63 (95% CI= 0,56–0,69) for the Equity and Need factor, 0,83 (95% CI= 0,80–0,86) for the Entitlement factor, and 0,81 (95% CI= 0,78–0,84) for the Merit factor.

Degree of Involvement (KMO= 0,91). EFA revealed that there was only one factor. Based on the theory we had expected that there would be at least two factors (with items expressing activities with lower degrees of involvement and those expressing higher degrees of involvement creating separate factors). However, as all items were expressions of different kinds of stakeholder involvement, it is also theoretically sensible to address all these items under a single sub-dimension of *Degree of Involvement*, where agreeing more with an item indicates being in favour of higher degrees of involvement. This single-factor solution explained 62% of variance and Cronbach alpha was 0,91 (95% CI= 0,89 – 0,92).

4.1.3. Recognitional justice constructs

Subject of Justice – Stakeholder Inclusion (KMO= 0,94). The final EFA model that we took forward for further analysis was a reduced version from what we had expected based on theory. It was a two-factor solution with a reduced number of items which together explained 45% of variance. One factor related to Farmer, Environmental, & Future Generations' Interests and explained 22% of variance, whilst the other factor related to Social and Economic Interests and explained 23% of variance. Cronbach alpha was 0,85 (95% CI= 0,82 - 0,87) for the Farmers, Environment, & Future Generations' Interests factor, and 0,85 (95% CI= 0,83 – 0,87) for the Social and Economic Interests Factor.

Subject of Justice – Social Inclusion (KMO= 0,89). The final EFA model was exactly as we expected based on the theory. It provided a three-factor solution which together explained 76% of variance. The factor related to Minorities explained 31% of variance, the factor related to Children and Disabled People explained 20% of variance, and the factor related to Sexes explained 25% of variance. Cronbach alpha was 0,88 (95% CI= 0,86–0,90) for the Minorities factor, 0,84 (95% CI= 0,80–0,87) for the Children and Disabled People factor, and 0,88 (95% CI= 0,86–0,91) for the Sexes factor.

4.1.4. CFA results

For all models where the EFA suggested a different factor structure than what was expected based on theory, the CFA model following the EFA factor structure outperformed the CFA model following the factor structure based on theory, apart from the model

Table 1
CFA model results with weighted summated means, standard deviation, completely standardized factor loadings (λ), Z-values, Cronbach's Alpha (α), and α if an item is dropped.

Item code	Dimensions, Sub-Dimensions, Constructs, & Items	M*	SD	λ**	Z-value	α if item is dropped
	Perceptions of Distributional Justice					
	Policy Focus[b]					
	To guide agricultural change in a way that is just, the government needs to…					
	Environment & Animal Welfare (α= 0,89)	1,56	0,87			
M_FD_1	… *set penalties on environmentally harmful practices.*			0,65	[a]	0,88
M_FD_2	… *set taxes on pesticides, fungicides, and herbicides.*			0,60	11,17	0,89
M_GI_1	… *support farmers and farm workers with advice and guidance to use more sustainable practices.*			0,68	10,40	0,88
M_GI_2	… *provide information to consumers on the environmental impact of specific types of food and food waste.*			0,70	11,55	0,88
M_GI_4	… *provide positive recognition for environmentally friendly farmers (e.g. through sustainability certificates).*			0,67	9,38	0,88
M_R_1	… *set strict environmental regulations.*			0,67	11,25	0,88
M_R_2	… *ban the use of environmentally harmful substances such as herbicides, pesticides, and fungicides.*			0,68	10,51	0,88
M_R_3	… *set legally binding targets for the maximum level of harmful substances in the soil, air, and water.*			0,64	9,69	0,88
M_R_6	… *set strict environmental regulations on imported food.*			0,58	10,99	0,89
M_R_7	… *create strict regulations for animal welfare.*			0,72	9,63	0,88
M_R_8	… *create strict regulations for the preventive use of antibiotics for farm animals.*			0,52	8,71	0,89
M_R_10	… *set regulations so that negative environmental impacts are compensated by improving the environment elsewhere.*			0,62	10,26	0,88
	Social (α= 0,79)	1,31	0,92			
M_FI_1	… *pay farmers public money to provide public goods (e.g. clean water, thriving wildlife, etc.).*			0,58	[a]	0,77
M_FI_3	… *provide subsidies or similar financial support to people who can't afford to buy sufficient food.*			0,59	7,30	0,76
M_FI_6	… *pay grants to farmers for innovation and adaptation to the change.*			0,65	8,90	0,76
M_FI_7	… *financially support farmers and farm workers who lose their job due to the change.*			0,69	7,74	0,74
M_GI_3	… *provide training to farmers and farm workers who want to stop farming and move to a different job.*			0,61	7,60	0,76
M_GI_5	… *support farmers and farm workers with training to move to a different job when they lose their job due to the change.*			0,63	6,64	0,76
	Reducing Agriculture (α= 0,76)	−0,50	1,30			
M_FI_4	… *buy out farmers from their farms to reduce the number of agricultural businesses in the country.*			0,84	[a]	0,62
M_FI_5	… *pay older farmers to stop farming so that younger farmers can take over.*			0,49	8,95	0,77
M_R_4	… *exclude land from agricultural use.*			0,57	10,94	0,74
M_R_9	… *revoke farm licenses to reduce the number of farms.*			0,78	15,83	0,64
	Principles of Distributional Justice[b]					
	Change in agriculture is just if…					
	Equality (α= 0,72)	0,52	1,21			
DP_Equal_1	… *everyone carries the same amount of costs to create the change, regardless of their circumstances.*			0,69	[a]	0,64
DP_Equal_2	… *everyone receives the same amount of benefits from the change, regardless of their circumstances.*			0,61	7,75	0,68
DP_Equal_3	… *it distributes the costs and benefits of the change so that everyone carries the same costs and benefits.*			0,76	8,52	0,59
	Merit (α= 0,63)	1,04	0,95			
DP_M_1	… *those who put more effort into the change receive more of the benefits of the change.*			0,61	[a]	0,50
DP_M_2	… *those who put in least effort to bring about the change carry most of the costs of the change.*			0,53	7,19	0,57
DP_M_3	… *it distributes the costs and benefits of the change based on the efforts that people undertake to create the change.*			0,67	9,03	0,52
	Personal Impact[c]					
	Changes in agriculture…					
	Self-improvement (α= 0,73)	0,88	1,15			
VJ_Intra_2	… *improve my living circumstances compared to what they were before.*			0,95	[a]	0,55
VJ_Inter_2	… *improve my living circumstances in comparison to others.*			0,61	6,26	0,60
	Not-worsening (α= 0,86)	1,34	1,09			
VJ_Intra_1	… *do not make my position in life worse than it was before.*			0,85	[a]	0,80
VJ_Intra_3	… *do not make my living circumstances worse than they were before.*			0,79	15,57	0,82
VJ_Inter_1	… *do not make my own living circumstances worse than those of others.*			0,78	14,25	0,82
VJ_Inter_3	… *do not affect my living circumstances more negatively than those of others.*			0,71	11,80	0,84
	Perceptions of Procedural Justice					
	Degree of involvement[b] *(α = 0,91)*	*1,41*	*0,99*			
	For agricultural change to be just, the government needs to …					
DI_1	… *inform stakeholders about the decisions government is taking.*			0,75	[a]	0,89
DI_2	… *invite stakeholders to express their views on government decisions before the decisions are taken.*			0,83	16,16	0,89

(continued on next page)

Table 1 (*continued*)

Item code	Dimensions, Sub-Dimensions, Constructs, & Items	M*	SD	λ**	Z-value	α if item is dropped
DI_3	*...invite stakeholders to give advice on what decisions the government should take.*			0,79	11,95	0,89
DI_4	*... involve stakeholders in the decision-making and implementation of decisions.*			0,81	13,83	0,89
DI_5	*...actively include stakeholders in setting the goals for change.*			0,78	13,67	0,89
DI_6	*...make decisions jointly with the stakeholders.*			0,76	9,92	0,89
	Principles of Procedural Justice[b]					
	An agricultural change process is just when...					
	Equality (α= 0,79)	0,78	1,22			
PP_Equal_1	*... everyone is involved in the same way, regardless of how much they will be affected by the change.*			0,70	[a]	0,74
PP_Equal_2	*... everyone's views are taken into account in the same way.*			0,73	11,64	0,71
PP_Equal_3	*... everyone has the same influence over decision-making.*			0,80	8,96	0,69
	Equity & Need (α= 0,63)	0,79	1,03			
PP_EN_1	*... those stakeholders who do not have sufficient resources to take part receive support to participate.*			0,41	[a]	0,66
PP_EN_2	*... the views of stakeholders who will be most affected by the change are taken into account most.*			0,74	5,99	0,34
PP_EN_3	*... those stakeholders who have more at stake in the change receive most influence on decision-making.*			0,68	3,65	0,54
	Entitlement (α= 0,83)	0,64	1,14			
PP_Ent_1	*...the views of those who have historically been influential in agriculture are taken into account most.*			0,74	[a]	0,79
PP_Ent_2	*...those who have historically been most influential in agriculture have most influence on decision-making.*			0,81	12,38	0,76
PP_Ent_3	*... those who have historically been most influential in agriculture receive most opportunities to be involved.*			0,81	13,08	0,74
	Merit (α= 0,81)	1,08	1,04			
PP_M_1	*... experts on agriculture have most influence in deciding the direction of change.*			0,77	[a]	0,74
PP_M_2	*... the views of experts on agriculture are taken into account most.*			0,73	12,77	0,75
PP_M_3	*...experts on agriculture have most influence on decision-making.*			0,79	12,53	0,72
	Perceptions of Recognitional Justice					
	Stakeholder Inclusion[d]					
	In order for agricultural change to be just, to what extent should the interests of the following stakeholders and the way they may be affected by the change be taken into account?					
	Agricultural Interests (α= 0,76)	0,81	0,85			
SJ_1	*Farmers*			0,49	[a]	0,74
SJ_4	*Agricultural educational institutions*			0,70	6,83	0,70
SJ_5	*Commoners (people who have the right to let their livestock graze on common/shared land)*			0,56	6,42	0,74
SJ_18	*Stakeholders focusing on social wellbeing of farmers*			0,78	7,27	0,66
SJ_19	*Stakeholders focusing on food availability, affordability, and nutritional quality*			0,60	7,35	0,71
	Environmental & Future Generations' Interests (α= 0,84)	1,17	0,94			
SJ_6	*Environmental organisations*			0,65	[a]	0,82
SJ_15	*Stakeholders focusing on animal welfare*			0,70	12,77	0,82
SJ_21	*Future generations*			0,61	10,31	0,83
SJ_22	*Farm-animals*			0,71	11,02	0,81
SJ_23	*Wild-animals*			0,70	11,42	0,81
SJ_24	*Nature*			0,73	11,27	0,80
	Social Interests (α= 0,74)	0,55	0,93			
SJ_13	*Stakeholders focusing on historical heritage*			0,67	[a]	0,66
SJ_14	*Stakeholders focusing on human health*			0,64	11,12	0,69
SJ_16	*Stakeholders focusing on recreation (e.g. access to land for walking or quality of water for swimming)*			0,63	13,51	0,68
SJ_17	*Stakeholders focusing on interests of rural life*			0,63	10,74	0,68
	Economic Interests (α= 0,79)	0,24	0,94			
SJ_7	*Supermarkets*			0,70	[a]	0,73
SJ_8	*Agricultural consultants*			0,65	11,38	0,77
SJ_9	*Trade organisations*			0,62	10,16	0,75
SJ_10	*Fertilizer and seed/crop industry*			0,69	14,00	0,76
SJ_20	*Stakeholders focusing on food processing and packaging*			0,64	9,45	0,75
	Social inclusion[d]					
	In order for agricultural change to be just, to what extent should the interests of the following societal groups and the way they may be affected by the change be taken into account?					
	Minorities (α= 0,88)	−0,18	1,39			
SI_3	*Transgender*			0,81	[a]	0,86
SI_4	*Ethnic minorities*			0,90	20,10	0,81
SI_5	*Religious minorities*			0,84	20,00	0,83
	Children & Disabled People (α= 0,84)	0,43	1,33			
SI_6	*Children/Youth*			0,82	[a]	0,71
SI_7	*Disabled people*			0,88	17,09	0,73
	Sexes (α= 0,88)	0,35	1,30			
SI_1	*Women*			0,92	[a]	0,82
SI_2	*Men*			0,86	20,55	0,76

* Weighted summated mean; calculated with the completely standardized factor loadings.
** Completely standardized factor loadings derived from a confirmatory factor analysis based on Yuan-Bentler correction for multivariate non-normality. All factor loadings are significant at $p < 0{,}001$.
[a] Z-values were not calculated as unstandardized loading of this indicator was set to 1,0 to control construct variance.
[b] Items have been measured on a 7-point Likert Scale, where −3 = Strongly disagree, −2 = Disagree, −1 = Somewhat disagree, 0 = Neutral, 1 = Somewhat agree, 2 = Agree, 3 = Strongly agree.
[c] Items have been measured on a 7-point Likert Scale, where −3 = Very Unimportant, −2 = Unimportant, −1 = Somewhat unimportant, 0 = Neutral, 1 = Somewhat important, 2 = Important, 3 = Very important.
[d] Items have been measured on a 7-point Likert Scale, where −3 = Not at all, −2 = Very little, −1 = Little, 0 = To a moderate extent, 1 = High, 2 = Very High, 3 = Highest priority.

for *Stakeholder Inclusion*. For the CFA model for *Stakeholder Inclusion* an adapted version of the theory-based model performed best. This model excluded items referring to stakeholders who do not clearly fit into a single construct (e.g. landowners or general society). Below we describe the results for the best performing CFA models.

All items had highly significant ($p<0{,}001$) completely standardized factor loadings between 0,41 – 0,95, with the majority exceeding 0,60. Details are shown in Table 1. Appendix A Table A.5. provides the construct correlations, AVEs and composite reliability (CR) estimates. Due to the low AVE and CR values for the construct of Merit (AVE= 0,36; CR= 0,62) in the sub-dimension *Principles of Distributional Justice* we exclude this construct from further analysis. For all others the Cronbach alpha and construct reliability estimates equal or exceed 0,65, with only the reliabilities for the construct of Equity and Need in the sub-dimension *Principles of Procedural Justice* falling below 0,70 (α= 0,63; CR= 0,65). These results indicate good reliability and convergent validity of our instrument. However, the AVE for the Equality *Principle of Distributional Justice* (AVE= 0,47), the three *Policy Focus* constructs (AVE= 0,41 for Environment and Animal Welfare; AVE= 0,39 for Social Support; AVE= 0,47 for Reducing Agriculture), the Equity and Need Principle of Procedural Justice (AVE= 0,40), and the four *Stakeholder Inclusion* constructs (AVE= 0,41 for Agricultural Interests; AVE= 0,47 for Environmental and Future Generations' Interests; AVE= 0,41 for Social Interests; AVE= 0,44 for Economic Interests) fall below the generally accepted minimum threshold of 0,50. In addition, the Fronell-Larcker Criterion indicates discriminant validity for all constructs except the constructs of Agricultural Interests, Social Interests, and Economic Interests in the sub-dimension of *Stakeholder Inclusion*. These results indicate that further research is required to improve the items used to assess these constructs.

4.2. Differences in justice perceptions of topics of distributional justice, geographical scale of justice, and knowledge types

Topics of Distributional Justice. The Friedman test showed that the items assessing perceptions related to the Topics of Distributional Justice were statistically significantly different, $\chi^2(11)= 544$, $p<0{,}001$, but the effect size is small ($W = 0{,}12$). Pairwise Wilcoxon signed rank test in combination with an assessment of the correlation matrix (see Appendix A Fig. A.1. and Table A.3. for details) revealed that there is some variation between these items but that there is no clear pattern visible. The topic 'food is affordable' received the highest mean rank ($M = 8{,}31$), closely followed by 'food is sufficiently available for all' ($M = 8{,}30$). The topic 'public access to nature is increased' received the lowest mean rank ($M = 4{,}55$). Further research is needed to indicate whether there really is no clear pattern or whether this result was caused by other aspects such as item formulation and question type. Because of this we excluded this sub-dimension from further analysis.

Geographical Scale of Justice. The Friedman test showed that the items assessing perceptions related to the Geographical Scale of Justice were statistically significantly different, $\chi^2(3)= 113$, $p<0{,}001$, but the effect size is small ($W = 0{,}09$). Pairwise Wilcoxon signed rank test revealed that only the item corresponding to a global scale differed significantly from the other items, with the global scale receiving less consideration ($M = 1{,}29$, compared to local $M = 1{,}86$, regional $M = 1{,}83$, and national $M = 1{,}87$) (see Appendix A Fig. A.2. and Table A.4. for details).

Knowledge Types. Pairwise Wilcoxon signed rank test revealed that there is a statistically significant difference between perceptions on Scientific Knowledge and Local/Traditional Knowledge ($p<0{,}001$), with Local/Traditional knowledge being valued higher than Scientific Knowledge. Table 2 indicates however that most respondents (62,75%) perceive the inclusion of both of these knowledge types simultaneously as important for the justice of agricultural transitions.

Table 2
Combined frequency of required degree of consideration of knowledge types for a just perception of an agricultural transition.

		Scientific Knowledge							
		Not at all	Very little	Little	Moderate	High	Very high	Highest priority	TOTAL
Local knowledge	Not at all	0,25%	0,25%	0,25%	0,00%	0,25%	0,00%	0,00%	1,00%
	Very little	0,50%	0,00%	0,00%	0,50%	0,00%	0,00%	0,00%	1,00%
	Little	0,25%	0,50%	1,00%	1,25%	0,75%	0,50%	0,00%	4,25%
	Moderate	0,00%	0,00%	1,00%	10,25%	3,25%	1,50%	0,25%	16,25%
	High	0,00%	0,50%	0,75%	7,75%	14,75%	4,25%	0,75%	28,75%
	Very high	0,00%	0,25%	0,50%	3,75%	11,00%	9,50%	6,00%	31%
	Highest priority	0,25%	0,00%	0,00%	1,00%	3,75%	8,00%	4,75%	17,75%
	TOTAL	1,25%	1,50%	3,50%	24,50%	33,75%	23,75%	11,75%	100%

4.3. Justice perceptions in the English context

Combining the results of our English sample into a summated scale based on weighted means can give us an insight into what the English society perceives as important for the justice of an agricultural transition and thereby support the governance of such a transition. Here we only included the constructs that showed adequate reliability and validity in the preceding analysis, but once the instruments to assess the other constructs have been improved through future research, they can be used in a similar manner.

As Fig. 2 and Table 1 show, in regard to distributional justice, our study indicates that a distribution of costs and benefits based on the Equality principle (weighted $M = 0{,}52$), with a focus on policy instruments that target Environmental and Animal Welfare improvement (weighted $M = 1{,}56$) as well as the provisioning of Social Support to farmers and consumers (weighted $M = 1{,}31$), and which does Not-Worsen peoples living circumstances (weighted $M = 1{,}34$) will likely be regarded as just by the English society. Note however that we were not able to adequately assess other *Principles of Distributional Justice*, which leaves open the possibility that the other principles could potentially be regarded as more just than the Equality principle.

In regard to procedural justice, our results indicate that using a combination of the Equality, Entitlement and Merit principles as inclusion criteria will likely be regarded as just, with most emphasis being placed on Merit (weighted $M = 1{,}08$, compared to weighted $M = 0{,}78$ for Equality and weighted $M = 0{,}64$ for Entitlement). Furthermore, including stakeholders in the governance process of the agricultural transition (weighted $M = 1{,}41$) increases perceptions of the justice of the transition.

In regard to recognitional justice, our results indicate that, in order to increase perceptions of justice, the consequences of the

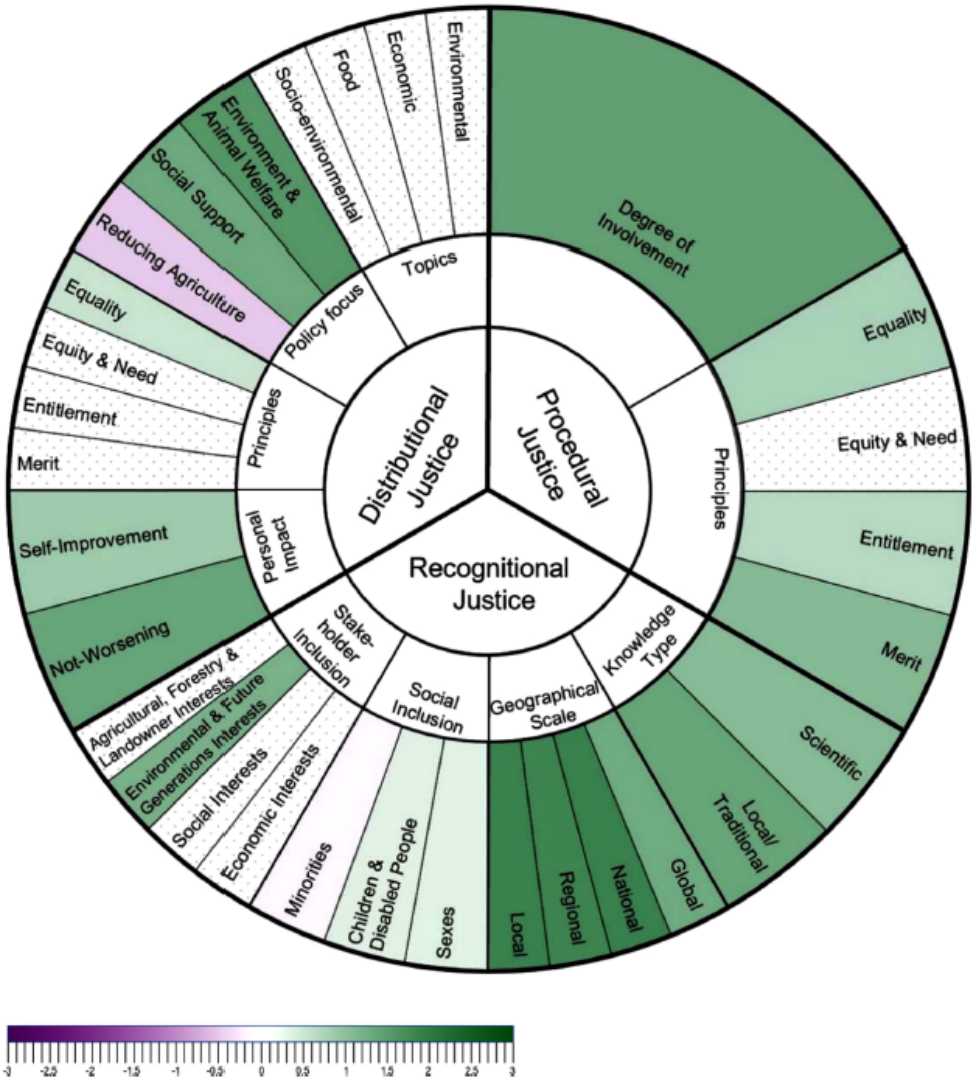

Fig. 2. Summary of the underlying dimensions of English Justice Perceptions on Agricultural Transitions based on weighted summated means. Scale ranging from −3 (not at all important) to 3 (highly important).
Nb.: Constructs marked with a dotted pattern are constructs that need further development.

transition for Children and Disabled People (weighted $M = 0,43$) as well as Sexes (i.e. women and men in general) (weighted $M = 0,35$) should receive specific consideration and attention should be paid to the interests of stakeholders representing the Environment and Future Generations (weighted $M = 1,17$) when making decisions in relation to the agricultural transition. Note here that we were not able to adequately assess perceptions on potential other stakeholder interests, so that we cannot make any statements related to those. In addition, whilst the general consequences need to be considered on all *Geographical Scales*, the Local, Regional, and National scale should be given most attention and during the decision-making process both Scientific and Local/Traditional Knowledge should be considered, with most emphasis being placed on Local/Traditional Knowledge.

Overall, the majority of our respondents thought that the justice of agricultural transitions is to some degree important: 34,00% found it very important, 33,50% found it important, and 16,00% found it somewhat important. The other respondents saw it either as neutral (11,25%), somewhat unimportant (0,75%), unimportant (0,75%), or very unimportant (3,75%), indicating that paying attention to justice perceptions in the governance of an agricultural transition in England is a valuable undertaking.

5. Discussion

In this study we aimed to develop an instrument that can assess societal justice perceptions in relation to agricultural transitions by gaining insight into the underlying dimensions on which people base their justice evaluations. Rather than abiding by a predefined, normative interpretation of what justice is, we built our instrument around central dimensions, sub-dimensions, and constructs on which interpretations of justice are generally based. As the results section showed, we were able to develop an instrument that assesses several constructs with adequate reliability and validity: a) in relation to distributional justice we were able to assess perceptions on the principle of Equality, the policy foci of Environment and Animal Welfare, Social Support, and Reducing Agriculture, and the personal impacts of Self-Improvement and Not-Worsening, b) in relation to procedural justice we were able to assess perceptions on the principles of Equality, Entitlement, and Merit, and the Degree of involvement, and c) in relation to recognitional justice we were able to assess perceptions on the inclusion of interests of Environmental- and Future Generations' stakeholders, the social inclusion of Minorities, Children and Disabled People, and Sexes, as well as the Geographical Scale that should be considered and the Knowledge Types on which decisions should be built.

For five of these constructs, related to the sub-dimensions of *Policy Focus* and *Personal Impact*, the empirical material suggested different constructs than what we had initially intended. For the sub-dimension of *Policy Focus* we had set out to assess the sub-dimension of *Policy Mechanism* with related policy instrument types as constructs. This could be an indication that policy focus is perceived as being more important for justice perceptions than the type of policy instrument that is used to fulfil a certain policy focus, as our respondents focused on that aspect of the items when answering. However, to gain more clarity in this regard it would be valuable for the further development of this instrument if a set of items would be developed that separate out the policy instrument type from the policy focus and vice versa. We had not done that here as we aimed to include policy instruments that are actually being discussed for use to bring about agricultural transitions and because making this separation would mean a considerable increase in length of the instrument. In regard to the *Personal Impact* sub-dimension and its related constructs we had originally intended to assess the *Viewpoint of Distributional Justice* (Intrapersonal versus Interpersonal). From previous studies that are not related to agriculture we know that this distinction plays a role in perceptions of justice in relation to environmental policies (Schuitema et al., 2011; Schuitema and Bergstad, 2019). Further development of our instrument should thus focus on developing items that can more clearly make a distinction between the *Viewpoint of Distributional Justice* and *Personal Impact* in order for both of these sub-dimensions to be captured.

For one of the sub-dimensions, *Degree of Involvement*, we were able to assess the general direction of degree of involvement, but were unable to capture a gradient of detailed levels of involvement. One potential reason for this is that for people who do not work with governance processes on a regular basis it could be difficult to grasp some of the implications and nuances between the items that we had formulated. As insights into perceptions on a detailed gradient of involvement would provide additional information that is highly relevant for the governance of agricultural transitions, we suggest that future research should focus on developing a number of items for each potential level of stakeholder involvement where the implications and differences between them from a practical point of view are clearer.

There were also a number of constructs that we were unable to reliably assess with the items that we have developed: the *Distributional Principles* of Equity and Need, Entitlement, and Merit, the *Procedural Principle* of Equity and Need, constructs related to *Distributional Topics*, and the *Inclusion of Stakeholders* with Agricultural Interests, Social Interests, and Economic Interests. In regard to the three *Inclusion of Stakeholders* constructs, we suspect that by aiming to include all potential stakeholders in an English agricultural context for inclusiveness reasons we made it difficult for respondents to grasp how all these different kinds of stakeholders relate to an agricultural transition. This in turn makes it difficult to develop a perception on whether these interests should be considered. We suspect that the reason why we were able to reliably assess the construct of *Environmental and Future Generations' Interests* is that the kinds of stakeholders under that construct are more generally known and it is therefore easier to understand how they might be impacted by an agricultural transition, even if one knows little about agriculture. In future developments of our instrument, the issues with the items related to the other constructs could be potentially remedied either by giving short explanations as to how these different stakeholders relate to an agricultural transition, or alternatively, items could be used that provide more descriptive accounts of the kinds of broader interests that certain types of stakeholders typically represent. The former comes at a cost of considerably lengthening the instrument and difficulties in describing complex links and interactions in a very brief manner, whilst the latter comes at a cost of reducing inclusiveness in the setup of the instrument and thereby risks leaving potential interests out based on pre-determined normative assumptions. In regard to the three constructs related to the *Distributional Principles* and the one construct related to *Procedural Principles* that we were not able to reliably assess, we want to highlight that these are basic justice constructs that

have been assessed reliably by previous studies in relation to justice in general (Bennet et al., 2019; Liebig et al., 2016; Rasinski, 1987). It can thus be argued that the adaptation of the items that we did in order to apply these constructs to the agricultural transition context has caused this lack of reliability and validity and future research should therefore focus on revising the wording of these items. In regard to the *Topics of Distributional Justice* we were not able to identify a clear pattern between the different kinds of topics. Further research is required to examine whether this lack of pattern was a consequence of the way we designed the question related to this sub-dimension or whether there really is no clear pattern for this sub-dimension in the English context.

There are also a number of limitations with this study that should be considered. Firstly, several of the items that we used in this instrument were specifically designed to fit within the English context and need to be revised when this study is conducted elsewhere. Secondly, in order to be able to include the variety of sub-dimensions and constructs that we did, there were some aspects that we were not able to take into account. For example, the importance of contextual factors that influence perceptions of justice in a specific situation, trade-offs between the constructs and relative importance if either-or-decisions have to be made, as well as potential changes in perceptions when specific kinds of costs and benefits at specific price points (monetary or otherwise) are considered. These are all aspects that are likely not possible to assess through an instrument like the one we have developed (Liebig et al., 2015). We therefore advise that when this instrument is used to support governance decisions it is accompanied by further, in-depth, assessments in which these kinds of aspects can be captured. Examples of methods that can be used for this include in-depth interviews, discrete choice experiments, or factorial surveys. This will also help in addressing potential biases when using this instrument as a result of the specific aspects that were included or excluded respectively. Thirdly, whilst we aimed to be comprehensive and inclusive in the sub-dimensions which we examined in this study, we do not claim that our instrument is exhaustive. Potential other constructs that could be more explicitly included in future development of this instrument include retributive justice and the timescale of justice (Heffron, 2021; Wenzel and Okimoto, 2016). An effort could also be made to capture the difference in justice perceptions in relation to taking certain decisions or actions versus the justice of not taking them. This could then incorporate perceptions of injustice in relation to the current system and taking a business-as-usual pathway (Buchel et al., 2022; Ciplet, 2022; Gliessman and Fergusonm 2021; Sanderson Bellamy et al., 2021). In addition, the underlying dimensions of justice perceptions that we described and aimed to assess here is primarily based on literature and insights from a western worldview. Future research should therefore also focus on examining how these dimensions might differ in other cultural settings (Álvarez and Coolsaet, 2020; Dhawan, 2012; Krishnan, L., 1992; Winter, 2020) and adapt the instrument based on that prior to applying it in these contexts.

In relation to the use of this tool to support the governance of agricultural sustainability transitions, we showed with an example of the English case that it can provide practical input into the decision-making process surrounding the agricultural transition pathway. Our visualization of the results in Fig. 2 showed that an agricultural transition that is designed together with stakeholders, building on both scientific and local/traditional knowledge, with a main policy focus on the environment and animal welfare, whilst including social support to farmers and consumers to adapt to the transition, and especially considering impacts on a local, regional, and national scale will likely resonate well with the justice perceptions of the English society. A focus on reducing agricultural practices, on the other hand, will likely not receive broad public support. These results align with earlier research by de Boon et al. (2022a). Building the governance of the agricultural transition around these justice perceptions of the English society, will make the transition more acceptable for society and will thereby reduce potential barriers to the implementation of the required changes (Markard et al., 2020; Martin and Islar, 2020; Meadowcroft, 2011; Rothmund et al., 2016). However, when applying this tool to support the governance of agricultural transitions in this way, it is important to be aware that justice perceptions are not static. What is regarded as just at one point in the transition may be regarded as unjust in another stage of the transition, for example when unanticipated consequences of earlier decisions become visible (de Boon et al., 2022b). This instrument should therefore be used multiple times throughout the transition to monitor if perceptions change and the governance system and processes need to be flexible and adaptable to react to potential changes, thereby preventing setting static boundaries to what a just transition entails. In addition, whilst this tool can be used to increase the likelihood that the transition and the measures to bring about the transition are accepted by the society within which the transition takes place, adapting the design of a transition to the outcomes of this tool does not make the transition just per se. Perceptions of justice are always subjective and by designing a transition around the outcomes of this tool, the transition becomes shaped around the normative majority views of a specific society. It does not incorporate justice perceptions from people outside the specific society within which the tool is applied, even though they may still be affected by the transition (Tschersich and Kok, 2022).

Because this instrument is built on general underlying dimensions of normative claims of justice, it can be used beyond the agricultural transition context and has value for the governance of sustainability transitions more generally. The operationalization of the various sub-dimensions and constructs will need to be adapted to fit to the specific transition that is under consideration, but their abstract form can be maintained. The instrument can therefore function as a first step to address the 'moral vacuum in transition research' (Köhler et al., 2019) and enable more critical considerations of the underlying principles and values that tend to be taken for granted in specific transition pathways (Wigboldus et al., 2021).

6. Conclusion

There is consensus that there is a need for transitions toward more sustainable practices across societal domains. We are increasingly becoming aware that these kinds of transitions are normative, political processes and that we therefore need to consider the moral, justice implications that lay within them. However, it is much less clear what exactly a just transition is and how this should be accomplished. In the just transition literature more broadly, and in the agricultural context specifically, the dominant approach has become to prescribe a specific notion of justice and then assess whether or not this notion of justice is adhered to (e.g. Bennet et al., 2019; Blattner, 2020; Heyen et al., 2021; Sunio, 2021; Tribaldos and Kortetmäki, 2022; Wieliczko et al., 2021). This is also reflected in

the practices of a wide variety of movements advocating for just transitions (Velicu and Barca, 2020). But this approach neglects to acknowledge that justice itself is a highly normative and political concept and that by predefining what it ought to mean we impose specific valuation systems on society rather than gaining an insight into societal understandings of justice and just transitions. However, it is precisely this insight that could help us better understand potential resistance to transitions and to reduce this resistance by taking these societal perceptions of justice better into account in the governance of transitions (Redpath et al., 2013; Sikor et al., 2014). In this paper we therefore examined what the underlying dimensions are based on which people make normative justice evaluations and whether these can be used to assess societal perceptions of what a just transition means to a specific society. By doing so, and with a focus on agricultural transition as a case study, we took a first step in developing an instrument that can assess perceptions of justice in relation to agricultural transitions without imposing a predefined notion of justice, but instead making use of the underlying dimensions on which perceptions of justice are built. Due to its foundation in these underlying dimensions of justice evaluations, when adapted, this instrument can also be used to inform the governance of transitions in other sectors. It is not the aim of this instrument to de-politicize or eliminate the normative nature of justice, but rather to identify the (plurality of) normative views that are present in a given society, identifying where there are shared perceptions and where there are contrasting views. In doing so, it can provide insights in how the dominant predefined notions of justice that are used in the scientific literature and beyond relate to societal justice perceptions and highlight whose and what notions of justice are currently excluded. Further research is required to improve this instrument and test it in different contexts, but we hope that this study will inspire other researchers to become more aware of the implications of predefining justice and give decision-makers a tool through which they can better understand societal justice perceptions in relation to transitions.

Ethics approval statement

This study received ethical approval by the University of Reading.

Data availability

The data that support the findings of this study are openly available from the University of Reading Research Data Archive at https://doi.org/10.17864/1947.000413.

Submission declaration and verification

We confirm that our work is original. Our manuscript has not been published, nor is it currently under consideration for publication, elsewhere.

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CRediT authorship contribution statement

Auvikki de Boon: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Data curation, Visualization. **Sabrina Dressel**: Supervision, Formal analysis, Writing – review & editing. **Camilla Sandström**: Supervision, Writing – review & editing. **David Christian Rose**: Supervision, Writing – review & editing.

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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Supplementary materials

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Appendix A

Table A.1. Items included in the survey with Cronbach Alpha (α), item mean (M), standard deviation (SD), Skew, and Kurtosis, ordered based on theoretical expectation (N=400).

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
	Perceptions of Distributional Justice					
	Topics of Distributional Justice[a]					
	Please rank the statements below from most important (1) to least important (12) for the justice of agricultural change.					
	Environmental (α= 0,31)					
TP_Env_1*	*Environmental damage is reduced.*	7,14	3,18	-0,25	-1,02	0,22
TP_Env_2*	*Diversity of life on Earth, including plants, animals, fungi, and micro-organisms increases and nature is thriving.*	6,78	3,54	-0,06	-1,21	0,39
TP_Env_3*	*Climate change is minimised.*	6,61	3,62	-0,04	-1,30	0,06
	Economic (α= 0,09)					
TP_Econ_1*	*New jobs created as a result of the change provide good working conditions.*	5,66	3,14	0,28	-0,93	0,10
TP_Econ_2*	*Rural communities are thriving.*	4,98	3,02	0,60	-0,60	0,07
TP_Econ_3*	*Farming is profitable enough for farmers to make a living.*	7,20	3,38	-0,31	-1,08	0,01
	Food (α= 0,42)					
TP_Food_1*	*Food is sufficiently available for all.*	8,30	3,11	-0,56	-0,71	0,28
TP_Food_2*	*Food is affordable.*	8,31	3,11	-0,63	-0,65	0,22
TP_Food_3*	*Food has good nutritional quality.*	7,28	3,13	-0,34	-0,95	0,45
	Socio-environmental (α= 0,02)					
TP_SocEnv_1*	*Exposure to environmental pollution is reduced.*	6,37	3,10	0,05	-1,06	0,45
TP_SocEnv_2*	*Public access to nature is increased.*	4,55	3,21	0,67	-0,67	-0,32
TP_SocEnv_3*	*Opportunities to enjoy nature are increased.*	4,84	3,23	0,66	-0,71	-0,33
	Mechanisms of Distributional Justice[b,**]					
	To guide agricultural change in a way that is just, the government needs to…					
	Financial Incentives (α= 0,67)					
M_FI_1	*… pay farmers public money to provide public goods (e.g. clean water, thriving wildlife, etc.).*	1,22	1,29	-0,75	0,70	0,60

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
M_FI_2*	*… create a private market for public goods (e.g. to enable private water companies to pay farmers to improve water quality).*	0,91	1,25	-0,60	0,57	0,66
M_FI_3	*… provide subsidies or similar financial support to people who can't afford to buy sufficient food.*	1,36	1,37	-0,85	0,65	0,64
M_FI_4	*… buy out farmers from their farms to reduce the number of agricultural businesses in the country.*	-0,70	1,73	0,49	-0,71	0,68
M_FI_5	*… pay older farmers to stop farming so that younger farmers can take over.*	-0,10	1,70	0,14	-0,87	0,64
M_FI_6	*… pay grants to farmers for innovation and adaptation to the change.*	1,43	1,19	-0,92	1,35	0,62
M_FI_7	*… financially support farmers and farm workers who lose their job due to the change.*	1,46	1,27	-1,00	1,23	0,62
	Financial Disincentives (α= 0,65)					
M_FD_1	*… set penalties on environmentally harmful practices.*	1,74	1,14	-0,84	0,60	0,58
M_FD_2	*… set taxes on pesticides, fungicides, and herbicides.*	1,08	1,48	-0,58	-0,06	0,49
M_FD_3*	*… set consumer taxes on food that has a strong negative environmental impact.*	0,65	1,64	-0,45	-0,53	0,58
	Guidance & Information (α= 0,77)					
M_GI_1	*... support farmers and farm workers with advice and guidance to use more sustainable practices.*	1,75	1,14	-1,12	1,79	0,71
M_GI_2	*… provide information to consumers on the environmental impact of specific types of food and food waste.*	1,51	1,26	-1,13	1,62	0,71
M_GI_3	*… provide training to farmers and farm workers who want to stop farming and move to a different job.*	0,96	1,47	-0,57	-0,22	0,76
M_GI_4	*… provide positive recognition for environmentally friendly farmers (e.g. through sustainability certificates).*	1,72	1,19	-1,31	2,57	0,74
M_GI_5	*… support farmers and farm workers with training to move to a different job when they lose their job due to the change.*	1,38	1,30	-0,89	0,85	0,74
	Regulations (α= 0,74)					
M_R_1	*… set strict environmental regulations.*	1,56	1,26	-0,97	1,19	0,70
M_R_2	*… ban the use of environmentally harmful substances such as herbicides, pesticides, and fungicides.*	1,56	1,32	-0,90	0,71	0,70
M_R_3	*… set legally binding targets for the maximum level of harmful substances in the soil, air, and water.*	1,70	1,22	-1,04	1,23	0,71
M_R_4	*… exclude land from agricultural use.*	-0,02	1,60	-0,03	-0,58	0,73
M_R_5c	*… remove regulations that protect the internal food-market (e.g. reducing trade barriers).*	-0,50	1,50	0,50	-0,13	0,79

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
M_R_6	*… set strict environmental regulations on imported food.*	1,64	1,29	-0,91	0,43	0,72
M_R_7	*… create strict regulations for animal welfare.*	1,94	1,20	-1,43	2,69	0,70
M_R_8	*… create strict regulations for the preventive use of antibiotics for farm animals.*	1,30	1,46	-0,77	0,32	0,70
M_R_9	*… revoke farm licenses to reduce the number of farms.*	-0,90	1,61	0,48	-0,64	0,76
M_R_10	*… set regulations so that negative environmental impacts are compensated by improving the environment elsewhere.*	1,14	1,34	-0,68	0,29	0,70
	Principles of Distributional Justice[b]					
	Change in agriculture is just if…					
	Equality (α= 0,72)					
DP_Equal_1	*… everyone carries the same amount of costs to create the change, regardless of their circumstances.*	0,22	1,53	-0,16	-0,65	0,64
DP_Equal_2	*… everyone receives the same amount of benefits from the change, regardless of their circumstances.*	0,52	1,59	-0,24	-0,77	0,68
DP_Equal_3	*… it distributes the costs and benefits of the change so that everyone carries the same costs and benefits.*	0,79	1,41	-0,48	-0,18	0,59
	Equity & Need (α= 0,56)					
DP_EN_1*	*… the costs of the change are distributed so that people contribute according to their means.*	1,33	1,22	-0,69	0,62	0,27
DP_EN_2*	*… the benefits of the change are distributed so that those who were worse off in society before are as well off as others after the change.*	1,05	1,34	-0,52	0,14	0,49
DP_EN_3*	*… support to adapt to the change is only provided to those who need it.*	1,01	1,31	-0,70	0,58	0,59
	Entitlement (α= 0,64)					
DP_Ent_1*	*… it provides more benefits to those who have historically benefitted from agriculture than to others.*	0,33	1,38	-0,24	-0,06	0,49
DP_Ent_2*	*… those who have historically carried least of the cost of agriculture carry least of the costs of the change.*	0,49	1,32	-0,26	-0,02	0,46
DP_Ent_3*	*… it distributes the costs and benefits of the change similarly as to how the costs and benefits of agriculture are currently distributed.*	0,75	1,18	-0,36	0,48	0,64
	Merit (α=0,63)					
DP_M_1*	*… those who put more effort into the change receive more of the benefits of the change.*	1,21	1,267	-0,89	1,03	0,50
DP_M_2*	*… those who put in least effort to bring about the change carry most of the costs of the change.*	0,72	1,35	-0,39	-0,04	0,57

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
DP_M_3*	*… it distributes the costs and benefits of the change based on the efforts that people undertake to create the change.*	1,15	1,17	-0,64	0,81	0,52
	***Viewpoint of Justice**[d,**]*					
	Changes in agriculture…					
	Intrapersonal (α= 0,74)					
VJ_Intra_1	*… do **not** make my position in life worse than it was before.*	1,45	1,28	-0,84	0,74	0,58
VJ_Intra_2	*… improve my living circumstances compared to what they were before.*	1,07	1,27	-0,42	0,07	0,80
VJ_Intra_3	*… do **not** make my living circumstances worse than they were before.*	1,49	1,30	-0,95	1,02	0,56
	Interpersonal (α= 0,63)					
VJ_Inter_1	*… do **not** make my own living circumstances worse than those of others.*	1,26	1,28	-0,75	0,95	0,42
VJ_Inter_2	*… improve my living circumstances in comparison to others.*	0,58	1,33	-0,36	0,14	0,72
VJ_Inter_3	*… do **not** affect my living circumstances more negatively than those of others.*	1,16	1,33	-0,71	0,56	0,39
	Perceptions of Procedural Justice					
	Degree of involvement[b] (α= 0,91)					
	For agricultural change to be just, the government needs to …					
	Informing					
DI_1	*… inform stakeholders about the decisions government is taking.*	1,56	1,19	-0,95	1,34	0,89
	Consulting					
DI_2	*… invite stakeholders to express their views on government decisions before the decisions are taken.*	1,50	1,21	-0,88	1,22	0,89
	Involving					
DI_3	*…invite stakeholders to give advice on what decisions the government should take.*	1,35	1,28	-0,86	0,87	0,89
	Collaborating					
DI_4	*… involve stakeholders in the decision-making and implementation of decisions.*	1,39	1,20	-0,74	0,82	0,89
	Cooperating					
DI_5	*…actively include stakeholders in setting the goals for change.*	1,42	1,17	-0,88	1,35	0,89
	Partnership					
DI_6	*…make decisions jointly with the stakeholders.*	1,26	1,16	-0,62	0,54	0,89
	Principles of Procedural Justice[b]					

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
	An agricultural change process is just when…					
	Equality (α= 0,79)					
PP_Equal_1	*… everyone is involved in the same way, regardless of how much they will be affected by the change.*	0,73	1,50	-0,45	-0,39	0,74
PP_Equal_2	*… everyone's views are taken into account in the same way.*	1,04	1,40	-0,50	-0,20	0,71
PP_Equal_3	*… everyone has the same influence over decision-making.*	0,58	1,47	-0,40	-0,34	0,69
	Equity & Need (α= 0,63)					
PP_EN_1*	*… those stakeholders who do not have sufficient resources to take part receive support to participate.*	0,85	1,27	-0,32	-0,10	0,66
PP_EN_2*	*… the views of stakeholders who will be most affected by the change are taken into account most.*	0,92	1,31	-0,69	0,46	0,34
PP_EN_3*	*… those stakeholders who have more at stake in the change receive most influence on decision-making.*	0,60	1,36	-0,48	0,07	0,54
	Entitlement (α= 0,83)					
PP_Ent_1	*…the views of those who have historically been influential in agriculture are taken into account most.*	0,71	1,30	-0,49	-0,01	0,79
PP_Ent_2	*…those who have historically been most influential in agriculture have most influence on decision-making.*	0,60	1,33	-0,36	-0,12	0,76
PP_Ent_3	*… those who have historically been most influential in agriculture receive most opportunities to be involved.*	0,64	1,33	-0,28	-0,20	0,74
	Merit (α= 0,81)					
PP_M_1	*… experts on agriculture have most influence in deciding the direction of change.*	1,06	1,21	-0,62	0,47	0,74
PP_M_2	*… the views of experts on agriculture are taken into account most.*	1,11	1,23	-0,61	0,26	0,75
PP_M_3	*…experts on agriculture have most influence on decision-making.*	1,09	1,23	-0,54	0,22	0,72
	Perceptions of Recognitional Justice					
	Stakeholder Inclusion[e]					
	In order for agricultural change to be just, to what extent should the interests of the following stakeholders and the way they may be affected by the change be taken into account?					
	Agriculture, Forestry & Landowner Interests (α= 0,81)					
SJ_1	*Farmers*	1,35	1,11	-0,59	0,69	0,80

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
SJ_2[*]	*Land-owners*	0,63	1,18	-0,12	0,06	0,79
SJ_3[*]	*Foresters*	0,68	1,25	-0,23	0,19	0,79
SJ_4	*Agricultural educational institutions*	0,64	1,16	-0,22	0,10	0,77
SJ_5	*Commoners (people who have the right to let their livestock graze on common/shared land)*	0,48	1,21	-0,29	0,34	0,79
SJ_18	*Stakeholders focusing on social wellbeing of farmers*	0,77	1,20	-0,27	0,27	0,76
SJ_19	*Stakeholders focusing on food availability, affordability, and nutritional quality*	0,92	1,20	-0,39	0,36	0,79
	Environmental & Future Generations' Interests (α= 0,84)					
SJ_6	*Environmental organisations*	0,84	1,27	-0,38	0,35	0,82
SJ_15	*Stakeholders focusing on animal welfare*	1,10	1,24	-0,50	0,31	0,82
SJ_21	*Future generations*	1,15	1,27	-0,46	-0,02	0,83
SJ_22	*Farm-animals*	1,26	1,24	-0,71	0,83	0,81
SJ_23	*Wild-animals*	1,17	1,31	-0,43	-0,11	0,81
SJ_24	*Nature*	1,46	1,22	-0,54	0,05	0,80
	Social Interests (α= 0,79)					
SJ_11[*]	*Local authorities (e.g. borough councils, county councils, district councils)*	0,41	1,27	0,02	-0,26	0,76
SJ_12[*]	*General society*	0,67	1,18	-0,04	-0,04	0,76
SJ_13	*Stakeholders focusing on historical heritage*	0,29	1,27	-0,07	-0,04	0,75
SJ_14	*Stakeholders focusing on human health*	0,85	1,21	-0,08	-0,37	0,75
SJ_16	*Stakeholders focusing on recreation (e.g. access to land for walking or quality of water for swimming)*	0,42	1,32	-0,08	-0,23	0,75
SJ_17	*Stakeholders focusing on interests of rural life*	0,67	1,17	-0,22	0,51	0,75
	Economic Interests (α= 0,79)					
SJ_7	*Supermarkets*	0,19	1,32	-0,04	-0,16	0,73
SJ_8	*Agricultural consultants*	0,34	1,23	-0,04	0,22	0,77
SJ_9	*Trade organisations*	0,11	1,19	0,08	0,20	0,75
SJ_10	*Fertiliser and seed/crop industry*	0,32	1,30	-0,01	0,03	0,76
SJ_20	*Stakeholders focusing on food processing and packaging*	0,25	1,27	-0,12	0,04	0,75
	Social inclusion[e]					

Item code	Dimensions, Sub-dimensions, Constructs, & Items	M	SD	Skew	Kurtosis	α if item is dropped
	In order for agricultural change to be just, to what extent should the interests of the following societal groups and the way they may be affected by the change be taken into account?					
	Sexes (α= 0,88)					
SI_1	*Women*	0,39	1,39	-0,22	0,03	0,82
SI_2	*Men*	0,31	1,34	-0,28	0,24	0,76
	Minorities (α= 0,88)					
SI_3	*Transgender*	-0,30	1,60	-0,08	-0,55	0,86
SI_4	*Ethnic minorities*	0,08	1,43	-0,23	0,02	0,81
SI_5	*Religious minorities*	-0,40	1,60	0,09	-0,45	0,83
	Children & Disabled People (α= 0,84)					
SI_6	*Children/Youth*	0,49	1,43	-0,31	0,05	0,71
SI_7	*Disabled people*	0,38	1,45	-0,30	-0,07	0,73
	Geographical Scale of Justice[d] (α= 0,84)					
	Potential consequences of the change for..					
	Local					
GS_1	*… local areas are taken into account.*	1,86	1,19	-1,64	3,90	0,76
	Regional					
GS_2	*… England are considered.*	1,83	1,16	-1,45	3,05	0,78
	National					
GS_3	*… the UK as a whole are considered.*	1,87	1,21	-1,67	3,73	0,75
	Global					
GS_4	*… all countries in the world are taken into account.*	1,29	1,37	-0,79	0,64	0,89
	Knowledge types[e] (α= 0,72)					
	In order for the change to be just, please indicate how much or little the government should take these types of knowledge into consideration.					
	Scientific					
KT_1	*Knowledge that is generated through the use of scientific methods.*	1,06	1,19	-0,48	0,69	0,55
	Local/Traditional					
KT_2	*Knowledge based on everyday experience, adapted to the local culture and environment.*	1,35	1,22	-0,70	0,64	0,58

[a] Items were measured by rank-order, with 12 indicating highest importance and 1 indicating lowest importance. M values here represent mean rank.

[b] Items have been measured on a 7-point Likert Scale, where -3 = Strongly disagree, -2 = Disagree, -1 = Somewhat disagree, 0 = Neutral, 1 = Somewhat agree, 2 = Agree, 3 = Strongly agree

[c] Reversed item which has been inversed prior to analysis.

[d] Items have been measured on a 7-point Likert Scale, where -3 = Very Unimportant, -2 = Unimportant, -1 = Somewhat unimportant, 0 = Neutral, 1 = Somewhat important, 2 = Important, 3 = Very important

[e] Items have been measured on a 7-point Likert Scale, where -3 = Not at all, -2 = Very little, -1 = Little, 0 = To a moderate extent, 1 = High, 2 = Very High, 3 = Highest priority

[*] Item was not included in the final analysis.

[**] This construct was changed in the final analysis based on EFA and CFA results.

Table A.2. Breakdown of sample distribution compared to population distribution.

	Sample distribution	Population distribution	Source[a]
Gender			
Female	50,50%	49,44%	Based on 2019 data from https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D2JAN__custom_2251815/default/table?lang=en
Male	49,25%	50,56%	
Other	0,25%		
Age			
18-24	10,50%	10,80%	Based on 2019 data from https://ec.europa.eu/eurostat/databrowser/view/DEMO_R_D2JAN__custom_2252088/default/table?lang=en
25-34	17,00%	17,25%	
35-44	16,00%	16,16%	
45-54	18,75%	17,37%	
55->55	37,75%	38,42%	
Income			
<£17,499	15,50%	19,55%	Based on 2019-2022 data from: https://www.gov.uk/government/statistics/households-below-average-income-for-financial-years-ending-1995-to-2020
£17,500-£29,999	35,25%	35,20%	
£30,000-£49,999	31,75%	31,83%	
£50,000 or more	13,25%	13,42%	
Non-paid employment/ unemployed	4,00%		
Prefer not to say	0,25%		
Education level			
Level 0-3	66,75%	66,86%	Based on 2011 data from: https://www.nomisweb.co.uk/census/2011/KS501EW/view/2092957699?cols=measures
Level 4 and above	33,25%	33,10%	
Region in England			
North East	5,00%	4,73%	Based on 2019 data from: https://ec.europa.eu/eurostat/databrowser/view/demo_r_d2jan/default/table?lang=en
North West	13,00%	13,00%	
Yorkshire and the Humber	9,75%	9,77%	
East Midlands	8,75%	8,57%	
West Midlands	10,25%	10,52%	
Eastern England	11,50%	11,10%	
Greater London	16,00%	15,99%	
South East	15,50%	16,33%	
South West	10,25%	10,00%	

[a] Most recent data for England that was available at the time of survey launch was used.

Figure A.2. Friedman Test and Pairwise Wilcoxon Signed Rank Test for items related to Topics to Address.

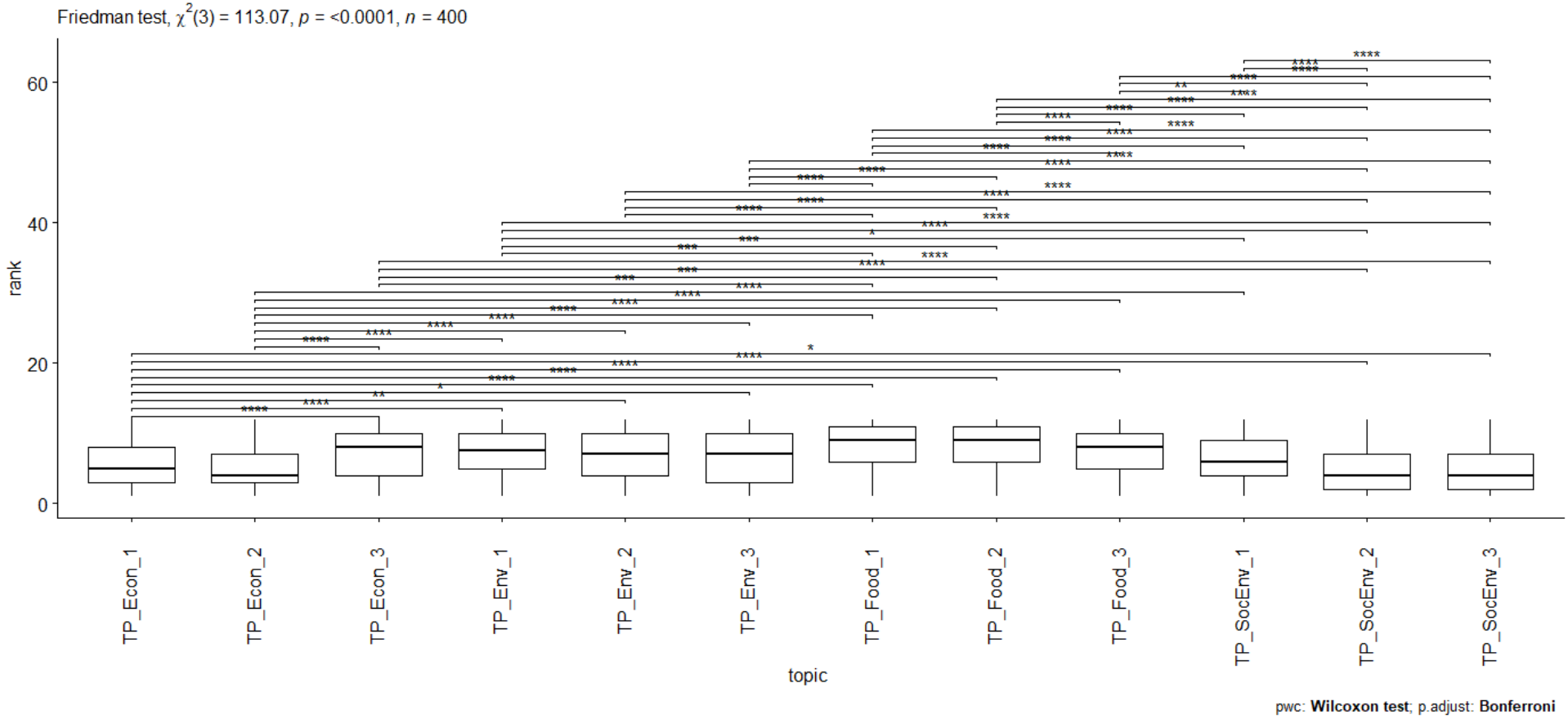

Table A.3. Item correlations for Topics to Address

	TP_Env_1	TP_Env_2	TP_Env_3	TP_Econ_1	TP_Econ_2	TP_Econ_3	TP_Food_1	TP_Food_2	TP_Food_3	TP_SocEnv_1	TP_SocEnv_2	TP_SocEnv_3
TP_Env_1	1											
TP_Env_2	0,03	1										
TP_Env_3	0,24***	0,12*	1									
TP_Econ_1	-0,18***	-0,22***	-0,21***	1								
TP_Econ_2	-0,22***	-0,15***	-0,25***	0,01	1							
TP_Econ_3	-0,14**	-0,21***	-0,24***	0,04	0,05*	1						
TP_Food_1	-0,15***	-0,23***	-0,17***	-0,03	-0,11	0,05	1					
TP_Food_2	-0,29***	-0,31***	-0,24***	0,00	-0,01	0,03	0,29***	1				
TP_Food_3	-0,15***	-0,15***	-0,25***	-0,07	-0,09	-0,04	0,12**	0,17***	1			
TP_SocEnv_1	0,13**	0,13**	0,09	-0,19***	-0,08	-0,24***	-0,19***	-0,18***	-0,19***	1		
TP_SocEnv_2	-0,13**	-0,06	-0,11*	-0,04	-0,02	-0,20***	-0,25***	-0,19***	-0,15***	-0,14***	1	
TP_SocEnv_3	-0,19***	-0,09	-0,14**	-0,04	-0,03	-0,11*	-0,24***	-0,17***	-0,15***	-0,14**	0,29***	1

* p<.05; ** p<0.01; *** p<0,001

Figure A.3. Friedman Test and Pairwise Wilcoxon Signed Rank Test for items related to Geographical Scale.

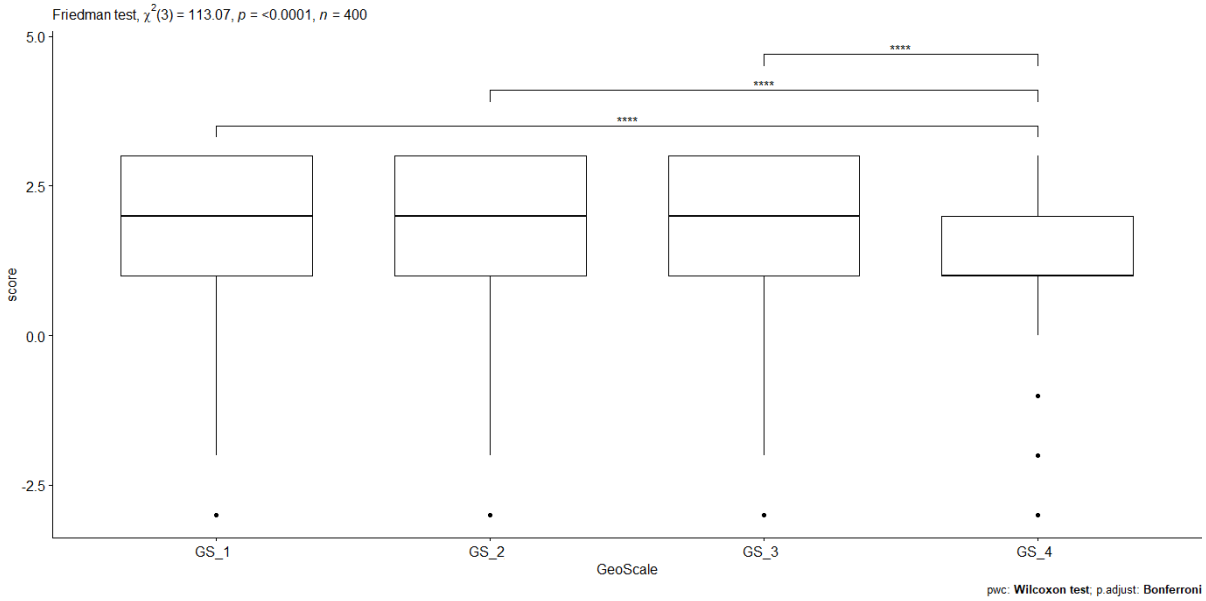

Table A.4. Item correlations for Geographical Scale

	GS_1	GS_2	GS_3	GS_4
GS_1	1			
GS_2	0,71***	1		
GS_3	0,75***	0,71***	1	
GS_4	0,43***	0,38***	0,49***	1

***p<0,001

Table A.5. Construct correlations (based on summated weighted means), construct reliability assessed via Raykov's factor rho coefficient (CR), and the Average Variance Extracted (AVE).

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1)	DP_Equality[a]	1																		
(2)	DP_Merit[a]	0,28***	1																	
(3)	Environment & Animal Welfare	0,17***	0,39***	1																
(4)	Social Support	0,28***	0,33***	0,58***	1															
(5)	Reducing Agriculture	0,29***	0,25***	0,23***	0,22***	1														
(6)	Self-Improvement	0,31***	0,27***	0,27***	0,29***	0,31***	1													
(7)	Not-Worsening	0,06	0,18***	0,35***	0,34***	-0,04	0,42***	1												
(8)	PP_Equality[b]	0,40***	0,22***	0,22***	0,30***	0,20***	0,18***	0,05***	1											
(9)	PP_Equity & Need[b]	0,22***	0,30***	0,23***	0,27***	0,18***	0,17***	0,18***	0,28***	1										
(10)	PP_Entitlement[b]	0,37***	0,35***	0,16***	0,29***	0,18***	0,31***	0,19***	0,23***	0,49***	1									
(11)	PP_Merit[b]	0,13**	0,29***	0,29***	0,36***	0,15***	0,19***	0,22***	0,18***	0,34***	0,47***	1								
(12)	Degree of Involvement	0,05	0,24***	0,37***	0,30***	-0,04	0,10*	0,30***	0,19***	0,44***	0,16***	0,32***	1							
(13)	Agricultural Interests	0,24***	0,25***	0,40***	0,48***	0,09	0,22***	0,29***	0,29***	0,32***	0,29***	0,32***	0,42***	1						
(14)	Environmental & Future Generations' Interests	0,16***	0,28***	0,62***	0,48***	0,15***	0,24***	0,27***	0,25***	0,22***	0,24***	0,31***	0,37***	0,67***	1					
(15)	Social Interests	0,32***	0,28***	0,40***	0,42***	0,31***	0,30***	0,20***	0,32***	0,34***	0,35***	0,30***	0,32***	0,71***	0,63***	1				
(16)	Economic Interests	0,45***	0,26***	0,15***	0,32***	0,31***	0,35***	0,14**	0,36***	0,35***	0,43***	0,29***	0,23***	0,61***	0,35***	0,66***	1			
(17)	Minorities	0,20***	0,22***	0,27***	0,30***	0,16***	0,20***	0,07	0,24***	0,23***	0,18***	0,18***	0,16***	0,42***	0,38***	0,45***	0,38***	1		
(18)	Children & Disabled People	0,22***	0,19***	0,26***	0,30***	0,27***	0,17***	-0,01	0,27***	0,18***	0,15***	0,14***	0,11*	0,37***	0,33***	0,40***	0,34***	0,74***	1	
(19)	Sexes	0,17***	0,22***	0,37***	0,38***	0,16***	0,19***	0,13**	0,25***	0,17***	0,20***	0,21***	0,17***	0,40***	0,47***	0,39***	0,26***	0,70***	0,65***	1
	AVE	0,47	0,36	0,41	0,39	0,47	0,62	0,61	0,56	0,40	0,62	0,59	0,62	0,41	0,47	0,41	0,44	0,72	0,72	0,80
	CR	0,73	0,62	0,89	0,79	0,78	0,76	0,86	0,79	0,65	0,83	0,81	0,91	0,78	0,85	0,74	0,80	0,88	0,84	0,89

* p<.05; ** p<0.01; *** p<0,001 ; [a]DP = Distributional Principle; [b]PP = Procedural Principle

Paper IV

To adapt or not to adapt, that is the question. Examining farmers' perceived adaptive capacity and willingness to adapt to sustainability transitions

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Abstract

The agricultural sector is one of the areas that has been highlighted as requiring a sustainability transition. Tackling the challenge of food production is key for the future of civilization as we know it. For these kinds of transitions to succeed over the long-term, farmers need to be able to adapt to the required changes. Identifying which aspects are important for farmers' adaptive capacity and willingness to adapt is therefore an essential step in gaining insight into the role of farmers' agency in transition processes and their long-term sustainability. So far, adaptive capacity literature has mainly focused on adaptive capacity in relation to climate change or individual innovations, thereby leaving a knowledge gap on adaptive capacity in relation to transitions. In this study, we aim to address this by deepening our understanding of these aspects through 24 in-depth, semi-structured interviews with English farmers and organisations in the context of the post-Brexit agricultural transition. Whilst we found many similarities with previous adaptation literature in the context of climate change and individual innovation, we also found aspects that have not been prominent and thus seem to be specific for adaptation in relation to transitions. These include the dual role that access to finances and information can play, land ownership status, state of mind, succession options, feeling respected, appreciated, and understood, perceived level of control, and considerations of (global) consequences. Further research is needed to strengthen and further develop our findings, for example through case studies in other geographical locations or sectors.

Keywords: sustainability transition, adaptive capacity, willingness to adapt, agriculture, governance

1. Introduction

The agricultural sector is one of the areas that have been highlighted as requiring a sustainability transition (El Bilali, 2020; FAO et al., 2021; Young Park et al., 2021), both to address the negative environmental impact of currently dominant agricultural practices (Awuchi et al., 2021; IPCC, 2019; Poore & Nemecek, 2018) and to ensure sufficient food production under changing natural conditions (FAO, 2019; Mbow et al., 2019). Tackling this challenge of how food is produced is key for the future of civilization as we know it today (Tauger, 2011, p.1). Efforts to set in motion these kinds of transitions have already begun. For example, in the European Union, reforms to the Common Agricultural Policy (CAP) are underway to bring it in line with the environmental ambitions of the Green Deal (European Commission, 2021) and in England, Brexit is being used by the Department of Environment, Food, and Rural Affairs (DEFRA) as a window of opportunity to structurally change agricultural policy to create a

system where farmers will receive public money for the provisioning of public goods (DEFRA, 2018; 2020a; 2020b). For these, and other agricultural transitions, to succeed over the long-term, farmers need to be able to adapt to the required changes. Identifying which aspects are important for farmers' adaptive capacity and willingness to adapt is therefore an essential step in gaining insight into the role of farmers' agency in transition processes and their long-term sustainability (Darnhofer et al., 2010; Martin et al., 2018).

Recent theoretical developments by de Boon et al. (2022) provided a starting point to deepen this understanding by creating a comprehensive framework to underpin the governance of agricultural transitions, connecting the micro-, meso-, and macro-level and highlighting the interactions between these throughout a transition process. However, the section of this framework that is concerned with adaptive capacity is primarily built on insights from literature that focuses on farmers' adaptive capacity in relation to climate change or individual innovations. As adaptive capacity always stands in relation to what the actor is adapting to (Ajzen, 1991; Akkari and Bryant, 2017; van der Veen, 2010), this framework could be further improved. It is therefore the aim of this article to examine empirically what aspects are central to farmers' perceived adaptive capacity and motivation to adapt to agricultural transitions specifically.

To address this aim, we conduct a case study of English farmers' perceived adaptive capacity and willingness to adapt in relation to the English post-Brexit agricultural transition. This provides a good context for this study because the English farmers' are directly confronted with a transition that they need to react to in one way or another. We can thus examine their perceptions in relation to the transition as it happens, rather than pro- or retrospectively. This is an important characteristic because the perceptions that farmers have in the moment will ultimately influence their adaptive behaviour, not the perceptions they have (far) in advance or afterward (Ajzen, 2011). In doing so, this study contributes by deepening our understanding of perceived adaptive capacity and willingness to adapt in the context of transitions.

2. Case context: the English agricultural transition

As agriculture is a devolved matter, after leaving the CAP in 2020, each of the UK nations can develop their own agricultural policy. We focus on England. In the period leading up to England leaving the CAP (2015-2018), 58% of the average farm business income came from direct payments, i.e. payments to farmers based on the amount of land that they manage. 75% of farms were profitable, but two thirds of them did so only due to additional income from diversification, agri-environment schemes, and direct payments (DEFRA and Government Statistical Service, 2019). A detailed overview of the

structure of the English agricultural sector and the contribution of Direct Payments to farm business income prior to Brexit can be found in Annex A Table 1 and 2.

The transition period away from CAP to a new agricultural system started in 2021 and is scheduled to be completed in 2028. The overall aim of the transition is to create an agricultural sector that produces healthy food, is profitable without subsidies, and contributes positively to the environment (DEFRA, 2020b). This transition is, therefore, not just a restructuring of subsidy policies, but a full-scale sustainability transition (Geels, 2011). The Agriculture Act 2020 (Agriculture Act, 2020) forms the legal basis for the transition, but the exact plans are still under development. At the time of our interviews, it was the plan that over the transition period, direct payments would be phased out through progressive reductions (this started in 2021) and payments would be delinked from farming activity (starting in 2024). Farmers could also opt to receive a one-off lump sum payment, which would cancel further entitlement to Basic Payments. The old Countryside Stewardship scheme would stay available until 2024, after which it would be merged into new Environmental Land Management schemes (DEFRA, 2021a). These schemes, which were set to be at the heart of the new agricultural policies, offer public money for the provisioning of public goods, such as clean air and water, thriving plants and wildlife, and climate change mitigation and adaptation. In addition, there were planned to be a number of support schemes ranging from one-off environmental projects and equipment and technology investments to innovation research and a lump sum exit scheme (DEFRA, 2021b). An overview of the various schemes as proposed at the time of our data collection is provided in Annex B. It should be noted, however, that this is a dynamic policy area.

Overall, this transition, which is set in a context of additional changes in aspects such as a new Environment Act (Environment Act, 2021) and new trade agreements (Department for International Trade, 2022), alters the immediate contextual structures within which farmers operate. The strong dependence on basic payments prior to the transition reveals the potential disruptiveness of this transition to the English agricultural sector and the scope of adaptations that farmers are expected to make.

3. A starting point to examine farmers' perceived adaptive capacity and willingness to adapt

The Theory of Planned Behaviour states that attitudes, subjective norms, and perceived behavioural control determine behavioural intentions (Ajzen, 2020). Thus, asking farmers directly what they think of the transition, whether they feel like they can and want to adapt to it, and what they think the consequences of (not) adapting would be, gives an indication of the most salient elements that make up farmers' perceived adaptive capacity and willingness to adapt (Ajzen, 1991; 2011). Below, we summarize the dimensions and elements of farmers' adaptive capacity and willingness to adapt that

have been identified in the context of climate change and individual innovations. They form a starting point through which we structure our examination of farmers' perceived adaptive capacity and willingness to adapt to transition.

It is important to keep in mind here that adaptation strategies can be diverse, ranging from adapting (parts of) the farm business structure or farming practices to exiting farming altogether. We refer to the exit strategy and continuing in the same way as before the transition as maladaptation and non-adaptation respectively. Whilst the exit strategy is a form of adaptation that requires adaptive capacity and is a manifestation of the disruptive nature of a transition, like non-adaptation, over time and at scale, this strategy can stand in the way of a successful agricultural transition. If a significant number of farmers chooses this option, food production would be at risk (Grothmann and Patt, 2005).

3.1. *Perceived adaptive capacity*

In de Boon et al.'s (2022, p. 413) framework, adaptive capacity is defined as "the capacity to adapt to (anticipated) change through the implementation of innovative or old practices". The elements comprising farmers' adaptive capacity included social capital, access to resources, innovative capacity, the (flexibility of) the institutional context, psychosocial factors, knowledge and education, local embeddedness, perceived adaptive capacity, the ability for collective action, and the degree of diversity. We focus on farmers' perceptions of these aspects, i.e. perceived adaptive capacity, because even if farmers have the capacity to adapt, they will not likely conduct adaptive behaviour if they do not think they have it (Ajzen, 2011; Armitage and Christian, 2003; Grothmann and Patt, 2005). Furthermore, we will address psychosocial factors, or the willingness to adapt, in section 3.2. and perceptions of the institutional context in section 3.3.

The elements identified as comprising perceived adaptive capacity can broadly be grouped into two categories: perceived social capability and perceived access to resources and skills. *Perceived access to resources and skills* relates to financial and material capital, natural capital, and human capital (Aase et al., 2013; Akkari and Bryant, 2017; Bussey et al., 2012; Li et al., 2019). Perceptions of financial and material capital describe the extent to which the farmer perceives the financial and material resources they have access to as sufficient to successfully adapt (Bitterman et al., 2019; Lowitt et al., 2015; Zeweld et al., 2019). Natural capital refers to the farmer's perceptions on the sufficiency of the natural capital of the farm to undergo adaptation, for example whether the farm size, soil quality, and water availability allow implementation of the required changes (Aase et al., 2013; Li et al., 2019; Lyle and Ostendorf, 2005). Human capital relates to the farmer's perceptions of the sufficiency of their own knowledge and skills to implement the required adaptation (Bussey et al., 2012; Makate, 2019; Morton et al., 2017). This also includes perceptions of the sufficiency of their innovative capacity, i.e. their own

creativity, explorative nature, and flexibility (Cohen et al., 2016; Schut et al., 2018; Turner et al., 2017), as well as the perception of having sufficient access to labour to carry out the required work (Lyle and Ostendorf, 2005; van der Veen, 2010). Across all these types of resources, perceptions of diversity are also relevant (Akkari and Bryant, 2017; Lin, 2011).

Perceived social capability encompasses the social networks, or social capital, of the farmer (Akkari and Bryant, 2017; Asfaw et al., 2016; Cohen et al., 2016; Makate, 2019; Shah et al., 2019), also sometimes referred to as relational capital (Zeweld et al., 2019), and the farmer's perceptions on whether or not these networks can support them with the adaptation. These networks or social relations can potentially be drawn on to access additional resources or mental support. A distinction can be made between bonding, bridging, and linking social capital (Arnott et al., 2021; Claridge, 2018). Bonding social capital relates to informal relations within homogenous networks, bridging social capital relates to more formal relations across heterogenous networks, connecting multiple dense networks with each other, and linking social capital refers to formal relations to institutions and organisations with authoritative power (Cinner et al., 2018; Hall and Pretty, 2008; Pelling and High, 2005). Strong social capital across these dimensions can increase levels of trust, local embeddedness, social learning, knowledge exchange, and mutual understanding, all of which strengthen the perceived ability for collective action (Hurley et al., 2020; Knox et al., 2010; Lowitt et al., 2015; Rust et al., 2020; Schut et al., 2018; Zeweld et al., 2019). However, it can also function as a hampering factor for adaptation, for example if the network is not supportive of adaptation, if the bonding capital is so strong that it does not allow for the uptake of knowledge from outside the homogenous network, or if the linking social capital is perceived to be concentrated in a select few people who receive privileged access to important information that is not made available to all (Cofré-Bravo et al., 2019; Saint Ville et al., 2016).

Regardless of whether a farmer perceives themselves as having sufficient capacity to adapt to a transition, this perceived adaptive capacity will not likely lead to the behavioural intention of adapting without a willingness to adapt (Ajzen, 2020; Bosnjak et al., 2020).

3.2. Willingness to adapt

The determinants that make up the willingness to adapt, or psychosocial factors, were identified in the framework by de Boon et al. (2022) as being the attitude to innovation, risk attitude, (social) norms and values, and self-identity. *Attitude to innovation* encompasses in how far farmers are interested in finding out about and trying new things in general and whether they perceive this specific transition as something positive that will be able to achieve desired outcomes. The more interested farmers are in innovation and the more positive they think about this transition in particular, the more likely they are to be willing to adapt to it (Bosnjak et al., 2020; Caughron et al., 2021; Lockwood et al., 2015;

Marshall et al., 2012; Mase et al., 2017; van der Veen, 2010). *Risk attitude* describes if a farmer is in general risk averse or risk seeking and their perception of the risk of being negatively affected by the transition when continuing their current way of farming relative to the risk of changing their behaviour and other challenges that they might be facing simultaneously. When the farmer perceives not adapting as a higher risk, it is more likely that they will be willing to adapt (Cinner et al., 2018; Eakin et al., 2016; Grothmann and Patt, 2005; Zeweld et al., 2019). *Social norms and values* refer here to the farmers' perceptions of whether or not adapting to the transition is in line with the norms and values of the people whose opinions they value. This can include both perceptions on whether others that they value are adapting and more general perceptions of social pressure to adapt or not (Ajzen, 1991, 2020; Bosnjak et al., 2020). This is closely related to farmers' perceived social capital. When the social norms and values are perceived to be in line with adapting to the transition, then the motivation to engage in adaptive behaviour will be higher than if this is not the case (Darnofer et al., 2010; Lockwood et al., 2015). *Self-identity* encompasses here the farmers' personal norms, values, and goals and occupational identity. When the transition and required adaptive behaviour is in line with the personal norms and values of the farmer and contributes to the achievement of their personal goals, then the farmer will have a higher degree of motivation to adapt to the transition (Grothmann and Patt, 2005; Lockwood et al., 2015; Mills et al., 2021). Occupational identity relates here to the attachment the farmers have to their job and their perception of what it means to be 'a good farmer'. If adapting to the transition requires a substantial change in their job, farmers with a strong attachment to their occupation will likely be less inclined to conduct that adaptation. Likewise, if the adaptation goes against their perception of what 'good farming' is, then it is less likely that the farmer will be willing to adapt (Marshall et al., 2012; Morton et al., 2017).

Both the willingness to adapt and perceived adaptive capacity are influenced by the immediate context within which farmers operate (Bitterman et al., 2019; de Boon et al., 2022; Eakin et al., 2016). The immediate context is to a large extent formed by institutions, i.e. "systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles" (IDGEC, 1999, p. 14). They influence the ease with which farmers will be able to adapt to a transition (Berman et al., 2012).

3.3. Institutional characteristics to enable adaptive capacity

Gupta et al. (2010) have identified six dimensions that can be used to examine whether or not institutions are perceived to enable adaptive capacity: variety, learning capacity, room for autonomous change, leadership, resources, and fair governance. Grothmann et al. (2013) have extended this with two further dimensions: adaptation motivation and adaptation belief. *Variety* refers to a diversity of

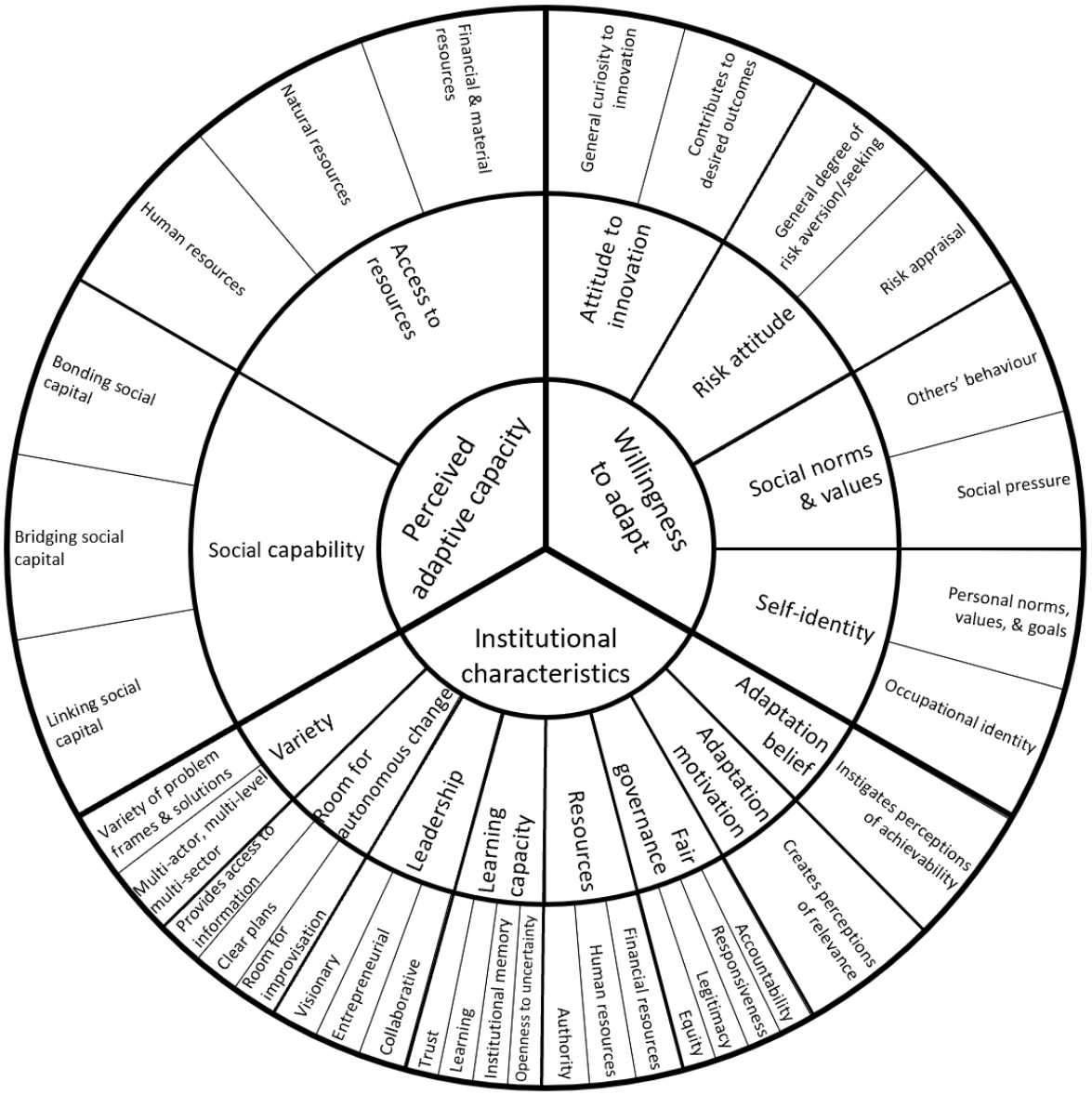

Figure 1. Operationalisation of perceived adaptive capacity, willingness to adapt, and institutional characteristics important for adaptation based on the literature. Adapted from Gupta et al. (2010) and Grothmann et al. (2013).

problem framings and solution strategies and the inclusion of diverse actors and stakeholders across all societal levels and multiple sectors in the process of solution identification (Gupta et al., 2010). This variety gives room to diversity in individuals' motivations (Pedersen et al., 2020) and can be of value in addressing uncertainty. *Learning capacity* describes the extent to which the institutions foster learning, are open to uncertainty, have an institutional memory, and promote mutual trust. *Room for autonomous change* describes the institutions' capacity to provide individuals with the information they require to adapt and clear plans that can be followed, as well as room and support for improvisation. *Leadership* refers to the degree to which the institutions encourage visionary, entrepreneurial, and collaborative leadership to emerge to lead through adaptation by example and

support collaborative efforts. *Resources* include the institutions' capacity to generate human resources, such as knowledge, skills, and financial resources to support adaptation, as well as having the authority to direct adaptation. *Fair governance* refers to the perceived legitimacy and equity of the institutions, the institutions' responsiveness to society, and the existence of mechanisms of accountability (Gupta et al., 2010). Finally, *adaptation motivation* refers to the degree to which decision-makers in the institutions give the impression that adaptation is relevant and *adaptation belief* refers to whether the institution instigate the feeling that adaptation can be achieved (Grothmann et al., 2013).

4. Methods

To assess farmers' perceived adaptive capacity and willingness to adapt in relation to the English agricultural sustainability transition, we conducted in-depth semi-structured interviews. We contacted farmers through mailing lists of farming organisations, the Just Farmers platform[6], the Farming Forum[7], a farmer WhatsApp group, and snowballing. In doing so, we contacted 61 farmers directly, and many more indirectly. We aimed to include farmers across England, spanning all agricultural sectors and farm types, ownership types, and a diverse range of age, gender, farm size, and experience with farming and environmental schemes. To ensure that we could also include farmers with poor or lacking internet connections, we offered to conduct interviews either via MS Teams, telephone, or in person. Through these methods we identified 16 farmers who were willing to be interviewed, two of which were married to each other so that we conducted a total of 15 interviews with 16 farmers.

To broaden our reach, we invited all of the 19 organisations who at the time had received an assignment from DEFRA under the Future Farming Resilience Fund to provide business support to farmers in the early transition stages, to participate in an interview (Powley, 2021). Eight of these organisations agreed to take part in an interview. Together, they are active across England, cover all agricultural sectors, and have collectively supported over 5,000 farmers in relation to the transition, through workshops or one-on-one advice. They therefore have detailed insights into the challenges and opportunities that farmers see on the road to adaptation. For two of the organisations, we spoke to two representatives within the same interview and for one organisation we had two separate interviews with two different representatives, meaning that we conducted nine interviews with organisations and spoke to a total of 11 representatives. By combining these interviews with the

[6] A project that aims to increase openness in British agriculture by providing a platform through which researchers and media can get in contact with independent farmers.
[7] A UK-run online forum for discussions of agriculture.

farmer interviews we reached data saturation. Annex A Table 3 summarizes key background characteristics of the interviewees and the interview guides are provided in Annex C. The interviews received ethical clearance by the University of Reading, took place during April-July 2022, lasted between 27 and 68 minutes, and were all conducted, transcribed, and analysed by the first author.

Analysis of the interview transcripts was conducted in NVivo 12 in an iterative manner. The material was categorized into initial themes following the dimensions and sub-dimensions of adaptive capacity as identified in the literature. Where appropriate, additional themes were added inductively. The farmer interviews and organisation interviews were analysed separately to identify potential differences in perceptions between them.

5. Results

Overall, the themes in the interviews showed many similarities with the dimensions of adaptive capacity and willingness to adapt identified in previous literature in relation to climate change and individual innovations. However, we identified several new aspects that have not yet been prominent in the adaptation literature discourse and additional nuance and detail that indicates that some of the already known aspects may have a slightly different role in relation to transitions specifically. A summary of the dimensions and sub-dimensions is provided in Table 1.

5.1. Dimensions of farmers' perceived adaptive capacity to agricultural transition

Most prominently mentioned were access to resources (financial, labour, and natural characteristics), bonding social capital, and farmers' state of mind. In terms of financial resources, it was highlighted that these can be both an enabling and preventing factor to adaptation. Having insufficient financial resources can be a hampering factor as there is no money available to invest in change, or a motivational force to make changes to keep your head above water. Equally, having access to sufficient financial resources can enable farmers to invest in adaptation, but can also form a barrier to it, as it reduces the incentive or need to make changes. This duality of the role of financial resources becomes clear in these contrasting statements:

> *"And I'm in the lucky position where financially it's not gonna have a significant impact if we don't bother following it through." (F3)*

and

> *"So it's all well and good to be 'do this, do that and you make loads of money'. If you don't have the money in the first place to do it, you've got to think of other sort of routes." (O9).*

In terms of natural characteristics, this included whether the soil quality or type, farming system, and/or the climate are seen as appropriate for specific measures that fall under the government proposals for the transition. In addition, the size of the farm and the presence or absence of other assets such as empty buildings that can be repurposed for diversification options have a strong impact on perceived adaptive capacity:

> *"It is tricky because potentially if I was to put several 100 acres into some sort of wildlife scheme, I then wouldn't have enough land to spread the muck on to get rid of […] utilize the muck from the pig unit in a responsible way." (F8).*

Equally, ownership over the land was seen as an important factor, with land owners being perceived as having a better position to adapt:

> *"And also tenants depending on what their landlord is thinking and with the new opportunities coming through that might just, they might not really have a choice with what the landlord wants to do" (O8).*

In terms of bonding social capital, having interactions with other (local) farmers was mentioned as a way to acquire needed skills and new ideas through peer-to-peer learning, sharing concerns, experience, and frustration. It was also seen as a way to share costs of adaptation by sharing needed machinery, thereby interacting with perceptions on access to resources.

The role of farmers' state of mind was brought up both by the organisations and the farmers. Both stated the importance of being in the right mindset to engage with change, feeling confident, having a positive outlook on life, and being able to cope with the mental stress of change: "*And there is my health as well to bear in mind, obviously my sanity and my well-being.*" (F14). Some of the organisations made this even more explicit by highlighting that there is a challenge of poor mental health among farmers and that this makes engaging with the transition very difficult for many:

> *"There is also an issue, it's been quite well published, in terms of anxiety and depression within farmers. […] And obviously when people are feeling under pressure in that way and feeling overwhelmed, they don't feel capable of implementing changes." (O5).*

Less prominently mentioned aspects that were regarded as important included reliable access to internet, technology, and active ingredients (e.g. fungicides, pesticides, and biostimulants), having people onboard with a business mindset, having the skills to sort through large amounts of information to understand how government documents translate into specific on-farm practices, having (access

to) the skills and knowledge to be able to implement required changes, and bridging social capital. The latter was highlighted by some of the organisations in terms of farmer organisations, consultants, agronomists, and vets providing support in breaking down government information around the transition and identifying the adaptation options that are available and suitable for the individual farm. Several farmers highlighted how being part of (farmer) organisations gives them a platform to give feedback to government on transition plans and learn from experience and ideas from farmers across the country. Other actors that farmers lean on for advice and support in relation to the transition include consultants, the vet, the bank, and salesmen (agronomists, machinery, fertilizer), although the latter were on occasion referred to in a negative light.

Linking social capital was least prominent in the interviews. Three of the organisations mentioned the importance of being able to seek out the government for financial support, highlighting interactions with perceptions on access to resources. Several of the farmers talked about the importance of having links to government in order to influence policy development or knowing people working for government who can give direct advice on how to interpret and action on government policy. Yet, two of the farmers expressed wanting to have as little as possible to do with government, for example:

> *"I try to have as little involvement with the government as I can, so in some ways BPS going would be great." (F7).*

Several expressed more generally that they are not in need of any kind of support and do not feel like they need input from anyone else, indicating that they do not think social capability contributes to their adaptive capacity.

5.2. Dimensions of farmers' willingness to adapt to agricultural transition

Most prominently mentioned were risk appraisal, perceptions of the transition contributing to desired outcomes, alignment with personal norms, values, and goals, occupational identity, and feeling respected, appreciated, and understood. Risk appraisal could work in favour of willingness to adapt, for example when the risk of not adapting was deemed too high or when adapting through diversification was seen as a strategy to spread risk:

> *"The more we can diversify our income, the better. […] Yeah, would be spreading risk for sure." (F13).*

Equally, it could also work against willingness to adapt, when making changes is seen as being too uncertain:

> *"I'm not sure what the changes are that I need to make. It is a bit like you hop out of bed to go to the loo. You shut your eyes and run down the corridor. You know that the bathroom is there somewhere, but exactly where is it? Are you going to find the bathroom first, or are you going to run into a brick wall?" (F10).*

Overall, it not only influenced whether or not farmers are willing to adapt, but also the kind of adaptations they are considering. The risk of (non)adapting to the transition was also generally considered in a wider context of risk and uncertainty stemming from climate change, new trade agreements, the current global political situation, and market changes, with the transition often not taking centre stage.

In terms of perceptions of the transition contributing to desired outcomes, the focus was on feelings of whether the required adaptation would benefit business profitability, whether it would address practical problems that the farmers were experiencing, whether it was aligned with changes that they were already thinking of making, and whether potential adaptation options aligned with personal interests around diversification options. This was also linked to whether the transition plans are regarded as being aligned with personal values such as caring about the environment or not being reliant on subsidies, or are perceived to contribute to personal goals such as maintaining a certain lifestyle, keeping the business going, and being able to pay staff: "*So, I think we would be changing anyway. This just focuses it and complicates it.*" (F2). One aspect that stood out in relation to personal goals was farmers' perceptions on succession options, seeing succession as a way to make the required adaptations happen or as a motivator to do them:

> *"obviously I'm heavily influenced by the idea that I was left this farm by my dad and I hope to make it available for my children to stay here if they want to." (F5).*

However, if the general idea of the transition is perceived as being in line with personal norms, values, and goals, but the way the transition is being designed is regarded as wrong, farmers become less willing to adapt:

> *"growing crops to go in a biomass boiler, from an ecological point of view, makes absolutely no sense at all. Yet you can earn money out of it. And you think it's just madness." (F11, Interviewee 1).*

In terms of occupational identity, the organisations highlighted that being a farmer is often not only an occupational identity, but part of farmers' general identity. If a transition is regarded as contradictory to the ability to produce food, farmers will be less inclined to adapt:

> *"I think they're all frustrated. They see their job as producing food. […] And they're very interested in these other things. But these are the things come along with that. Most of them don't see their job as producing these other things, and food comes along as an accident. What they're doing the job for is to produce food." (O3).*

The farmers differed in their views, with some stating that farming is so much more than just food production, which could also include taking care of the environment and taking on various diversifications. Others highlighted that all these things are "*another job*" (F11, Interviewee 2), and that it is therefore not something they want to do. Furthermore, when proposed adaptation strategies are regarded as poor farming, farmers are less inclined to implement them: "*And I think you gotta believe in it before you jump into it really.*" (F12)

In terms of feeling respected, appreciated, and understood, the organisations stated that farmers would be more willing to adapt to the transition if they would receive respect and recognition from the general public and the government for the work that they are doing:

> *"I think it makes a difference of how you talk about things and I think that's something farmers say as well that when government talks, they're not always fully supporting what they're doing, and they're kind of not recognizing the role they play." (O8).*

This was also echoed by the farmers, for example:

> *"I'm exasperated really with the blinkered one sided view. I'm offended actually, to be accused that what I do isn't sustainable." (F2).*

Several of the farmers stated that the feeling that they are not respected and understood and that society is out of touch with farming can be demoralizing and potentially a reason to give up on farming altogether, i.e. maladapt:

> *"I think people find it demoralizing. And I think it might be a reason that people, it could be one of the contributing factors to the reason people might start, if they do this golden handshake, people would take it." (F1).*

Less prominent in the interviews were general curiosity to innovation, behaviour of others, social pressure, and perceived level of control. In terms of general curiosity to innovation, important traits that were mentioned included being curious, open-minded, and willing to try things out and learn from mistakes. Being traditional, set in your ways, and not open to change on the other hand was pointed out as standing in the way of proactive advice seeking and engagement with the transition. The

behaviour of others was only brought up by some of the organisations as giving inspiration by being able to see the possibilities of how other farmers are adapting. In terms of social pressure, emphasis was put not so much on conforming to the norms and values of people whose opinions farmers value, but primarily on feeling pressure from consumers and the market to farm in a specific way. In terms of perceived level of control, several organisations highlighted that farmers are focusing on making adaptations around aspects that they feel like they can control, but do not adapt when they feel like something is out of their control. Furthermore, when farmers feel like they have ownership over the adaptation decisions and the kind of adaptation pathways they can take, they are more willing to make the required changes:

> *"Maybe if you've decided you're gonna change something about your business, that's much easier, so that feels very different to feeling that you have to change because the government is painting the goal post." (O8).*

An aspect that was not prominent in the interviews was the role of the general degree of risk aversion or risk seeking.

5.3. Dimensions of institutional characteristics perceived by farmers to influence adaptation to agricultural transition

Most prominently mentioned were three clusters of aspects: 1) legitimacy, trust, institutional learning, institutional memory, equity-fairness-justice, and inclusion of multi-actors, multi-levels, and multi-sectors, 2) visionary leadership, clear plans, access to information, and variety of problem frames and solutions, and 3) adaptation motivation and belief. All three clusters were strongly interrelated.

In the first cluster, in terms of legitimacy, or the lack thereof, the organisations highlighted that the relationship between farmers and DEFRA is constrained:

> *"I think it's also worth noting that 49-50% of the farmers weren't confident with their relationship with Defra, but that's of a cohort of mostly arable or mixed farmers. And that's not including many solely livestock farmers, which I imagine would have very little confidence in DEFRA." (O7).*

This situation was perceived as hampering farmers in wanting to give support to the government and adapt to DEFRA's plans. This constrained relationship was rooted in past experience, different views on how land should be used, a perception that DEFRA does not communicate openly on their real aims, and a belief that they do not know what they are doing:

> *"Not over positive for the way this government, no, at the moment not. I don't think they've got it really. I don't think they do, yeah. There is people within there that are, but they're not being heard." (F12).*

Linked to this lack of legitimacy, and further hampering willingness to adapt, was a lack of trust. The organisations pointed to a distrust in government, government agencies, and experts that is keeping farmers from taking up their advice and following their directions:

> *"There's something, if that's the advice they're being offered, it can't be the advice that they need. Do you see? It's that thing about not trusting expertise." (O3).*

This was echoed by the farmers, for example:

> *"any advice we got from government, I would spend days analysing whether I thought it was any good. We wouldn't accept anything." (F11, Interviewee 1).*

The farmers indicated that this lack of trust stems from a variety of reasons, including the impression that the government does not care about agriculture due to the kind of trade agreements that they are entering into and not stepping up to support farmers when they need it, feeling that the government does not have the capability or even desire to do what is right for farming, and perceptions that government is saying that it will do A but then does B or nothing at all.

Interacting with this were also perceptions on institutional learning and institutional memory, where perceptions that the government is not learning from the past, is trying to re-invent the wheel, and has seemed to have forgotten previous schemes, are negatively impacting trust. They also practically hamper perceptions of adaptive capacity when there is a disconnect in the transition from old to new schemes:

> *"And I suppose the other challenges as well is that as the BPS and one scheme comes to an end, you want to be in a position to immediately seamlessly move to another scheme. But there's a sort of hiatus gap between the old scheme and the new scheme." (F6).*

In terms of the inclusion of multi-actors, multi-levels, and multi-sectors it was highlighted that these all need to be linked up through a holistic approach in order to foster adaptive capacity. The diverse range of actors that interact with farmers need to have a shared understanding and communicate a joint message on the transition. Impacts and influences across governance levels need to be considered. Furthermore, as farmers are affected by multiple policy areas, it is important for adaptive capacity that these areas do not work in siloes and ask contradictory things of farmers:

> *"And I think that one of the issues at the moment is that there is less than perfect clarity about what government really want from farming. Different bits of government seem to have sort of slightly different agendas." (O2).*

This lack of a coherent, holistic structure and message around the transition also negatively impacted perceptions of legitimacy, institutional memory, and trust.

A perceived lack of fairness and justice in the transition policies was mentioned by farmers as another strong hampering factor for adaptation. For example, when transition policies were considered to be morally wrong by neglecting their implications on a geographical scale beyond England, when they were seen as unfair because they do not alter the cheap food policy, or because farmers in other countries are receiving support that English farmers are not receiving:

> *"I think I can compete and produce beef and lamb as well as anyone else. But I can't do it if I'm continuously having my hands tied on my back and somebody else is being helped. You know it's just getting too unfair really. So I think that's the biggest obstacle." (F5).*

In the second prominent cluster, all aspects that were brought up related to the need for clarity. In relation to visionary leadership, it was highlighted that farming requires long term planning, so any adaptation efforts require a stable long-term vision, as one farmer stated:

> *"So I think clarity. We were talking about it being a long term job. You can't jump in and out of food production." (F2).*

The lack of long-term thinking, understanding of potential long-term consequences, and assurance of the stability of the direction that the transition is taking by the government were regarded as hampering factors for adaptive capacity.

Equally, clear (short-term) plans were also emphasised as being essential. Without these in place farmers feel like they are unable to make decisions and adapt their farms:

> *"It's so unknown what the plans are of the government. I think everyone's a bit up in the air about it. And a bit like we just carry on how we're doing it because we don't know what's gonna happen." (F1).*

Incomplete or constantly changing plans make it difficult to grasp what is required and do not provide a solid basis to make sometimes drastic, long-term adaptation decisions. This also relates to the availability and accessibility of information on the transition plans as they currently stand and what is

to be expected further down the line. However, several organisations highlighted that it is not just the availability of information and the way in which that information is communicated (in accessible language) that is important, but also being able to know what to do with it:

> *"However, the downside of so much information is that people are just generally feeling really quite bamboozled. […] They've got the information but it's now what do you do with it?" (O5).*

In addition, it is about the right balance, as the availability of too much information can also be a hurdle.

The right balance and clarity are also important in relation to variety of problem frames and solutions. The existence of some variety is important according to both the farmers and organisations because every farm is different, and therefore one-size-fits-all solutions to bring about the transition would be inappropriate. However, the availability of too many different solutions can be overwhelming and complicate finding an appropriate adaptation strategy:

> *"it's almost at the moment there is so much permutations and variations of schemes and requirements and understandings and undertakings. It's pretty tricky at the moment to try and find a way through it all." (F8)*

The third cluster of prominent aspects that were highlighted links the other two together. A lack of trust, legitimacy, and clear plans strengthened perceptions that there is a lack of adaptation motivation amongst government, which in turn was brought up as an important separate factor in farmers' adaptation decisions:

> *"Well, I think I'm not confident that the government is going to see it through. That is the problem." (F15).*

Feeling that the government does not really want to make the transition work, that there is a lack of political will, and that statements on the transition are just made for PR purposes, negatively impact farmers' willingness, and sometimes ability, to make any adaptations on their farm, as one farmer explained:

> *"But I want to be in environmental schemes and DEFRA have been obstructive. I do not believe that they believe the rhetoric of their own publicity." (F2).*

In addition, there was a feeling amongst the farmers that the transition is not done properly, indicating a lack of adaptation belief. They had the perception that the government does not know what it is doing, for example:

> *"I would say it's a mess. I don't think, the politicians certainly don't understand what they're doing." (F4).*

There was also a perception that the proposed plans are not capable of solving the problems that the farmers think the transition should be addressing. Both of these aspects created a negative perception of the transition, and made the farmers less willing to adapt to it.

Important factors that the farmers highlighted here include a worry that the transition plans cannot be integrated with food production, thereby creating food insecurity and rising food prices, that the policies are designed to fail, that the timescale is too little too late, and that other governmental activities relating to trade agreements will undercut the transition by effectively lowering environmental and animal welfare standards. Another major worry and hampering factor for adaptation belief was a perception that the whole of the transition was a form of greenwashing, as an expected reduction in food production due to the transition would mean that England would import more food and thereby only move the environmental footprint of food production elsewhere, rather than actually improving environmental impact. As one farmer stated:

> *"But you don't produce as much food. And do you then just shift food production elsewhere in the world and import it? And if you're doing all of this for environmental reasons, that to me also doesn't make sense, because if you're importing food that could be grown locally, and eaten locally, why spend sort of carbon credits, if you like, on importing it to this country?" (F9).*

Less prominently mentioned were access to resources, room for improvisation, responsiveness, and collaborative leadership. In terms of access to resources, the capacity of government to provide financial support to farmers to help them make changes on the farm and clarity about the availability of government funding was highlighted. Likewise, the lack of availability of human resources, in the form of impartial, independent expertise were stated as negatively contributing to perceived adaptive capacity. This also included perceptions on the inadequacy of infrastructure for independent research and training, as well as the unavailability of enough staff to administer the transition. Several of the farmers also discussed government authority as an important resource by providing some degree of

market control and steering through regulations. This was perceived to give farmers a better position to make adaptations. However, one organisation and one farmer pointed out that it was important to have some flexibility in guidelines, thereby providing room for improvisation. That way, the farmers themselves could decide how to enact guidelines in a way that works best for their farm: "*but if they're too restrictive, we just won't do it.*" (F7).

Responsiveness, or a lack thereof, was also brought forward as being important. Especially governments' (lack of) responsiveness to market change and reactions from other countries to this was regarded as influencing the ability of farmers to adapt. As one farmer described: "*the world has changed. But the government is not thinking.*" (F10).

Collaborative leadership was mentioned in a dual light: it was perceived that support from government to create collaborations between farmers and involving farmers in the transition design was valuable and would ease adaptation. But it was also stated that collaboration takes up a lot of time and takes away from the clarity of the transition process, thereby making it more difficult to adapt.

Aspects that were not mentioned in the interviews include entrepreneurial leadership, accountability, and institutional openness toward uncertainty.

6. Discussion

The results of this study present deeper insights into aspects influencing perceived adaptive capacity and willingness to adapt in the context of transitions. They showcase the complexity of farmers' agency in deciding if and how to react to an ongoing transition and the impact that institutional structures and processes have on these decisions. The qualitative nature of this study allowed us not only to identify key influencing aspects but also to gain a more nuanced understanding of their role. The limitation of this approach is that whilst we ensured to include interviewees across farming sectors, farming types, locations across England, and stage in life, and furthered our reach by including representatives of organisations who work with many farmers, our sample is not representative and relatively small compared to the total number of farmers that are active in England. In addition, it is a commonly known problem that some farmers are more difficult to include in research (Hurley et al., 2022), indicating that it is highly likely that a sample of farmers such as ours is skewed toward farmers who are generally more engaged with the transition. However, many of the sentiments that were expressed in our interviews are also reflected in the general trends in opinions that have been recorded in DEFRA's Farmer Opinion Tracker for England in the last three years (DEFRA, 2020c; 2021c; 2022a), and therefore are likely to be largely in line with the wider farming community.

Table 1. Summary of contributing factors to farmers' perceived adaptive capacity and willingness to adapt to transition.

Perceived Adaptive Capacity	Willingness to adapt	Institutional characteristics
Access to resources	***Attitude to innovation***	***Resources***
Financial & material resources	*General curiosity to innovation*	*Financial resources*
sufficient money (+/-)	openness to change	long-term funding
internet*	willingness to try & fail	*Human resources*
technology	*Contributes to desired outcomes*	independent advice & research
active ingredients (fertiliser, pesticide, etc.)*	addresses perceived problems	labour
Human resources	keeping business going	*Authority*
labour	improving environment	market control
knowledge	aligned with personal interests	steering through regulation
skills	***Social norms & values***	***Leadership***
Natural resources	*Others' behaviour*	*Visionary*
natural characteristics	gaining inspiration	commitment to long-term plan
assets for diversification	*Social pressure*	*Collaborative*
land ownership*	market pressure	enabling farmer-to-farmer learning
farming system	consumer support	involving farmers in transition design
Social Capability	***Risk attitude***	time consuming & reduces clarity (-)
Bonding social capital	*General degree of risk aversion/seeking*	***Fair governance***
local farmers	openness to risk	*Responsiveness*
staff	*Risk appraisal*	to global change
friends	spreading risk	to feedback
Bridging social capital	reducing risk	*Legitimacy*
farmer organisations	no perceived alternative	communicate openly on aims
environmental organisations	risks from other developments	showing competence
internet	***Self-identity***	fostering good relationships
consultants	*Personal norms, values, & goals*	*Equity/fairness/justice*
agronomists	succession options*	morally acceptable policies
vet	stage in life & career	fairness compared to other countries
salesmen	lifestyle	***Variety***
accountant	maintaining business	*Variety of problem frames & solutions*

Perceived Adaptive Capacity	Willingness to adapt	Institutional characteristics
consumer	improving environment	acknowledge difference
Linking social capital	policy preferences	no one-size fits all
government support	*Occupational identity*	within reason (not too many options)
knowing people in government	good farming practice	*Multi-actor, multi-level, multi-sector*
participating in pilots	part of the job	holistic
State of mind*	***Feeling respected, appreciated, & understood****	comprehensive
*Mental health**	*Recognition for work**	coherent
*Confidence**	*Valuing food**	***Learning capacity***
*Positive outlook**	***Perceived level of control****	*Learning*
	*Ownership over change**	showing willingness to learn
	*Control over situation**	act on lessons from the past
		Institutional memory
		not re-inventing the wheel
		build on what is there
		Trust
		following through
		providing support
		showing competence
		consistency
		Room for autonomous change
		Room for improvisation
		flexibility
		Provides access to information
		timeliness
		quantity*
		accessible language
		through multiple channels
		Clear plans
		detailed
		consistent

Perceived Adaptive Capacity	Willingness to adapt	Institutional characteristics
		complete
		Adaptation motivation
		Political will
		Showing action
		Adaptation belief
		*Considering (global) consequences**
		*No greenwashing**
		Effectiveness
		Showing competence

* Indicates aspects that were not prominent in previous literature on adaptive capacity and willingness to adapt in relation to climate change or specific individual innovations.

Aspects marked in green were most prominent in the interviews.

Whilst we found many similarities with previous adaptation literature in the context of climate change or individual innovations, there were also aspects that have not yet been prominent in the literature and thus seem to be specific for adaptation in relation to transitions. These included the dual role that access to finances and information can play (especially the potential hampering factor of having access to plenty of financial resources and 'too much' information); land ownership status; state of mind; succession options; feeling respected, appreciated, and understood; perceived level of control; and considerations of (global) consequences. In terms of the hampering factor of access to too much information and the role of farmers' state of mind, a potential reason why this is more prominent in relation to transitions than in relation to climate change and individual innovations is the scale and diversity of change of a transition. Rather than receiving information and needing to react to one particular innovation or threat, they receive information and need to make adaptation decisions about multiple changes simultaneously (Geels, 2011) which more easily might become overwhelming and create mental stress. In addition, individual innovations are, generally speaking, less impactful than a transition, as only one thing changes rather than the entire context within which the farmer has to operate.

In terms of the potentially hampering role of access to plenty of financial resources and perceptions on considerations of global consequences, as well as the role of feeling respected, appreciated, and understood, feeling in control, and succession options, a potential reason for why these aspects are prominent in our results but not in the previous literature is the more overt normative and prescriptive nature of transitions in comparison to individual innovations or climate change. Where there exist generally multiple pathways to adapt to climate change, with multiple accepted new 'end states' (Eisenhauer, 2016; Leach et al., 2007), transitions tend to be more prescriptive, following a specific mission, with only few accepted and supported adaptation pathways (Geels, 2011; Hekkert et al., 2020; Klerkx and Begemann, 2022). Equally, individual innovations generally do not question the overall acceptability of the agricultural system as a whole, and the role and identity of farmers within that.

In terms of the prominence of land ownership status, we think that this was more prominent in relation to transition than in the previous literature because several of the adaptation options that are supported by the government in the specific transition that we looked at require large-scale, long-term changes to the landscape (e.g. rewilding, planting trees, taking land out of agricultural production) (DEFRA, 2022a; 2022b). In the case of tenant farmers, such actions generally require approval by the land-owner. This will less often be the case when it comes to specific individual innovations (e.g. adopting a new kind of tractor or harvester, feed for livestock).

There were also a number of aspects that have been prominent in previous literature (e.g. Grothmann and Patt, 2005; Gupta et al., 2010; Zeweld et al., 2019) but that were not in our interviews, namely general degree of risk aversion/seeking, institutional accountability, entrepreneurial leadership, and institutional openness toward uncertainty. In terms of general degree of risk aversion/seeking, this may be the case because it requires a high degree of self-awareness to recognise one's own character traits as being a hampering or enabling factor for adaptation and we did not ask about this aspect explicitly unless it was brought up by the interviewee themselves. In terms of entrepreneurial leadership, we expect that this aspect has been overshadowed by the stated lack of trust and perceived legitimacy, i.e. if there is no trust in, and perceived legitimacy of, institutions, it is not likely that one would look at these institutions for leadership by example (Stupak et al., 2021). In terms of the lack of mentions of the aspect of accountability, a potential reason for this is that, in our institutional context, it is clear that DEFRA is the responsible institution to develop and implement the transition. In the case of climate change or individual innovations on the other hand, there are often many more (institutional) actors who potentially carry responsibility, which makes accountability more blurred and, therefore, a more salient aspect in the minds of farmers. In terms of institutional openness toward uncertainty, we think that this was not addressed by our interviewees because it was overshadowed by the perception that there currently is too much uncertainty in the transition plans. So, rather than focusing on room to discuss doubts, our interviewees wanted clarity.

Overall, our results showed that multiple of the aspects influencing perceived adaptive capacity and willingness to adapt are highly interconnected. One aspect that is on its own seen as an enabling factor can potentially become a hampering factor when it interacts with another aspect. An example of this is access to sufficient financial resources becoming a hampering factor when the transition is not aligned with personal, norms, values, and goals, as it then provides the option to not adapt to the transition. This means that when policy makers want to improve perceived levels of adaptive capacity and willingness to adapt, it is essential that they do not only focus on one aspect in isolation but take a more holistic approach (Mills et al., 2021). The overview of the structure of perceived adaptive capacity and willingness to adapt that we have built in this study can be used by policy makers in support of that. Furthermore, we also identified that perceptions of trust, legitimacy, clear (long-term) plans, and institutional memory and learning have a strong reinforcing impact on each other and on multiple other aspects, including adaptation belief, adaptation motivation, and risk appraisal. For example, having negative perceptions of trust also negatively influences perceptions of adaptation belief and institutional learning and vice versa. Focusing efforts to amplify perceived adaptive capacity and willingness around these sets of aspects will therefore likely be an effective and efficient approach.

Whilst our study focused on agricultural transitions specifically, we expect that these overarching lessons can also be relevant for transitions in other sectors, as they appear to be linked more generally to the nature of transitions than to the specifics of agriculture. However, the more detailed lessons, such as the ones in relation to land ownership status will likely be more specific to agriculture and similar sectors that are based around land use. Indications that underpin these expectations are similarities in our findings to findings for example by Hagerman (2016) and Lawrence and Marzano (2014) who examined adaptive capacity in forestry and Phan et al. (2021) who looked at adaptive capacity in tourism.

7. Conclusion

In this study we set out to gain deeper understanding of the aspects that influence perceived adaptive capacity and willingness to adapt in the context of transition, both of which impact individual agency in adaptation decision-making and are influenced by the disruptive and normative nature of transitions. Understanding what aspects make up the perceived level of adaptive capacity and willingness to adapt is a first stepping-stone to understanding who is likely to benefit or lose out from a transition, and thus who might need to receive extra support through governance arrangements. Our study of English farmers' perceptions in the context of the post-Brexit agricultural transition highlighted that there are a wide variety of interconnected aspects that influence perceptions of adaptive capacity and willingness to adapt, the majority of which are expressions of the normative and disruptive nature of transitions. Through our in-depth qualitative approach, we identified several aspects that have not yet been prominent in previous literature on perceived adaptive capacity and willingness to adapt in relation to climate change and individual innovation. Therefore, if we want to understand these aspects in the context of transitions, we cannot solely rely on adaptive capacity literature that has been developed within other contexts. Further research is needed to strengthen and further develop our findings, for example through case studies in other geographical locations or sectors.

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Annex A.

Table 1. Structure of the agricultural sector in England in 2017.

Based on DEFRA and Government Statistical Service, 2019. The future farming and environment evidence compendium. September 2019 - update. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834432/evidence-compendium-26sep19.pdf, accessed 28.02.2022.
Note: data for Gender and Age are for 2016, as this is measured less frequently.

Farm Type	Percent of total	Ownership Type	Percent of total	Farm holder gender	Percent of total	Farm holder age	Percent of total
Lowland grazing livestock	31%	Owner occupied	52%	Male	84%	Younger than 35	2%
Cereals	18%	Mixed tenure	34%	Female	16%	35-64	58%
General cropping	16%	Wholly tenanted	14%			65 and older	40%
LFA[8] grazing livestock	12%						
Mixed	8%						
Dairy	6%						
Horticulture	4%						
Poultry	3%						
Pigs	2%						
Unclassified	1%						

[8] LFA= Less Favoured Area, describing environmentally challenging areas.

Table 2. Contribution of Direct Payments to farm business income in the period 2016-2018 divided by farm type and farm size.
Based on: DEFRA and Government Statistical Service, 2019. The future farming and environment evidence compendium. September 2019 - update. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834432/evidence-compendium-26sep19.pdf, accessed 28.02.2022.

Farm Type	**Average Farm Business Income**	**% Direct Payments**	**Farm Size[9]**	**Average Farm Business Income**	**% Direct Payments**	**Ownership type**	**Average Farm Business Income**	**% Direct Payments**
Lowland grazing livestock	£17,700	86%	Spare & part time	£16,600	77%	Owner occupied	£30,800	60%
Cereals	£45,200	73%	Small	£26,100	73%	Mixed – mainly owner occupied	£54,300	53%
General cropping	£78,000	54%	Medium	£39,100	63%	Mixed – mainly tenated	£63,700	54%
LFA Grazing livestock	£27,000	88%	Large	£56,100	58%	Tenated	£28,400	86%
Mixed	£29,600	103%	Very large	£127,900	46%	All farm types	£43,400	58%
Dairy	£75,900	34%	All farm types	£43,400	58%			
Horticulture	£42,000	9%						
Poultry	£107,500	8%						
Pigs	£39,600	26%						
All farm types	£43,400	68%						

[9] Size determined based on standard labour requirements (LSR), spare & part time refers to farms with less than 1 SLR, small includes farms with 1 to less than 2 SLR, Medium includes farms with 2 to less than 3 SLR, Large includes farms with 3 to less than 5 SLP, and Very large includes farms with 5 or more SLR.

Table 3. Background characteristics of interviewees

Farmers		Organisations	
Number of interviews	15; interview F11 included two interviewees (husband and wife) simultaneously	Number of interviews	9; interviews O7 and O8 included two interviewees simultaneously and interview O1 and O2 were with representatives of the same organisation
Agricultural sector	Arable, Dairy, Beef, Sheep, Pigs, Poultry, Horticulture, Agro-forestry (most farmers had a mixed farm)	Agricultural sector covered	All
Farm type	Conventional, Organic, Pasture For Life Certified	Location covered	Whole of England
Ownership type	Owned, Tenated, or mixed owned/tenated	Kind of support provided	One-to-one advice, workshops
Farm size range	69 - 2470 acres	Mode of interview	All interviews were conducted via MS Teams
Location	East, South, South West, South East, East Midlands, West Midlands		
Average age	54		
Gender	13 Male, 3 Female		
Mode of interviews	1 interview was conducted in person 3 interviews were conducted via phone 11 interviews were conducted via MS Teams		

Annex B. Overview of post-Brexit agricultural schemes proposed in England around the time of our interviews (April-July 2022)

Note: there also exist several schemes in support of woodland creation. These have been excluded here, as they are not mentioned as part of the transition plan (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/954283/agricultural-transition-plan.pdf). However, farmers are able to apply for these kind of schemes as well if they fulfil the eligibility criteria.

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
Environmental Land Management						
Sustainable Farming Incentive	Support production of public goods, contributing to 25 Year Environment Plan, Net Zero, & animal health & welfare standards	> The scheme consists of several standards that farmers can apply for. Each standard has 3 levels that farmers can choose from (introductory, intermediate, & advanced), although not all levels are available yet. Each level covers a set of specific actions that a farmer needs to undertake when taking part in this scheme. Payment rates increase from the introductory to the advanced level. There is a plan to introduce more standards from 2023 onwards. > Farmers can enter individual fields rather than the farm as a whole. > Duration of agreements: 3 years, with flexibility to amend every 12 months. > Payment rates will stay stable for the first 3 years of agreements made in 2022, both payment rates and standards will be updated after this period > The scheme will be underpinned by the Agriculture (Financial Assistance) Regulations - which are currently being updated.	> Farmers with land fully located in England, initially only those who are eligible for BPS, wider eligibility to all farmers expected after 2024 > Agreement holders must have management control of the land for the duration of the agreement	Pilot started in 2021; rollout of full scheme from 2022		DEFRA, 2021a
Local Nature Recovery	Making space for nature in the farmed landscape and countryside	> The scheme is still under development, with details on the rules and proposed payment rates still to be revealed. > So far, it is set to focus on payments for managing feeding, shelter & breeding areas for wildlife on arable farms; managing, restoring, & creating wetland habitats, lowland heathlands, & costal habitats; managing & restoring upland & lowland peat & moorland areas on farms & in the countryside; managing & creating trees & woodlands; restoring rivers, flood plains, streams & riparian habitats; targeted measures to support the recovery & reintroduction of particular wildlife species; & nature-based solutions for water > Length of agreements will depend on the activities undertaken, but in all instances, they will cover multiple years	> Farmers, foresters, & other land managers; as individuals or as groups collaborating together > Farmers can be enrolled in SFI & this scheme simultaneously, when actions are compatible & there won't be double payments on the same actions	Aimed at opening the scheme for testing to a limited number of people in 2023, with full roll out of the scheme starting at the end of 2024		DEFRA, 2022a

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
Landscape Recovery	Support long-term significant habitat restoration & land use change	> The scheme will fund large scale projects. The first round of pilot projects should focus on recovering & restoring England's threatened native species or restoring streams & rivers. Projects will be selected based on longevity, environmental benefits, carbon & climate resilience, social impact, project leadership & delivery, & costs. Funding will be divided in a project development & an implementation stage. It is aimed for that funding will stem both from DEFRA & the private sector. There will not be specific actions that will be paid for, rather project funding will be based on negotiated bespoke agreements.	> Any individual or group who can deliver large scale projects (500-5000 ha) > The scheme will be competitive; in the first round of pilot projects up to 15 projects can receive funding	Pilots to run between 2022-2024		DEFRA, 2022a
Farming in Protected Landscapes	Support nature recovery, mitigate climate change impact, protect/improve quality & character of the landscape, & provide opportunities for people to discover & enjoy the landscape & its cultural heritage	> Projects need to be in line with priorities of the relevant protected landscape body's management plan. Projects can receive up to 100% funding for the project costs if the project does not generate commercial gain. If projects do generate commercial gain, only a portion of the project costs can be funded. After the programme ends, no natural, cultural, or access activities need to be maintained. Capital infrastructure & machinery assets need to be maintained for 5 years from the completion/purchase date.	> Farmers & land managers in Areas of Outstanding Natural Beauty, National Parks & the Broads; farmers & land managers on land outside of protected landscapes. > Applicants must manage all the land included in the application & have control of all the activities they like to undertake; or written consent from all parties who manage & control the land > Others can apply when collaborating with a farmer or land manager, or in support of a farmer or group of farmers	July 2021	March 2024	DEFRA, 2021b
Tree Health Scheme	Slowing the spread of pests & diseases in specific trees	> Grants will be provided to cover some of the costs of work related to removing and replacing diseased trees; throughout the pilot phase tree types or pests and diseases as well as grants or payment rates might be changed, removed, or added. Set agreements will not be affected by this. All applications must have a minimum value of £500. > The scheme is competitive, around 100 grant agreements will be allocated in total	> Landowners, occupiers, tenants, landlords, & licensors; can also include others who manage trees on behalf of others (e.g. local council, charity, or land agent) > Primary target areas include Arnside, Silverdale Area of Outstanding Natural Beauty, the Lake District National Park, Kent, East Sussex, Malvern Hills & Shropshire Hills Area of Outstanding Natural Beauty >Type of trees/woodlands need to be either ash with ash dieback, larch with Phytophthora ramorum, spruce growing in the high-risk spruce bark beetle (Ips typographus) area, or sweet chestnut	Pilot starts August 2021	Pilot ends 2024	Forestry Commission & DEFRA, 2021

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
			with Phytophtora ramorum or sweet chestnut blight > Both individual & group applications are allowed > People who already receive funding through other agri-environment or woodland schemes cannot take part in the pilot			
Animal Health and Welfare Pathway	Gradual & continual improvement in farm animal health & welfare					DEFRA, 2022b
Annual Health and Welfare Review	Rewarding higher animal health & welfare, above the regulatory baseline	> Provides funding for an annual visit from a vet to consider health & welfare of the animals	> Initially for cattle, sheep, & pig farmers who are eligible for BPS & who have more than 10 cattle, 20 sheep, or 50 pigs > The aim is to make it available to farmers outside BPS as soon as possible	2022	Intended to end after 3 years	
Animal health and welfare capital grants	Support the delivery of health & welfare priorities	> There will be smaller grants where farmers can select from a specific list of equipment & technology items & larger grants for bespoke infrastructure projects > The scheme is competitive	> Initially open to livestock farmers with cattle, pigs, sheep, meat chickens, & laying hens > Plans to open the scheme in future to goats, ducks, or turkeys	Planned for late 2022		
Disease eradication and control programmes	Support to prevent & reduce endemic diseases and conditions	> The focus of the scheme will initially target Bovine Viral Diarrhoea in cattle, Porcine Reproductive & Respiratory Syndrome virus in pigs, & tailored health screening for sheep. > The programme is still under development.	> Initially targeted at livestock farmers with cattle, pig, & sheep	From 2023		
Payments-by-results	Rewarding high animal health & welfare outcomes	> The scheme will focus on contributing to costs associated with higher welfare practices, but is still under development.	> Currently under consideration are livestock farmers with dairy cattle, beef cattle, pigs, sheep, laying hens or meat chickens	Trailing in 2023; possible full-scale offer from 2025		
Farming Investment Fund	Improving productivity & bringing environmental benefits			2021	Planned to continue at least until 2025/ 2026	DEFRA, 2020

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
Farming Equipment and Technology Fund	Improve productivity & efficiency for farming, horticultural, & forestry businesses	> Provides grants between £2,000 & £25,000 towards the cost of new equipment & technology (a list of specific items that are eligible is provided by the government). > Grant payments are made after the items have been bought, so applicants need to have sufficient funds to initially pay for all the items themselves. > For each eligible item there is a set price that will be funded; if the real cost of the item is higher than what is stated in the list, the applicant has to pay the difference themselves.	> Farmers, horticulturalists, & forestry owners > Contractors who have a registered business address in England	The first round started end 2021	First round closed January 2022	Rural Payments Agency, 2021a
Farming Transformation Fund	Improve productivity, profitability, & environmental sustainability	> Grants are available for large capital investments related to water management, improving farm productivity, & adding value.				DEFRA, 2020
Water Management grant	More efficient water use for irrigation & securing water supplies for crop irrigation	> There is a specific list that describes the items that are eligible for funding under this grant. > For each project, the minimum grant you can apply for is £35,000. The maximum grant is £500,000 per theme per applicant business. > Grants can cover up to 40% of the eligible costs of a project. The minimum total eligible cost of a project would therefore be £87,500. >At least 60% of project costs must be paid for with money from private sources & remaining project costs must be covered by the applicant. > The scheme is competitive.	> Arable & horticultural businesses who grow, or intent to grow, irrigated food crops, ornamentals, or forestry nurseries. > The land must be owned by the applicant or have a tenancy agreement in place until 5 years after the project has completed.	November 2021	Deadline for full applications is 30 June 2022	Rural Payments Agency, 2021b
Improving Farm Productivity grant	Reducing environmental impacts	> The grant covers slurry treatment equipment & robotics & innovation equipment (both up to 40% of the costs). > Minimum grant that can be claimed for is £35,000 (40% of £87,500). The maximum grant available under the Improving Farm Productivity theme is £500,000 per applicant. > Applying to both slurry treatment & robotics projects is possible, but 2 separate applications need to be submitted. > The maximum grant amount for both projects is £500,000 in total. >At least 60% of project costs must be paid for with money from private sources & remaining project costs must be covered by the applicant.	> Farmers and horticulturalists > The land must be owned by the applicant or have a tenancy agreement in place until 5 years after the project has completed.	January 2022	Application period for eligibility check closed March 2022; deadline for full application 14 September 2022	Rural Payments Agency, 2021c

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
Future Farming Resilience Fund	Support farmers to transition their business to the new policy landscape	> Through this fund funding has been awarded to 19 organisations to provide free advice/support to farmers who are in receipt of BPS payments. > Farmers signing up to the scheme can receive help in understanding the changes that are under way, identifying how, what, & when they need to adapt their business model, & receive tailored support to address the changes.	> Farmers who are in receipt of BPS payments	August 2022	2024	DEFRA, 2021c
Farming Innovation Programme	Increase productivity, sustainability, & resilience, reduce environmental impact, apply agricultural research, & use science to address challenges		> Will depend on the specific competition	October 2021	The fund is set to be active at least until 2025/2026	DEFRA 2020; UK Research and Innovation, n.d.
Industry-led Research and Development Partnership Fund	Supporting research ideas, project implementation, development of new products or services, and long-term innovation	> Several competitions aimed at a) exploring ideas and developing a team (project size between £28-56K, project length up to 1 year), b) checking if an idea works in practice, (project size between £200-500K, project length up to 2 years), c) developing a new product or service (small projects of up to 3 years with a project size of £1-3 million and large projects of up to 4 years with a project size of £3-5 million), and d) work on longer-term innovations (project size between £3-6 million, project length up to 4 years).		October 2021	The fund is set to be active at least until 2025/2026	DEFRA, 2020; Innovation Funding Service, 2022
Farming Futures Research and Development Fund	Supporting the Net Zero Strategy	> Competition based; aimed at funding high-value collaborative projects between businesses & researchers to reduce greenhouse gas emissions & adapt to climate change. > Project size will be between £3 million to £6 million, with a project length of up to 4 years.		March 2022	The fund is set to be active at least until 2025/2026	DEFRA, 2022c
Projects to Accelerate Adoption Fund	Supporting farmer-led projects to trial the viability of new innovations on farm	Not yet clear.		Sometime in the end of 2022		DEFRA et al., 2021

Scheme	Aim	Summary of how the scheme works	Eligibility	Start date	End date	Source
New Entrant Support Scheme	Encourage new starters into farming	Not yet clear.	> Not yet clear; will be developed in partnership with stakeholders	Applications are set to open in 2022	Likely until 2023/2024	DEFRA, 2020, 2021d; Bidstats, 2022
Lump Sum Exit Scheme	Supporting farmers who wish to retire or take up a different occupation & freeing up land for new entrants & existing farmers who wish to expand	> The amount of the payment is based on a reference amount, which is calculated based on the average BPS payments made to the business for the BPS 2019-2021 scheme years. > The reference amount will be capped at £42,500. > The lumpsum will be equivalent to the amount that could have been paid out through Direct Payments for the period 2022-2027 (except when affected by the cap). > To receive the lump sum, the farmer has to transfer out the land in England which was agricultural land 'at your disposal' on 17 May 2021 (the BPS 2021 application deadline). This land will have been eligible for BPS &, if you claimed BPS 2021, it should be shown on your BPS 2021 application. > The land does not need to be transferred out all at the same time nor to the same person. At the latest, farmers must have to have transferred out the agricultural land & provide evidence of this by 31 May 2024.	> Those who have either claimed & been eligible for BPS payments in the 2018 scheme year or in an earlier scheme year, or inherited agricultural land in England or succeeded to an Agricultural Holdings Act 1986 tenancy, after 15 May 2018	Planned for April 2022	Planned for September 2022	Rural Payments Agency & DEFRA, 2022

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Annex C.

Interview guide – farmers

Introduction/background

1. Can you tell me a bit about your farm?

2. There are many changes happening at the moment in relation to subsidy schemes such as the phasing out of basic payments and introduction of environmental land management schemes, new environmental regulations, and new trade agreements. What do you think about all these changes?

3. How do you think you and your farm will be affected by these changes?

4. What changes do you think you would need to make to your farm to adapt to these new policies?

A. Questions if the farmer plans to stay in farming

Perceived Adaptive Capacity

1. Do you feel like you will be able to adapt your farm to all these changes? Why?

2. What do you think are the biggest challenges or barriers for you to adapt your farm?

3. What are the most important sources of support for you to adapt the farm?

Willingness to Adapt

1. Do you think that, overall, this transition is a positive thing or do you see it as something negative?

2. Do you want to adapt your farm to these changes? (if you had a choice)

3. What do you think the consequences would be if you would not make any changes to your farm?

4. What would motivate you/what are your main motivations to change your farm to adapt to the transition?

Institutional support for Adaptive Capacity

1. Do you think that this new landscape of subsidies and regulations enables you to continue producing food even when climatic and other natural conditions are changing? Why?

2. What sources of support from the government are especially important for you to adapt your farm in a way that you can continue producing food?

3. Do you think there is currently any kind of support missing that you think would be helpful?

Ending

1. Is there anything else that we haven't talked about that you would like to mention?

B. Questions if the farmer plans to stop farming

Perceived Adaptive Capacity

1. What made you decide to stop farming?

2. What were some of the biggest challenges you saw on the road ahead that contributed to that decision?

3. Do you feel like you have sufficient support to move away from farming?

Willingness to Adapt

1. Do you think that, overall, this transition is a positive thing or do you see it as something negative?

2. If you would have had all the needed support and resources to adapt your farm to the transition, would you have wanted to do that?

Institutional support for Adaptive Capacity

1. What kind of support would you have needed in terms of policy structures, regulations, etc. to stay in farming throughout the transition?

2. What sources of support from the government are especially important for you to make your move away from farming?

3. Do you think there is currently any kind of support missing that you think would be helpful?

Ending

1. Is there anything else that we haven't talked about that you would like to mention?

Interview guide – Support organisations

Background

1. Can you tell me a bit about your organisation and why it decided to get involved in the Resilience Fund project?

2. What is your role within the organisation/the Resilience Fund projects?

3. There are many changes happening at the moment in relation to subsidy schemes such as the phasing out of basic payments and introduction of environmental land management schemes, new environmental regulations, and new trade agreements. How does your organisation think that this will impact farmers?

4. What changes does your organisation think that farmers need to make to adapt to these new policies?

5. What is the kind of support that your organisation provides to farmers?

Perceived Adaptive Capacity

1. Based on your organisation's interactions with farmers, would you say that farmers generally feel like they will be able to adapt their farms to all the changes?

2. What are the biggest challenges or barriers that farmers talk about regarding the adaptation of their farms?

3. What do farmers see as the most important sources of support to adapt their farm?

Willingness to Adapt

1. What do the farmers that are involved in your support projects think about the transition? Do they see it as something positive or negative?

2. Do you get the impression that the farmers that take part in your support project want to adapt their farm/are enthusiastic for the changes, or are they more reluctant?

3. Do the farmers that you work with describe what kind of consequences they envision if they do not or cannot adapt to the transition? What do these look like?

4. During the support project, what have been the main motivations that you observed of farmers to want to change their farm and take part in your project?

Institutional support for Adaptive Capacity

1. How do the farmers that you work with see the impact of the new landscape of subsidies and regulations in relation to their capacity to continue producing food even when climatic and other natural conditions are changing?

2. What sources of support do the farmers you work with mention as being especially important for them to adapt their farm in a way that enables them to continue producing food?

3. Do the farmers you work with point out any forms of support that they think is currently missing that they would find helpful?

Ending

1. Is there anything else that we haven't talked about that you would like to mention?