Master Thesis - Sustainable Business and Innovation

A Farmers' Perspective on the Tractions and Frictions for Transitioning to a More Agroecological Approach to Dairy Farming

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Preface

Dear reader,

From an early age, I became familiar with dairy farming as my grandfather used to be a dairy farmer in North Holland. I believe that emphasizing, listening and acknowledging their perspective on dairy farming is crucial for achieving a sustainable transformation in the dairy farming sector. As part of the final academic element of the master programme Sustainable Business and Innovation, I have had the opportunity to broaden my knowledge on this topic in the past eight months through conducting research. As a result, I hereby present my research on a farmers' perspective on the tractions and frictions on transitioning towards sustainable dairy farming.

I would like to thank my supervisor Brian Dermody for the pleasant guidance, encouragement and for sharing his rich knowledge on system transformations. Also, the moral support during the process of writing my thesis increased my pleasure of learning. Next to this, I would like to thank Niko Wojtynia for the critical and valuable feedback at the start of the thesis. Moreover, I would sincerely thank all fifteen interviewed farmers that were willing to cooperate in my research. Without their knowledge, visions and opinions, this thesis would not have been possible. I appreciate that you shared your time to support me in completing this research and share valuable contacts of other dairy farmers. Furthermore, I would like to thank the experts that shared their insights on the dairy farming sector. Also, I'm thankful for the time and exciting conversations on applying the three spheres of transformation framework with Ana Mahecha Groot, Catherine Day and Hannah Gosnell. Lastly, I'm thankful for the support of a friend who read the entire thesis and gave feedback on different moments in the process of writing the thesis.

Abstract

The current Dutch dairy farming regime is under pressure as there is a growing political recognition of the enormous detrimental environmental effects of farming on biodiversity loss and climate change. At the same time, dairy farmers are hindered or supported by factors that contribute to a sustainable farming transition. Therefore, this study aims to understand farmers' perspectives in the transition towards agroecological or organic dairy farming.

For that purpose, the heuristic novel framework of the three spheres of transformation is used where the personal, practical and political spheres of transformation were examined to capture the breadth and depth of the zones of traction and friction that facilitate or restrict farmers' transformation, respectively. To do so, a qualitative research method was adopted in desk research, combining primary (expert consultation) and secondary (literature review) data, which served as a rigorous analysis of the dairy farming sector. Secondly, fifteen semi-structured interviews were conducted with conventional, organic and biodynamic dairy farmers.

Results indicated that most traction zones exist in the personal sphere, followed by the practical and political sphere. On the contrary, most frictions are identified in the political sphere, followed by the practical and personal sphere. Moreover, this study argues the importance of the personal sphere to facilitate transformation. However, such interventions should be complemented by congruent changes in the political and practical sphere.

Overall, this research contributed to the existing literature on sustainable transformation in the dairy sector by being first of its kind to (1) recognising the need to integrate the farmers' perspective, and their subjective realm, (2) uses a non-binary approach on worldviews and (3) enriches the three spheres framework. Moreover, additional research that analyses how actions within the personal, political, and practical sphere interact, evolve, and shape outcomes within the other spheres offers insights into targeting and improving future initiatives.

Key words: Farmers' Perspective, Agroecological Dairy Farming, Organic Dairy Farming, Three Spheres of Transformation Framework.

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List of Abbreviations

AmvB	General administrative order in council for land-based dairy farming
CAP	Common Union Agricultural Policy
CBS	Bureau Statistiek
CBV	Centraal Veevoerbureau
CH_4	Methane
CO_2	Carbon Dioxide
GBL	Gemeenschappelijk Landbouw Beleid
ESS	Ecosystem Services
EU	European Union
GHG	Greenhouse Gas
Ha	Hectare
IWF	Intergrative Worldview Framework
LTO	Land- and tuinbouworganisatie Nederland
Ministry LNV	Ministry of Agriculture, Nature and Food quality
MLP	Multi-Level Perspective
NH_3	Ammonia
NZO	Dutch Dairy Assocation
N_2O	Nitrous oxide
PBL	Plan Bureau voor Leefomgeving
RQ	Research question
RVO	Rijksdienst voor Ondernemend Nederland
RVWA	Nederlands Food and Ware Authority

SSBP	Subsidieregeling Stimulering Biologisch Productie
VBBM	Vereniging tot behoud van boer en natuur
WLR	Wageningen Livestock Research
WUR	University of Wageningen

Chapter 1. Introduction

1.1 General Introduction

Dutch farming is a leader in technological innovation (Ministry of Agriculture, Nature and Food quality [LNV], 2019; Viviano, 2017). Those innovations have contributed to the Netherlands becoming a leading player in the global food system, with exports reaching a value of 94.5 billion euro in 2019, second only to the USA in terms of export value (Centraal Bureau Statistiek [CBS], 2020a; Jukema, Ramaekers & Berkhout, 2020). However, the farming sector can be considered as a 'productivist' regime that is primarily based on intensive, industry-based agriculture and focussed on increasing efficiency and productivity (Zariņa, Vinogradovs & Šķiņķis, 2018).

The current production regime is under pressure as there is a growing political recognition of the enormous detrimental environmental effects on biodiversity loss and climate change induced by greenhouse gas (GHG) emissions (Dagevos, 2021). Biodiversity is negatively affected through manure use, nitrogen deposition and overutilisation of pesticides and fertilisers (Aiking, 2014; Vermunt et al. 2020). These practices contributed to decreased Dutch biodiversity from 40 per cent of the natural situation in 1900 to 15 per cent in 2010 (Van Egmond et al., 2018). Furthermore, in 2018, agriculture was a significant contributor to total national methane (CH_4) and nitrous oxide (N_2O) emissions, accounting for 69.8 per cent of total CH_4 emissions and 73.3 per cent of total N_2O emissions (Jukema et al., 2020).

1.2 Social Relevance

The increase in awareness of the harmful effects of the aforementioned productivist regime has led to the announcement of the European Green Deal by the European Commission, which acknowledges the need for a transition towards sustainable food production (Stibbe & Prescott, 2020). At a national level, the Dutch government has outlined a vision for an agricultural system that improves biodiversity indicators and reduces GHG emissions. Such a sustainable pathway in the Dutch agri-food system is the transition in the agricultural subsector of dairy farming. This transition entails a shift from increased productivity and cost price reductions towards optimising resource use and food production in harmony with nature (Ministry LNV, 2019).

Central to the vision of Ministry LNV is the concept of nature-inclusive agriculture or, as Runhaar (2021) calls it, 'agroecology', also used as term for this research. Agroecology is based on three interconnected dimensions: enriching dimension – care for nature and landscape, utilisation dimension – use the natural processes rather than external inputs, and conservation

dimension – minimise negative environmental impacts (Runhaar, 2021; Smits et al., 2020). Another pathway a farmer could follow to contribute to sustainable dairy farming is organic farming (Plomp & Migchels, 2021; Gomes et al., 2020).

In 2018, the first tentative indications of the move from the productivist regime of scale enlargement and intensification towards restoring more sustainable grazing practices (Runhaar et al., 2020).[1] Collaborative efforts from citizens, environmental NGOs, political parties and legitimacy concerns in the dairy sector contributed to encourage grazing and led to a commitment to the more 'land-based' character of dairy farming. However, even though this first attempt on the move away from the productivist regime offers positive perspectives, wider adoption of agroecology or organic farming remains challenging to achieve. Therefore, the government is working on a transition fund to provide finance for farmers aiming for transition (Ministry LNV, 2019).

Dairy farmers are executors of agricultural practices and among the most vulnerable groups of adverse environmental effects such as climate change (Guo et al., 2021). Nevertheless, the farmers' agency is limited by institutional, ecological and economic factors, dependent on the broader agri-food system (Härri, Levänen & Koistinen, 2020). With this dependency and skewed power division between farmers and the wider agri-food actors, farmers usually pay for a sustainable transition and are called the 'losers' of the transition (Van der Ploeg, 2020; Vermunt et al., 2020).

The success of a sector-wide transition towards sustainable dairy farming depends on the farmers' willingness and possibilities to adopt sustainable practices. Therefore, this research delves deeper into understanding the farmers perspective, including their barriers and opportunities for transitioning. Knowing this, possible guidelines can be provided to approach the conflicts or exploit opportunities to accelerate the transition towards a sustainable regime.

1.3 Scientific Relevance

To understand the farmers' environment, the dairy farming sector needs to be clearly explained. Research investigating agri-food sustainability transitions most often use the Multi-Level Perspective (MLP) to understand socio-technical transitions (Schiller et al., 2020). The MLP suggests that transitions are the result of the interplay between the development of three

[1] Grazing is more sustainable than indoor housing of cows, although not in all perspectives. It is more sustainable for animal welfare and biodiversity but poses a threat to the higher risk of pathogens, more nitrate leaching and nitrogen losses, and higher nitrous oxide emissions (Runhaar et al., 2020).

analytical levels. First, the socio-technical regime stabilises and intertwines five dimensions – science, socio-cultural, technology, policy, and user & market (Geels, 2002). Each dimension shares various rules, regulations, cognitive structures, and shared beliefs maintained by incumbent actors, resulting in stability. The second and third levels are the exogenous landscape and the niches (Rip & Kemp, 1998; Geels, 2002). The landscape represents natural trajectories that put environmental and socio-political pressure on the regime, forcing the regime to change and adopt sustainable practices. This pressure results in an open window for sustainable niche innovations to break into the regime, such as agroecological or organic dairy farming (Geels, 2002).

While the MLP framework gives valuable insights for explaining the dynamics of regime dimensions and sectoral regime changes in the agri-food sector (El Bilali, 2020; Köhler et al., 2019), it focuses predominantly on systemic processes on the niche level (Runhaar et al., 2020). This results in concentrating on niche actors or 'frontrunners' such as experts and policymakers (Avelino & Wittmayer, 2016; Pesch, 2015), while regime actors such as most dairy farmers are disregarded (Geels, 2010; Geels & Schot, 2007; Vermunt et al., 2020). Furthermore, scholars argue the need to capture actors' drivers and mindsets, determining the transition trajectories (Abson et al., 2017). The MLP is unable to do so, and hence, there is a recognition that a more comprehensive approach to sustainable farming and stress that an integral perspective on social theories can generate relevant perspectives (Wigboldus & Jochemsen, 2020). Therefore, adding a different approach to find out the root determinants of Dutch dairy farming can offer valuable insights (Rauschmayer, Bauler & Schäpke, 2015).

Next to the MLP, another approach is taken by O'Brien and Sygna (2013), called the 'three spheres of transformation'. With this approach, the deeper level of an actor perspective is addressed in which subjective and objective forms of knowledge are included. They argue that transition occurs by the interaction of the actor's personal, practical and political spheres. In light of this, the focus is on understanding how the connection between the spheres influences outcomes for sustainability. The personal sphere includes the underlying worldviews and values of actors. The practical sphere represents the outcome sphere, in which changes in, for example, technologies take place. Lastly, the political sphere represents the systems and structures that define the opportunities and threats under which the practical transformations occur (O'Brien & Sygna, 2013).

Gosnell et al. (2019) use the three spheres of transformation to critically address the zones of traction and friction on socio-ecological aspects between and within three spheres on a farm level. Zones of friction may involve resistance to more sustainable outcomes. In contrast, zones of traction refer to pathways towards more sustainable outcomes. According to Meadows (1999), changes in the mindsets or paradigms – which can be categorised in the personal sphere – are the most powerful in leveraging sustainability transformation but the most difficult to achieve.

This research is scientifically relevant because the focus is not on the system's 'niches' but the possible aforementioned called 'losers' of the transition. Hence, it contributes to an understanding of the underpinning personal, practical and political realms embedded of farmers within the regime. Moreover, the research strengthens the connection between sustainability transition theory and the actors' perspective, closing the gap in the literature related to neglecting a deeper level of an actor perspective (Avelino & Wittmayer, 2016; Sovacool & Hess, 2017). Additionally, the three spheres of transformation have not yet been widely applied in sustainability transition studies. Therefore, using the framework allows evaluating how the framework can be applied and offers possibilities to enrich the framework.

1.4 Aim and Research Question

An understanding of farmers' perceptions and associated adaptive behaviours is still limited in the context of transitions in the Dutch dairy farming sector (Abid et al., 2019). Therefore, research is needed that focuses more closely on the farmers' perspective. This research aims to understand where farmers are constrained or supported in the transition towards sustainable dairy farming regarding their worldviews and existing economic, political, legal, social, cultural and practical system structures. To do so, the MLP framework will be adopted to understand the current dairy farming regime, the landscape pressures and what a sustainable regime entails. This is important because many measures and modifications in the transition towards sustainable dairy farming ask for changes on the farmers' side, and studying real-life interactions and social relations of farmers, provide insights into these changes. After finding this, the three spheres of transformation framework helps to understand the underlying worldviews, values, practicalities and political realms of the farmers. Eventually, the zones of traction and friction between and within the spheres of the farmers may be found. A combined perspective caters for a deeper understanding of the underlying processes, reasons, and motives and points towards potential future development and opportunities for intervention. From this approach, the following research question (RQ) has emerged:

RQ: *What are the zones of traction and friction for Dutch dairy farmers in the transition towards agroecological or organic dairy farming?*

1.5 Reading guide

Chapter two considers the theoretical framework that draws on the MLP framework and sustainability transition studies at the farm level. It argues why it is necessary to add a social approach in finding out the deeper level of the farmers' perspectives. Chapter three concerns the desk research on the dairy farming sector through the MLP in order to provide a comprehensive outline of the dairy farmers' environment. Furthermore, chapter four explains the research methodology. The empirical findings and analysis of the findings are presented in chapter five. In this chapter, the three spheres of the farmers are elaborated on, and consequently, the barriers and opportunities for transiting towards agroecological or organic dairy farming are evaluated. Chapter six provides the discussion, which discusses the main findings, reflects on the MLP framework, the three spheres of transformation framework, and the research methods. Furthermore, limitations, strengths and suggestions for further research are discussed in this chapter. Lastly, chapter seven concerns an overall conclusion.

Chapter 2: Theoretical Framework

2.1 Multi-Level Perspective

Many authors have documented how transitions in the agri-food context have unfolded, providing descriptions of players and processes in a different context (Schiller et al., 2020). Contributing to this development, this research uses MLP, which has been helpful to explore national agri-food transitions in industrialising economies (Gaitán-Cremaschi et al., 2019).

Through the MLP lens, the agri-food regime consists of deep structures that link five dimensions; science, socio-cultural, technology, policies, and user & market. For instance, referring to dairy farming, with milk production, linkages exist between the science and technology dimension, as universities research into developing technological innovations to provide sustainable modes of production. The landscape includes heterogeneous factors at the macro-level, such as climate change (Geels, 2002). According to Geels (2002), the niche level contains various actors that work on innovations or new ways of doing things to solve problems of existing regimes (Markard & Truffer, 2008). A high level of institutionalisation characterises the transition towards more sustainable dairy farming, or lock-ins where structures and linkages

are hard to change, and novel practices fit poorly in the current regime (Geels, 2002; Vermunt et al., 2020).

Investigating the dairy farming sector through the MLP framework gives insights into possible restraining or promoting factors for transitioning. Firstly, the operationalisation of the landscape pressures on the dairy farming regime and the system structures embedded in the five dimensions give a rich contextual understanding of the farmers' environment, providing an objective examination. Secondly, the framework stems from a myriad of underlying theories, rendering it possible to complement the MLP across other disciplines (Geels, 2020). This sentiment is echoed by Geels (2010, p. 508), who agrees with Shove and Walker (2007) that the MLP "*does not need to be the only model in town"* to understand socio-technical transformations and stress that also an integral perspective on social theories can generate relevant perspectives (O'Brien, 2021; Wigboldus & Jochemsen, 2020). Therefore, adding a different approach while finding out the root determinants of Dutch dairy farmers perspectives can offer valuable insights (Avelino & Wittmayer, 2016; Runhaar et al., 2020).

2.2 Sustainable Transition at Farm level

Research demonstrates the influence of numerous social aspects, such as cultural norms, identity, values, principles and worldviews of farmers, that contribute to the degree farmers adapt sustainable farming practices (Bakker et al., 2021; Caffaro et al., 2020). Another essential aspect to consider when studying whether a farmer might transition to sustainable farming is the diversity of farmers and their motivations to make farm-specific changes, which can create issues to apply sustainable farming practices (Liu, Bruins & Heberling, 2018; Wigboldus & Jochemsen, 2020). Therefore, it is essential to provide assessments based on individual human development and changes at a societal level (Rauschmayer et al., 2015).

Furthermore, transitions at the farm level are non-linear and are identified by changes at various dimensions. These dimensions entail changes in the policy, technology, market, and environmental aspects, making agricultural regimes and niches highly heterogeneous (Dumont, Gasselin & Baret, 2020; Huttunen & Oosterveer, 2017). Besides, triggering events concerning the farm contribute to transitions on the farm level (Huttunen & Oosterveer, 2017).

Additionally, scholars have argued the value of studies focused on farming systems that aim to link soils, plants, and animals with landscape-level aspects (Baur, 2020). For instance, they are linking biodiversity rates with socio-political pressures. Hence, ecological aspects are

also relevant to consider in examining the resilience of the dairy farming regime, with a farm level focus (Gosnell et al., 2019; Gosnell, Charnley & Stanley, 2020; Vermunt et al., 2020).

These developments highlight the need to focus more on social aspects in the farmers' life and the influence these aspects have on the possibility of a transition. El Bilali (2020) conducted a study and analysed frameworks in research on agri-food sustainability transitions and revealed that the framework of Social Practice Theory is the trend and upcoming in recent years. This theory bridges individual lifestyles and social relations between producers and consumers, embedded in infrastructures (Shove & Walker, 2010). However, the focus of this theory is merely on single practices and point out the dynamics of those practices, but not the linkages and interconnections in the broader context (Huttunen & Oosterveer, 2017). Even though incremental changes in farming practices might pave the way to broader transitions, considering transitions that encompass the entire farm or regime are beyond the scope of the social practice theory, making this approach less suitable in investigating the encouraging or hampering factors for farmers to transit to sustainable dairy farming.

Another approach that seems promising acknowledges the heterogeneity and non-linearity of sustainable farming transitions, but does not focus on single practices, includes a robust elucidation of social aspects of transformation and human development. This approach is termed the three spheres of transformation framework and is discussed more in-depth in the following section (O'Brien & Sygna, 2013).

2.3 Three Spheres of Transformation

O’Brien & Sygna (2013) introduced the framework of three spheres of transformation to understand how, where, and why transformations to sustainability occur in the regime. The three spheres are: practical, political and personal. The framework integrates elements from transformational theories where culture, systems, and behavioural experiences are interdependent; and where mindsets and paradigms influence how systems are viewed, which theories, relationships and goals are desirable, and which behaviours are prioritized (O’Brien, 2018). Furthermore, the three spheres are interrelated and represent objective and subjective assumptions, and when investigated simultaneously, they could provide valuable insights and intervention points into sustainability transformations. **Table 1** below shows the definition of each sphere, what it encompasses and its role in transformation.

Table 1

The three spheres of transformation framework and their characteristics.

	Practical sphere	**Political sphere**	**Personal sphere**
Definition	The practical sphere represents both behaviours and technical solutions, the 'outcome' sphere;	Economic, political, legal, social and cultural systems	Where the transformation of individual and collective beliefs, values and worldviews occur
What does it encompass	Changes in management practices, the introduction of new technologies, and socio-technical and cultural innovations. It also includes changes in strategies, practices and behaviours;	Where the "rules of the game" are set; "where social movements, collective action campaigns, lobbying, electoral politics, and revolutions respond to them, and where threatened interests resist or quash pressures to change;	Discourses and paradigms emerge…influence the framing of issues, the questions that are asked or not asked, and the solutions that are prioritised in the political and practical spheres;
Role in transition	By itself can be an ineffective lever for system change; pathways/options limited by the other spheres.	Represents the "enabling/disenabling conditions"; defines the constraints and possibilities for transformation.	Changes here generate different ways of "seeing" and influence the possible practical sphere parameters.

Note. Retrieved from Gosnell et al. (2019).

2.3.1 The Practical Sphere

As described in **Table 1**, the practical sphere represents the 'outcome' sphere that contributes directly to the desired outcome. This includes farming habits, sustainable management practices, or participating in programmes that pay for ecosystem services.

This sphere is most often targeted for system change as technical and behavioural interventions produce results that can be measured, monitored and evaluated. The target on the practical sphere for system change is a shallow leverage point target or, as Abson et al. (2017) call it, quick fixes - points that are the easiest to target but bring about the least potent changes. Despite its ineffectiveness, the responses that emerge in this sphere are influenced by

transformations in the political and personal sphere and can trigger transformations in the other spheres (O'Brien, 2018).

2.3.2 The Political Sphere

The political sphere entails the larger systems and structures of a regime. In light of this, systems can be described as relationships between parts that form a larger whole, and structures describe the norms, rules, regulations, institutions and regimes that influence how systems are designed (O'Brien & Sygna, 2013). The existing structures and systems in social and ecological realms are perpetuated by cultural norms, regulations, and infrastructure, inhibiting response in the practical or personal sphere (O'Brien, 2018). Regarding leverage points for change, greater leverage is found in the political sphere through policies that strengthen or weaken information flows or rules of the system.

Most often, research on transitions and social practices focus on this sphere to understand how and why transformations at the practical levels occur (O'Brien, 2018; Geels, 2002). The political sphere also involves the management of natural systems, which was first considered outside of the realm of human agency. However, human activities are crucial to global ecological processes in transforming the environment. The scale of the transformations in the political sphere has become a matter of collective choice (O'Brien & Sygna, 2013). Therefore, the leading systems and structures have been established by societies through time and reflect past and present worldviews.

2.3.3 The Personal Sphere

The personal sphere encompasses both individual and shared understanding about the world, perceptions of agency, and assumptions about leadership which influence the practical and political spheres in material and non-material ways (O'Brien, 2018).

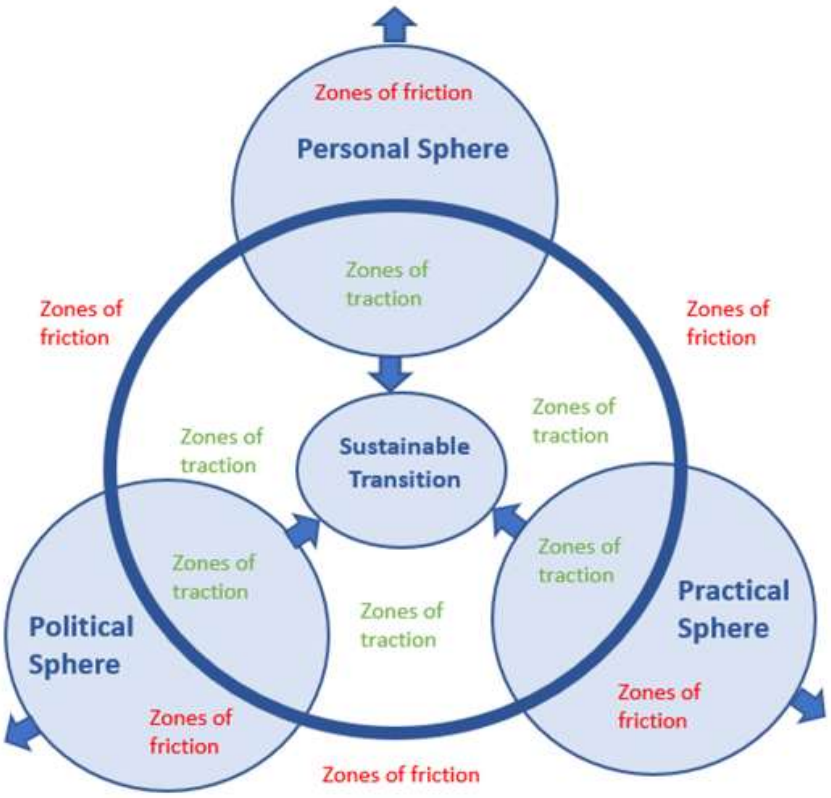
Contrary to the shallow leverage points, as mentioned in the practical sphere section **2.3.1**, deep leverage points are points to intervene in the system that might be more difficult to alter but potentially result in the transformational change (Abson et al., 2017). The personal sphere is said to be the most critical to understand since transformations of worldviews or paradigms have more powerful consequences than transformations in other spheres (O'Brien & Sygna; Meadows, 2009). Changes in the personal sphere are not static; beliefs, values and worldviews can change within an individual and over generations and through pivotal events.

2.3.4 Interconnectivity of the Three spheres

Interconnectivity of the three spheres is crucial to understand and examine what facilitates and constrains sustainability transitions. Gosnell et al. (2019) add to this three spheres framework the concept of "zones of traction and friction" to explain how to achieve sustainability outcomes and to serve as a tool to delineate critical areas at which transformation might occur. Zones of friction may involve pathways to more contradictory practices which entrench less sustainable outcomes. In contrast, zones of traction refer to pathways towards more sustainable outcomes. A sustainable transition can occur when friction zones are eliminated (Gosnell et al., 2019). **Figure 1** shows the spheres and where the zones of traction and friction occur.

Figure 1

The three spheres of transformation with zones of traction and friction



Note. This conceptual framework is adapted and adjusted from Gosnell et al. (2019). The places where the zones of friction are depicted represent the current regime, whereas the places where the zones of traction are depicted represent the sustainable regime.

Chapter 3. Desk Study of Dutch Dairy Regime

To provide orientation for the Dutch dairy farming regime and an objective evaluation of dairy farmers' environment, this chapter elaborates on concepts of the MLP framework in the context of the dairy farming regime. Those concepts are gained from theoretical insights from literature, and the operationalised concepts can be found in **Appendix A**.

Secondary data is retrieved on natural and social research publications, policy/white paper reports, expert and practitioner websites, websites with statistics and forward references by experts. This work is supplemented with primary data by experts consultation from different organisations. **Appendix B** shows the number of documents analysed, the number of interviews, expert characteristics, and specifics on the expert consultation (e.g., experts collection method and duration of interview).

The desk study first starts with landscape pressures; subsequently, it dives into the regime dimensions, and lastly, the possible transitions pathways for dairy farmers or niches are considered.

3.1 Dairy Farming Landscape Pressures

The dairy farming regime experiences exogenous socio-political and environmental pressures. In this section, first, environmental pressure is elaborated on, and subsequently, socio-political pressure is under analysis.

3.1.1 Environmental pressure

One of the most urgent environmental pressures is climate change induced by GHG emissions (Mostert et al., 2018). The dairy sector contributes around 30 per cent of the worldwide GHG emissions. Important GHGs in dairy products are carbon dioxide (CO_2), methane CH_4), and nitrous oxide (N_2O), which are mainly emitted during feed production, enteric fermentation and manure management (E_7; Van Middelaar et al., 2014). Thereby, enteric CH_4 emissions are responsible for 46 per cent of GHG emissions along the global production chain of milk (McGregor et al., 2021). In the Netherlands, CH_4 and N_2O emissions from manure management contributed 21.3 per cent and 4.4 per cent of the agricultural sector's GHG emissions, respectively (Ruyssenaars et al., 2021).

Furthermore, dairy farming contributes significantly to the acidification and eutrophication of the soil. This is mainly due to high discharges of N_20 and ammonia (NH_3) emissions (E_1;

Van Calker, 2005). A regime change has to be made to avoid acidification and eutrophication of the soil and surface water.

Another significant factor that exerts pressure on the dairy production sector is the loss of biodiversity. Dairy farming has an indirect and direct effect on biodiversity loss. The direct effect arises through the land-use change from less productive natural land into agricultural land. At the same time, the high nature value of natural land contributes to the enhancement of biodiversity (Kok et al., 2020). In the Netherlands, the most prominent known example is the decrease of the meadow birds, such as the redshank and the black-tailed Godwit (Tanis et al., 2020).

The indirect effects arise from eutrophication, acidification, freshwater use, climate change and pesticide use in feed production (E_1; E_3; E_7; Kok et al., 2020; Zijp, 2017). Moreover, the more significant occurrence of plant species rich in nitrogen results in unbalanced biodiversity and loss of other species (E_3).

3.1.2 Social-political pressure

The social-political pressure comes from threats to human health and international and national pressure (E_1; E_5; E_6). Human health risk arises due to antibiotic use in the cows, resulting in antimicrobial resistance in humans and animals (Lam, Jansen & Wessels, 2017). Even though the amount of antimicrobial usage decreased by 47 per cent in 2009-2015, veterinarians acknowledge the need to decrease these amounts even further (E_2; Lam et al., 2017; Lam et al., 2020).

The landscape level of the Dutch dairy farming sector is also strongly determined by the Common Agricultural Policy (CAP) and December 2019 published European Green Deal by the European Union ([EU], Bilali, 2019; Pe'er et al., 2020). The European Green deal presents a framework for EU policy-making with an ambition to align economic processes within the planetary boundaries and has set a target of at least 25 per cent of the EU's agricultural land under organic farming.

Besides the international political pressure, national pressure is visible. Sustainability indicators in the dairy farming sector are a part of animal welfare policy and legislation voiced by political parties (Runhaar et al., 2020). Thereby, Ministry LNV announced the Gemeenschappelijk Landbouw Beleid (GBL) and introduced phosphate rights to give dairy

farmers direction in reducing on-farm GHG emissions.[2] Furthermore, to encourage agricultural nature conservation outside the nature reserves, agri-environment schemes have been introduced where participating farmers are financially rewarded according to the number of indicator plant species (Van Doorn & Jongeneel, 2020). Such a collaborative initiative is commissioned by Friesland Campina – a global dairy product supplier -, Rabobank and the World Wide Fund for Nature that introduced a biodiversity monitor. Also, private funds are in the picture for compensation for far-reaching biodiversity increase measures by dairy farms (Van Rooij et al., 2021; Beldman et al., 2020).

Next to this, social movements and NGOs exert pressure (E_6). With signalling concerns and organising social involvement, the social movements and NGOs stress the undesirable effects of intensive dairy farming practices, and hence the tension arises in the productivist regime (Hoes et al., 2019). For instance, to preserve farmland biodiversity, agricultural land is converted to nature reserves which are subsidised. These subsidised reserves are typically managed to promote certain aspects of biodiversity, such as protecting key breeding areas for meadow birds. Farmers lease the land from NGOs and the government and are obliged to carry out the management (Tanis et al., 2020).

3.1.3 Summary Landscape Pressure

Environmental landscape pressure on the dairy farming regime became apparent due to high GHG emissions, biodiversity loss, acidification and eutrophication of the soil. Consequently, the Dutch Ministry pleads for less environmental pressure and improved environmental impacts (Runhaar, 2021). As a result, national political pressure was noticed by a collaboration of governmental bodies, social movements and NGOs, and the European Union puts pressure on the transition towards sustainable dairy farming.

3.2 Dairy Farming Regime

The dimensions of the productivist dairy farming regime are meaningfully grouped to present the findings logically. Hence, the following regime groups proceeded: *User Preferences & Culture, Industry & Industry Culture, Scientific Knowledge & Technology, and Policy.*

[2] From the 1st of January 2018, dairy farms will be allocated several phosphate rights based on cattle kept as of the 2nd of July 2015. Land-based farms with plenty of land in proportion to the number of cattle are exempt from this reduction, which is necessary to keep phosphate production below the European maximum.

3.2.1 User Preferences and Industry Culture

In this section, the user preferences and industry culture from a consumer perspective are elaborated on. The following topics are discussed: consumer preferences and collective interests.

Consumer preferences

Consumers' interest in products from animal-friendly husbandry systems has increased, and the sustainability of dairy production has put into question by consumers (Placzek, Christoph-Schulz & Barth, 2021). Despite the interest in sustainable dairy production, Grashuis (2021) found that consumers are unwilling to pay an extra price for sustainable products. Through a branded choice experiment with 252 Dutch milk consumers, the researcher constructed a choice design with three brands and three other attributes: price, organic production, and milk producer ownership. One finding is that consumers are unwilling to pay a price premium for a hypothetical farmer-owned label if additional information is left undisclosed. Hence, transparency of the production of the product is essential (E_5; Grashuis, 2021). Two experts echoed this, confirming that Dutch citizens are used to high food quality for low costs and do not want to pay a higher price for sustainable dairy products (E_4; E_6).

Additionally, Dutch consumers appreciate cattle-enhanced landscapes, i.e., the dairy cows maintain and improve landscape beauty. Therefore, consumers promote outdoor cow grazing and call it Dutch cultural landscape value (Brouwer et al., 2017). However, Runhaar et al. (2020) found that even though 70 per cent of Dutch citizens state that they are willing to pay more for milk to keep cows in the pastures, it was recognised that what consumers are prepared to pay does not reflect their willingness to pay. Another factor related to the aesthetic value of dairy farming is the aesthetics of buildings in the landscape, which is becoming an issue because of the construction of larger barns due to the need for more space per cow and increasing herd sizes (Galama et al., 2020).

Collective interests

NGO's and other societal organisations play a role in informing consumers about sustainable dairy consumption (De Wit-de Vries & Krijgsman, 2021). The functional feature of the organisation ranges from informing, e.g., Milieucentraal, to certification of organic milk, such as Skal. Additionally, organisations want to motivate the public to consume differently and more politically and campaign-oriented organisations (e.g., Milieudefensie, Natuur & Milieu, Dierenbescherming or Wakker Dier). Persistent and increasing NGO criticism and adverse

public debates challenged positive attitudes that stabilised the current dairy-milk regime, providing an opportunity for regime change (Mylan et al., 2019).

3.2.2 Industry and Industry Culture

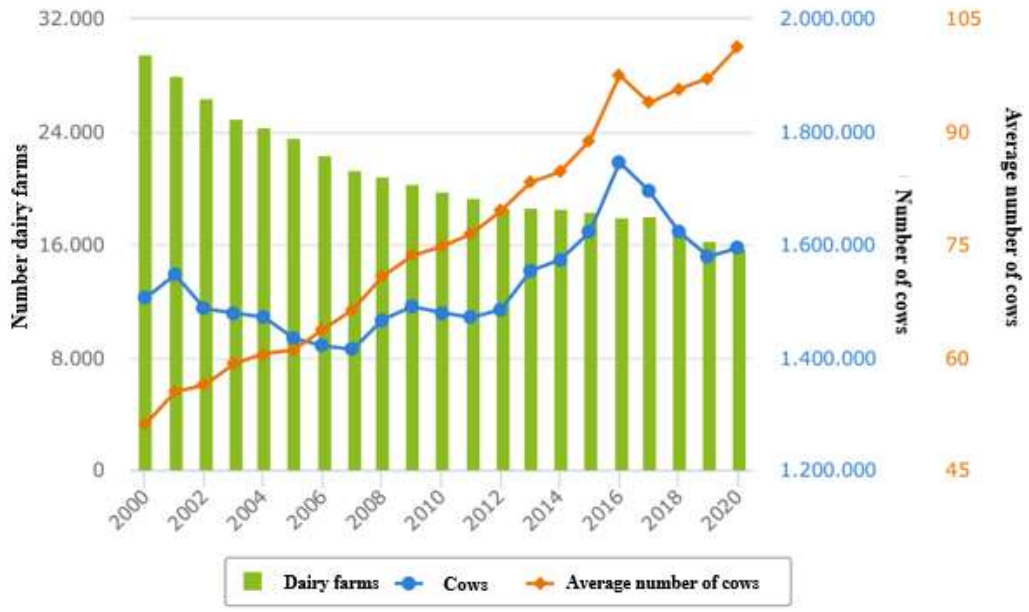
The following topics are discussed on the producer side: The dairy industry, intensification, farmers' culture, and national structure.

Dairy Industry

Figure 2 depicts the number of dairy farms, cows and the average number of cows per farm. It shows a decrease in the last five years of dairy farms and the number of cows. Nevertheless, the number of average cows per farm increased. Despite the decrease in the number of cows, the milk supply increased from 10.73 billion kg in 2000 up to 13.96 billion kg in 2020 (CBS, 2020b). The annual average milk production per farm is 707-ton milk per year, implying an average milk production per cow of 8160 kg milk per year (Moerkerken et al., 2021). These developments show higher intensity rates (Agrimatie, 2021).

Figure 2

The average number of cows per farm



Note. Developments of the Dutch dairy farmers. Adopted and adjusted (e.g. translated) from Agrimatie (2021).

Intensification

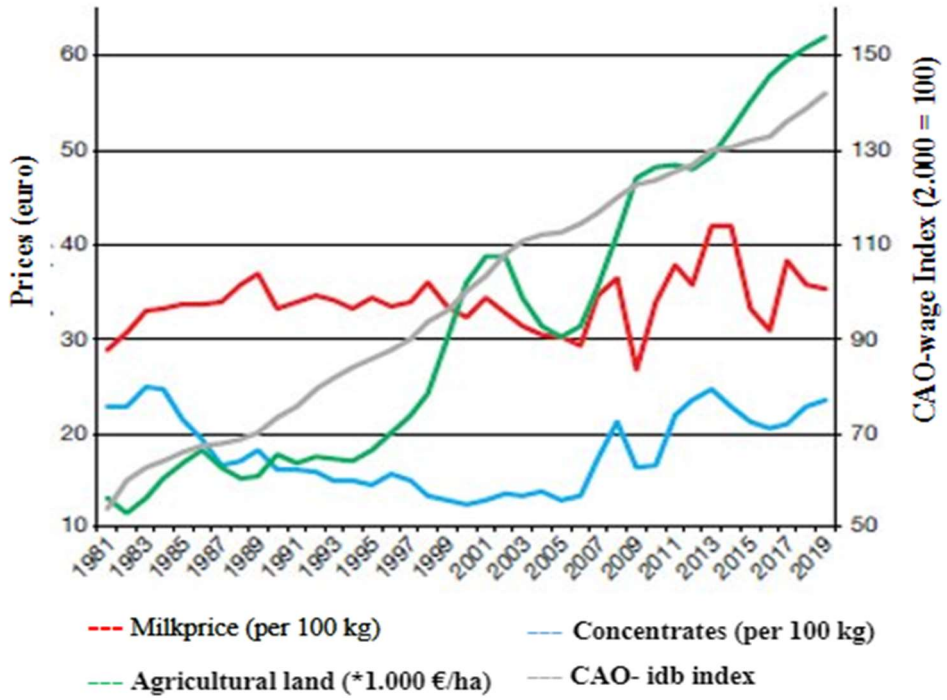
"*The Dutch dairy system is optimised towards maximising production."* - (E_2)

Several aspects contributed to the intensification of the dairy farming sector. Firstly, technological developments offered possibilities to milk more cows in a shorter time frame, for instance, by milking robots. Secondly, the availability of relatively cheap inputs such as fertilisers and cheap international concentrates made the intensification possible (De Wit et al., 2020; Van der Meulen, Van der Meer & Van Asseldonk, 2020). Thirdly, dairy farmers needed to offset stabilised milk and volatile international prices. Intensification helps to reduce costs and remain competitive in a global market (Oenema & Oenema, 2021). **Figure 3** shows that milk prices have been relatively stable for decades, ranging from 1981 until 2019 only between 27 and 42 cents per litre.

Fourthly, a factor that comes with the intensification and increased productivity of dairy farms is the substantial increase in agricultural land value (Pijlman et al., 2021). As depicted in **Figure 3,** agricultural land reached a value of more than €70.000/ha in 2019. This increase results from the fact that land investments are low-risk investments, and hence, private investors buy land and lease the land to the farmers. The increase in demand for agricultural land contributes to increased prices (De Wit et al., 2020)

Figure 3

Milk prices compared to prices of concentrates, agricultural land and wages



Note. The wages are retrieved from the CAO- inb Index. The figure is adapted and adjusted (translated) from De Wit et al. (2020).

Farmers' Culture

It is widely recognised that farmers' management of nature and landscape can effectively produce higher results than those of nature conservation organisations (Van der Ploeg, 2021). Therefore, farmers participate (predominantly) voluntarily in conservation measures that best fit their circumstances (Zwartkruis et al., 2020). Besides this, there are also initiatives commenced by farmer organisations. For example, Farmer and Nature (in Dutch: Boernennatuur) is a collective of farmers engaged in agricultural nature management. Milk corporations cater to this and make non-statutory supplementary sustainability demands on the milk they buy, thereby compensating farmers to better reflect market conditions (Grashuis, 2021).

Frequently farmers are board members of the preceding mention organisations and decide upon the non-statutory supplementary demands. This way, farmers find new opportunities to sustain and improve their incomes (Van der Ploeg, 2021). Furthermore, according to E_4, dairy farmers have no power position in the market. As entrepreneurs, they do not have much to say regarding government, weather conditions, and position in the business environment. Similarly, de Wit-de Vries & Krijgsman (2021) researched the influencing behaviour of farmers and consumers in the entire manure supply chain, and results have shown that farmers have very little agency and are under the influence of others in the supply chain. To offset the weak position in the market, farmers become cooperative members or start a cooperative and create more bargaining power for the collective (Härri et al., 2020).

National Structure

Sustainable banks accompany the dairy industry; Rabobank, ABN Amro, ASN Bank and Triodos bank (De Wit et al., 2020). According to the consulted expert from Rabobank (E_5), the requirements which the public authorities and society propose to produce milk, become stricter and therefore, lower rates should compensate the farmer for sustainable endeavours. Land-based dairy farmers should, in turn, produce within the planetary boundaries to protect the environment. However, recently banks upgraded their loan and investment criteria and set stricter rules for funding, more focused on future returns, to lower risks (De Wit et al., 2020).

Furthermore, the national structure of dairy farming is marked by consultancy companies or suppliers of products used in dairy farming, such as animal feed, innovative technologies, pesticides or fertilisers (de Wit-de Vries & Krijgsman, 2021). They influence the considerations of farmers when purchasing a product or equipment. However, there is often a discrepancy

between suppliers' and the Ministry's goal. Whereas chemical fertilisers companies are steering on selling the chemical fertilisers, the ministry steers on soil improvement and less fertiliser use (De Wit-de Vries & Krijgsman, 2021).

Milk producer cooperatives, which have a long and successful history in the Netherlands (Bijman, 2018), play an instrumental role in management (Manfredo & Richards, 2007). Such a cooperative is the CONO that introduced the ‘Caring Dairy’ program in 2008 (CONO, 2008). This program allows a dairy farmer to earn an extra payment of 5 cents per 100 kilos of milk (up to 75 cents) on the milk price via a points system on so-called indicators. Eighteen indicators are divided into four pillars, 'happy cows', 'more grass & biodiversity', 'better climate & environment', and 'social involvement'. Similarly, ‘on the way to planet proof’ from Friesland Campina stimulates sustainability goals by paying a higher price for milk (Friesland Campina, 2018). Next to this, other companies within the sector, and the trade association for Dutch dairy farmers ([NZO], representing dairy processing companies that process 98 per cent of Dutch milk) and agriculture ([LTO], representing 70 per cent of Dutch dairy farmers), have put out their targets regarding energy use and sustainability.

3.2.3 Scientific Knowledge and Technology

In this section, the leading research institutes in the dairy regime, research focus and the scientific research structure are delved into.

Research institutes

Scientists are involved in sharing knowledge on various topics stimulated by the government, the supplier industry and banks. The leading research institute in the Dutch dairy farming regime is the University of Wageningen (WUR), with an individual department, 'Wageningen Livestock Research' ([WLR], WUR, 2021). Next to the WLR, the department of 'Economic Research' and 'Environmental Research' investigate developments in the dairy farming sector (Remmelink et al., 2021).

Another prominent research institute is van Hall Larenstein, a sustainability university of applied sciences that links education, applied research, and the labour market. They are currently developing two new masters focusing on large-scale dairy farming, sustainable dairy farming, and smart farming & chain efficiency. Hence, van Hall Larenstein enhances sustainable dairy farming education (Van Hall Larenstein, n.d.).

Besides, WUR created the 'Dairy Campus' to realise sustainable development within the dairy sector (Dairy Campus, n.d.). On the Dairy Campus, scientists and professional practice go hand-in-hand, and pioneering research is conducted. Additionally, scientists work together with independent certification or research organisations to evaluate and analyse developments in the dairy sector and publicly share the information. For instance, the Centraal Veevoederbureau (CVB), a Dutch company that evaluate feed materials for farm animals in a transparent and scientifically substantiated manner, publishes the latest insights on the nutritional needs of cows in different life and production stages (CVB, n.d.). Accordingly, farmers base their feed composition on this.

Furthermore, Louis Bolk Institute is a prominent institute that researches and advises various actors to advance sustainable agriculture, nutrition and health (Louis Bolk Institute, n.d.)

Research focus

The reduction of emissions on dairy farms focuses on CH_4 and N_2O and, to a lesser extent, on CO_2. Since 2010 the Netherlands also addressed topics concerning the support of natural behaviour of cows, manure quality, aesthetics values, bedding management, low-emission floors in barns and new ventilation techniques (Galama et al., 2020). After 2019, this focus has placed more emphasis on agroecology, in line with the policy vision of Ministry LNV (E_4). Upgrading waste, improve energy production, reducing GHG emissions, efficient water use, improving soil quality and balancing biodiversity fit within this vision (Galama et al., 2021). Additionally, the increase in GHG emissions and thus climate change, heat stress by cows become more relevant; thus, a likely focus will be on the natural behaviour of cows with access to outdoor exercise or grazing (Galama et al., 2021; Smits et al., 2020).

Despite these developments, according to E_5, education and science lack the ability to detect clear insights on how nature and capital can provide positive outcomes. Hence, the knowledge system is insufficiently developed for farmers' needs to gain knowledge on linking farming practices with sustainability outcomes.

Scientific knowledge infrastructure

In the dairy farming regime, the business sector is encouraged to commit to, and invest in, innovative projects on the Dairy Campus (Dairy Campus, n.d.). Therefore, agribusinesses often co-financed research; however, they have predominantly commercial interests with a short time horizon on profits (E_2; E_4). Consequently, agricultural research is not independent and mainly

focuses on conventional farming – centred around the intensive industry and increased productivity (E_1; E_5).

Furthermore, knowledge development and subsequent dissemination of knowledge to farmers are not sufficient. Existing knowledge is not applicable for farmers and focuses on detail rather than practical tools for applying sustainable practices (Smits et al., 2019). Another aspect within the knowledge infrastructure of the dairy farming sector is the lack of integration of research and is fragmented (E_2). How a professor of Larestein puts it:

> *"In dairy farming science, knowledge is centred around one view. On the contrary, the NWA project is a great example of how we are supposed to do it. Interdisciplinary research is important because the dairy sector does entail not only technological development but also societal development. Interdisciplinary research is, therefore, the key."* - E_7

Technologies

Technology in the dairy sector is strongly developed because it is often financed by financial sector funding (E_4). An essential step in incorporating new technologies and acknowledging new scientific knowledge lies in the farmers (Cuperus et al., 2019). They would need to be trained in these kinds of alternative farming methods and, once having made the switch, earn enough with it to make a living (Cuperus et al., 2019). However, the existing technologies are most often detailed and lack a practical aspect essential for the executors of the innovation (E_4).

3.2.4 Policy

In the policy dimension, the structure and the existing policies and subsidies of the Dutch dairy farming sector are explained.

Structure

By the end of 2020, the cabinet reserved 175 million euros for farmers who want to transit to more sustainable agriculture or fewer nitrogen emissions (Ministry LNV, 2020). The government has a three-pronged approach to environmental problems. Firstly, they set a standard by policies or prescribe sustainable farming methods; secondly, they provide subsidies; thirdly, they control and enforce rules regarding manure transport, animal husbandry, and fertiliser use. Concerning the latter, audit is performed by the 'Netherlands Enterprise Agency' (in Dutch: Rijksdienst voor Ondernemend Nederland, RVO) and 'Netherlands Food and Ware Authority' (in Dutch: Nederland Voedsel- en wareautoriteit', RVWA). The national

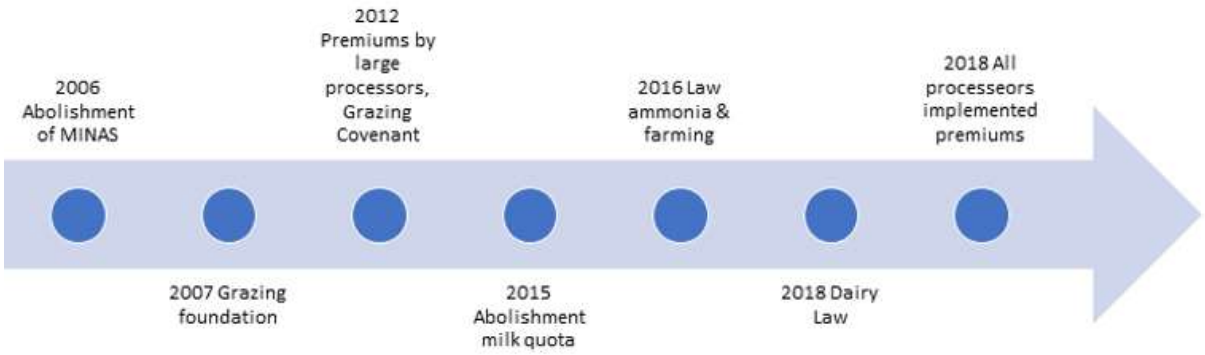
government creates policies, and subsequently, additional measures can be taken by local authorities such as the municipality or province (De Wit-de Vries, & Krijgsman, 2021). Two researchers emphasise that the government is the most important actor within the dairy system; one stress that *"Where the market does not work as it belongs, the government has to help the farmers to get sufficiently paid*" (E_3).

Policies

Policies play an important role in dairy farmers business operations. **Figure 4** shows various policies within the dairy sector that directly influence the farmers from 2006 onwards. In 2006 a new manure policy was introduced with a new set of regulations and policies such as no more than 170kg per ha exertion (RVO, 2021a).[3]

Figure 4

Timeline of policies and premiums introduced in the dairy sector



A policy change that heavily affected the Dutch dairy sector was abolishing the EU milk quota system in 2015 (Moerkerken et al., 2021). Thereby, farmers were not restricted anymore to the amount of milk produced. Soon after the abolishment, the Dutch government issued regulations to limit the amount of nitrogen and phosphate from manure and artificial fertiliser that can be put on the land (Leenstra et al., 2019). The responsible growth of dairy farmers was alleviated in the 'dairy law' (in Dutch: 'Melkveewet'). By that, farmers are allowed to grow under the condition that the increase in phosphate production above the phosphate reference number is placed on 'own land', completely processed or a combination of both. The existence of excesses resulted in the trade of the excesses among the agricultural sectors (Groeneveld, 2018).

[3] A derogation on this guideline exists in which a farmer with at least 70% grassland can use 230-250kg nitrogen from animal manure per ha (RVO, 2021a).

Under the dairy law, it is possible to grow without acquiring land. To prevent that from happening, the 'General administrative order in council for land-based dairy farming' (AmvB) was introduced, and on the 1st of January 2018, the features were anchored in the 'Land-based dairy farming act'. [4] Thereby, farmers are obliged to measure if there exists a dairy phosphate surplus.[5] In the case of a surplus in excess of the amount before the milk quota abolishment, a part of the manure must be processed; this depends on where the farm is located (RVO, 2021b). Another regulation regarding manure treatment is the spreading of manure. Therein, restricted to use the application manure 'narrow-band and 'shallow injection' rather than above-ground spreading, resulting in lower emissions (Huijsmans et al. 2018). Nevertheless, approximately one-third of dairy farmers are authorised to spread manure above the ground (Ministry LNV, n.d.).

Simultaneously, more attention was given to the grazing practices of the cows. In 2007 a grazing foundation was started, and in 2012 the largest dairy processors introduced premiums for grazing (Runhaar et al., 2020). Eventually, in 2018, all dairy processors have implemented premiums for grazing, which has become the norm in the supply of milk to retailers. In December 2018, it was announced that the formal objectives of the Grazing Covenant were achieved. A total of 82 per cent of all Dutch dairy farmers practised grazing according to the minimum requirements (Runhaar et al., 2020).

Subsidies

Dairy farmers in the Netherlands are entitled to several subsidies as income support, as shown in **Table 2.** Furthermore, starting in 2005, the 'subsidy development organic production' (in Dutch: Subsidieregeling Stimulering Biologisch Productie', SSBP) subsidised the certification costs to transfer to organic farming (Ecorys, 2007). However, in 2011 this subsidy was abolished even though transition towards organic farming comes with costs. During the conversion period, dairy farmers are not allowed to sell their milk for organic prices. Therefore, Ministry LNV announced in November 2020 to guarantee financing and bridge the conversion period (Rijksoverheid, 2020).

[4] General administrative order in council for land-based dairy farming' in Dutch: Maatregel van Bestuur grondgebondenheid and 'land based dairy farming act' in Dutch: Wet Grondgebonden groei melkveehouderij.

[5] Dairy phosphate surplus in Dutch: Melkvee Fosfaat Overschot.

Table 2

Income support by the government (RVO, n.d.)

Name	What for
Netting scheme (in Dutch: salderingsregeling)	Feeding electricity from solar panels back into the grid
Sustainable energy production (in Dutch: Stimuleringsregeling Duurzame Energieproductie, SDE)	Producing green energy
Rural development programme (in Dutch: Plattelandsontwikkelingsprogramma, POP3)	Agricultural development on behalf of a nature and landscape organisation or government
Subsidy modules on source-oriented sustainability of barn and management measures (in Dutch: Subsidiemodules Brongerichte verzuumaning stal- en managamenmaatregele, SBv)	Sustainable barn and management practices
Sustainable livestock farming yardstick (in Dutch: Maatlaat Duurzame Veehouderij)	A barn with low environmental impact

3.2.5 Summary Dairy Regime

A general conclusion drawn from the consumer industry and industry culture is that there are various doubts about whether consumers are prepared to pay for practices that benefit the environment (Runhaar et al., 2020).

To summarise the industry and industry culture section, various actors try to motivate farmers to implement sustainable practices and introduce methods to compensate farmers financially. Nevertheless, economic pressure to transit towards sustainable dairy practices is low for two reasons (E_7). Firstly, there exists a skewed power division between farmers and the wider agri-food actors. Secondly, farmers are highly dependent on stabilised milk prices, volatile international prices, high agricultural land prices. Hence, intensification of farming practices creates financially more attractive prospects.

Additionally, the scientific knowledge and technology dimension display threats for the development of the transition. In light of this, research should be more interdisciplinary and independent of businesses. Furthermore, the knowledge is too detailed and needs more helpful

content for farmers. A positive development concerns the formulation of two different masters on dairy farming that are centred around sustainable dairy farming practices.

In the policy dimension, potential lock-ins for farmers to transit to sustainable dairy farming can be detected. For instance, regulations regarding subsidies and policies have been changed heavily over time, making it difficult to anticipate the future. Yet, the changing policies and subsidies support the acceleration of the transition towards sustainable dairy principally.

All in all, the regime dynamics (skewed power division, price dependencies, consumers unwillingness to pay a higher price and changing policies) result in farmers being the ones that pay for the application of sustainable practices and can be called the 'losers' of the transition (Van der Ploeg, 2020; Vermunt et al., 2020).

3.3 Dairy Farming Niches

Literature is used to investigate which transition pathway is available for dairy farmers to move towards sustainable dairy farming. To do so, a clear-cut pathway that a farmer could take is elaborated on. After that, other possible opportunities to become more sustainable, announced by Ministry LNV, are delved into the Dutch dairy farming sector.

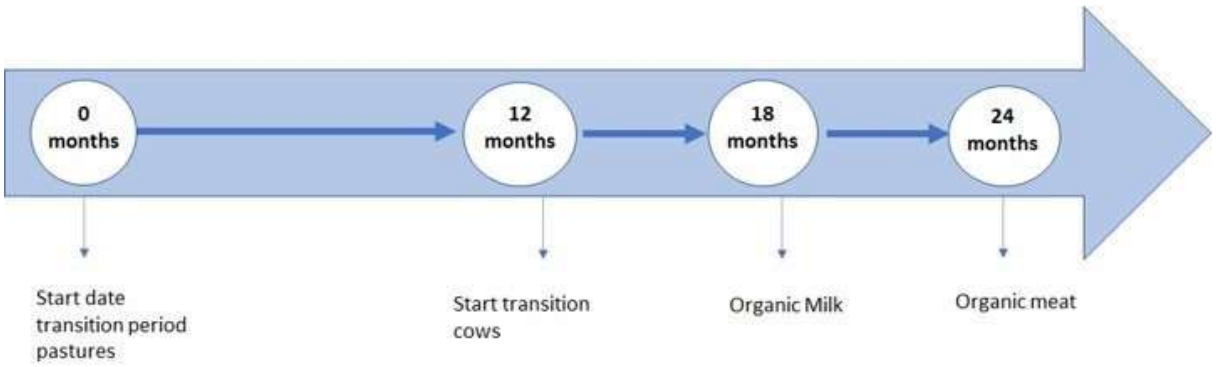
3.3.1 Organic Dairy Farming

One pathway a farmer could choose to contribute to sustainable dairy farming is organic farming (Plomp & Migchels, 2021; Gomes et al., 2020). In the face of the incumbent agro-industrial regime, organic farming is a niche underpinned by a set of practices, actors, and networks (El Bilali, 2019; Goulet, 2021; Metelerkamp, Biggs & Drimie, 2020; Smith, 2007). Organic farming entails various requirements and a comprehensive approach to land application to reduce GHG emissions and enhance biodiversity (Plomp & Migchels, 2021; Gomes et al., 2020). In the Netherlands, the control authority for organic production is ‘Skal Biocontrole’, which is dedicated to inspecting the reliability of organic products, as assigned by the Minister of LNV (Skal, n.d.a).

The transition process from conventional to organic dairy farming requires a maximum of two years. After the transition period, a farmer will receive premium prices for his/her products (Seufert, Ramankutty & Mayerhofer, 2017). As illustrated in **Figure 5**, first, pastures should be converted into organic. After that, the cows, and after eighteen months, the farmers can sell organic milk.

Figure 5

Timeline presentation of transiting towards organic dairy farming (Skal, n.d.b)



In **Table 3**, the requirements to be a certified organic farmer are shown. As can be seen, contrary to conventional farming, organic agriculture prohibits the use of artificial fertilisers, pesticides and has a stricter policy for antibiotic use. Moreover, the intake of roughage (organic grass, organic hay, and organic corn, which may not contain genetically modified ingredients) should be at least 60 per cent of the total intake.

Table 3

Requirements to be a certified organic farmer

	Conventional	**Organic**
Cow ration	No restriction	- < 40% concentrates - > 60% feed from own grassland or region - Solely organic
Outdoor Grazing	120 days, >6h/d*, >720h./y**	Between 15th of April – 15th of October, > 8h/d, > 1440 h/y
Manure spreading	< 170 kg N / ha, if no derogation	< 170 kg N/ha
Fertilisers	Approved	Prohibited
Antibiotics	Solely curative use, maximum of daily doses	Solely on prescription, max three times a year same cow
Pesticides	Approved	Prohibited

Note. Retrieved from Skal (n.d.b)*;* *h/d= hours/day, **h/y, hours/year

In 2019 almost 40.000 dairy cows were organically farmed, which is 2.5 per cent of the total number of dairy cows (Agrimatie, 2020a). The number of organic dairy farms is 469, which is 3.1 per cent of the total number. Organic farmers produce more than half less milk than conventional farmers per ha forage due to the self-sufficiency of organic farmers. Furthermore, on average, farmers are one-third less intensive than conventional farmers and therefore have

higher costs. These costs are compensated in the milk price, estimated at 12.5 cents per kg of milk (Agrimatie, 2020b). A step further is biodynamic farming. It has at least the specific requirements as organic farming; however, some additional requirements are within the biodynamic terms.

In addition to the clear-cut transition towards organic farming, multiple directions exist to become more sustainable in dairy farming, as announced by the ministry LNV. In the following section, these opportunities are delved into. Additionally, examples are given of certain practices.

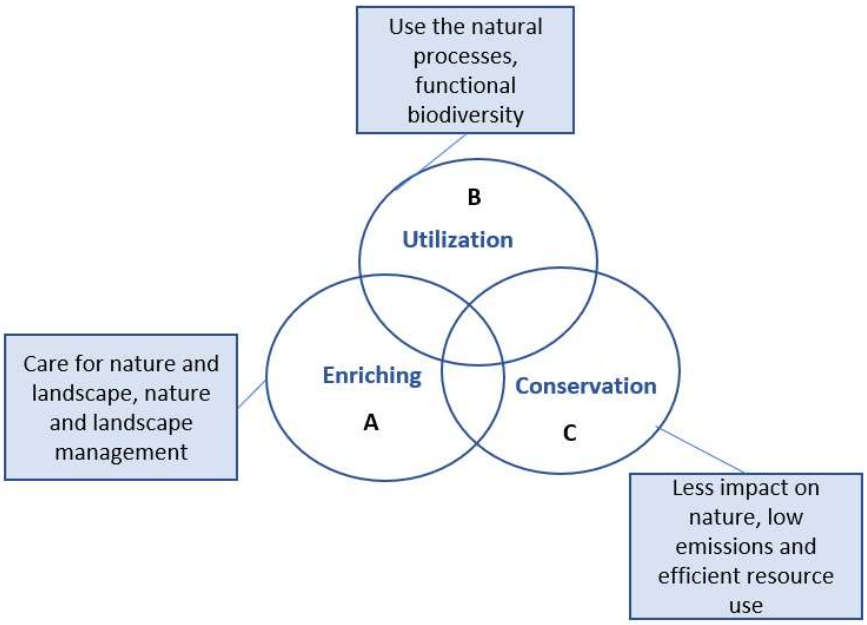
3.3.2 Ministry LNV Vision

In September 2018, the Dutch Ministry of LNV launched its 'Agriculture, Nature and Food: Valuable and connected' vision document in which the term agroecology was central (Ministry LNV, 2018). Agroecology is based on principles and considers the farming system as an agroecosystem (Runhaar, 2020). However, agroecology is considered a niche (El Bilali, 2019; Kaweesa, El Bilali & Loiskandi, 2021) and seeks to optimise ecological processes for food production, integrating food production and natural capital in such a way that agriculture and nature can reinforce one another (Vrolijk, Reijs & Dijkshoorn-Dekker, 2020). Thereby, agroecology aims for fewer emissions, improving energy production, upgrading waste, better animal welfare, soil/manure management, and balancing biodiversity (Dagevos & Lauwere, 2021; Schrijver, Westerink & van Eldik, 2021).

Figure 6 shows three dimensions that exist within agroecology, namely: nature enriching, utilisation and conservation (Van Doorn et al., 2016; Smits et al., 2020). A dairy farmer can narrow down the focus to one of the three dimensions. In dairy farming, model A, nature enriching, and C, nature conservation, are mostly considered. However, model B can also be used (De Boer & van Ittersum, 2018). Even though the vision of the Ministry LNV aims evidently for agroecology, an apt pathway to get there, their aims and the tools needed to get there are not yet clearly stated (Runhaar, 2020). Consequently, dairy farmers can apply a myriad of sustainable practices on their farms.

Figure 6

Nature enriching, utilisation and conservation



Note. Adopted from Smits et al. (2020).

In the enriching dimension, the emphasis lies on the management of nature on and around the farm. The goal is to use raw materials efficiently, thereby lowering emissions, closing nutrient cycles and minimising the farms' impact on the natural environment (Oberč & Schnell, 2020). Besides, the management of nature around the farm is a goal itself and not a derivative of agricultural production. Two examples of sustainable practices are the management of meadow birds and the construction of herb-rich grassland (Smith et al., 2020).

In the utilisation dimension, the emphasis lies on making better use of natural processes for agricultural production. Functional agrobiodiversity – using biodiversity as the basis of resilient agriculture and food system – strengthens and uses this biodiversity and the ecosystem services (ESS) that it offers the farm (Oberč & Schnell, 2020). An example is improved manure treatment by the use of mono-digestion of manure. Thereby, the fermentation of manure takes place in the absence of oxygen and converts into biogas. The biogas is subsequently burned and results in a renewable energy source. Additionally, the fermented biomass can be used on the farm as organic fertiliser and emissions are lowered (Evers et al., 2019).

In the conservation dimension, the emphasis lies on saving the landscape and specific species on the farm. In order to do so, the focus is on using fewer chemical fertilisers,

minimising external protein content for feed, and avoiding pesticide use to lower emissions (Oberč & Schnell, 2020). Optimisation of the cow's ration – mainly composed of grass silage, maise silage, hay, clover and concentrates – fits within this model. Optimisation of cow's ration entails higher protein value from own land and better use of residual flows from agriculture or feed material industry (Huhtanen & Huuskonen, 2020; Puente-Rodriguez et al., 2021).

3.3.3 Summary Dairy Niche

To summarise, dairy farmers have multiple options for a transition towards sustainable farming—namely, organic farming or agroecology. The government sets clear-cut requirements to become an organic farmer. Furthermore, a farmer can focus on nature enrichment, utilisation and conservation, and apply various sustainable practices contributing to agroecology. In light of this, organic farming and agroecology do not exclude one another because organic farming entails various practices that fit agroecology dimensions. For instance, a minimum of 1440 hour grazing (organic farming requirement) fits the enriching dimension while avoiding fertiliser and pesticides use (organic farming requirement) fits within the conservation dimension.

Chapter 4. Methodology

This research aims to understand where farmers are constrained or supported in the transition towards sustainable dairy farming. In this chapter, firstly, the research strategy is explained, followed by the operationalisation. Furthermore, the data collection and the data analysis method is presented. Lastly, measures taken to assure the validity of the research are elucidated.

4.1 Research Strategy

This research adopts a constructivist ontology and thus approaches the phenomenon central to this research; sustainable dairy farming as social constructs. Constructivism assumes that social phenomena are not naturally given but constantly change through interaction between actors (Bryman, 2012). Thus, the researcher is open to multiple interpretations of the social phenomena.

This research aims to gain insight into the underlying worldviews and values of the farmers within their personal, practical and political spheres to eventually find their zones of friction and traction within and between all three spheres. Therefore, this research departs from an interpretivist epistemology that emphasises the understanding of social action (Bryman, 2012). Hence, the interpretations of actors of social phenomena have been carefully interpreted to

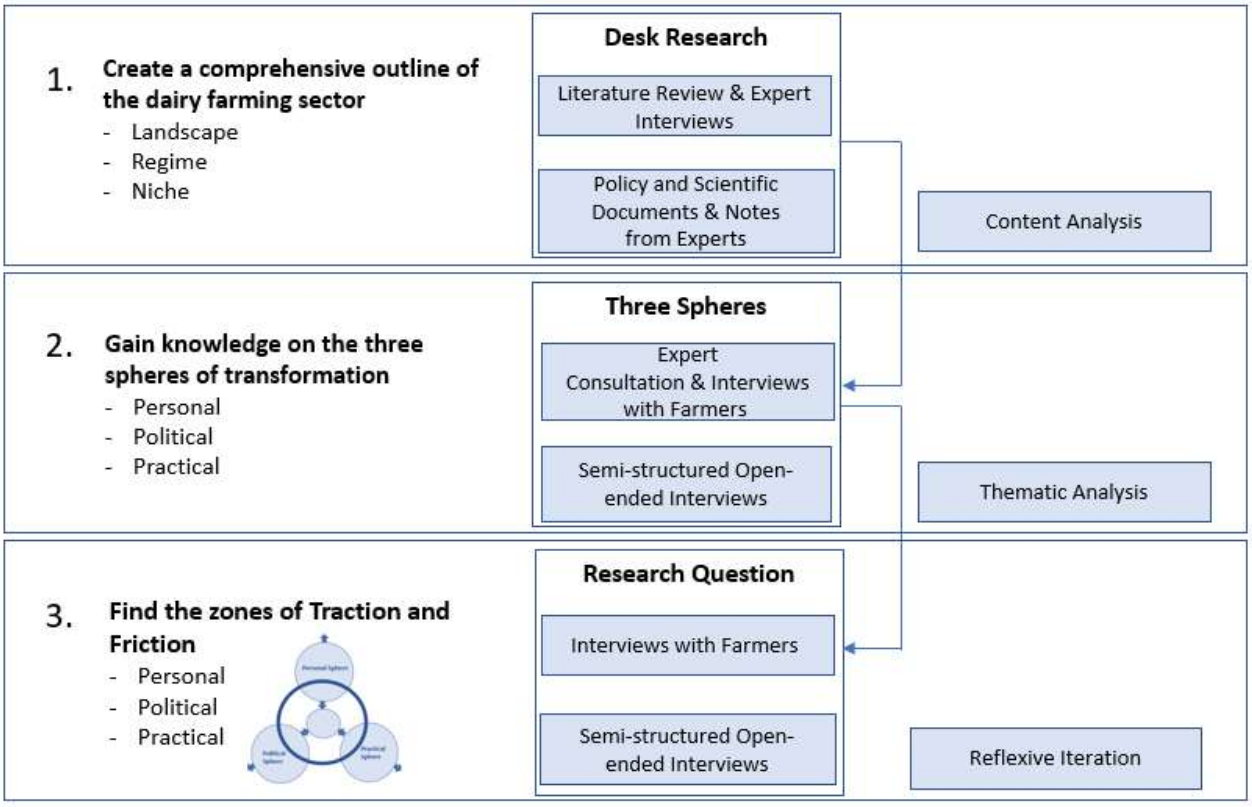
understand the actions taken. For example, farmers' interpretation of sustainable dairy farming is carefully listened to, to understand why the farmers adopt certain practices.

Semi-structured interviews with open-ended questions have been conducted with farmers. This method allows the researcher to ask critical questions and find out about the underlying perceptions of the respondents that might not come to light in, for example, structured interviewing (Bryman, 2012). However, some form of structure is applied to collect the relevant data (see **Appendix C** for the interview guide).

The research design consists of three methodological steps, as shown in **Figure 7**. The first step entailed the preceded desk study in **chapter 3**. The second step is used to identify the three spheres of the farmers, and subsequently, an in-depth analysis of zones of traction and friction in the transition towards sustainable dairy farming is found.

Figure 7

The methodological steps that are taken for this research



Note. In the table, thematic analysis means thematic coding and analysis.

4.2 Operationalization of Concepts

The concepts that are central to the research question are operationalised to conduct interviews. The concepts regarding the spheres are made measurable by defining dimensions, and

indicators resulting from the theory (see **Table 4**. Next to this, the Integrative Worldview Framework (IWF) is used as support to generate statements that can assess and discover the farmers' worldviews associated with sustainable farming (Hedlund-de Witt, 2012). The IWF consists of five perspectives and differentiates four ideal-typical worldviews: traditional, modern, postmodern, and integrative (de Witt et al., 2016). The desk research in **Chapter 3** is used as input to discover the farmers' practical and political spheres.

Table 4

The three spheres of transformation framework categories and five perspectives of IWF

Sphere	Sub-Category	Indicator
Personal sphere	Anthropology	a perspective on who the human being is; Human-nature relation, interference in nature.
	Axiology	a perspective on what a 'good life' is; What is important, what is appreciated, what gives value.
	Epistemology	a perspective on how knowledge of reality can become about; the role of science, knowledge creation.
	Ontology	a perspective on the nature of reality: Value and view on nature.
	Societal vision	a perspective on how society should be organized and how societal problems and issues should be addressed; the role of science, the role of technology, the role of farmers.
	Emotions	Fear, uncertainty, joy etcetera
Practical sphere	Ecologic	Changes in management practices
	Economic	Subsidies, Taxes
	Social	Changing behaviour
	Technical	New technologies, socio-technical innovations
Political sphere	Cultural system	Consumer preferences, collective interests, industry culture
	Economic system	Agricultural prices
	Political/legal system	Rules, regulations

Note. Adapted and adjusted from Gosnell (2019), Hedlund- de Witt (2012) and De Witt et al. (2016).

In the framework of De Witt et al. (2016), farmers with a traditional worldview have a religious approach, and nature is seen as something that should be controlled and managed by a human. Next to this, the modern worldview trusts science and technology and their capability to provide knowledge, reality and sustainable development. Moreover, individual values are essential. Furthermore, the postmodern worldview accepts multiple perspectives on reality. Lastly, the

integrative worldview states that reality is connected to nature, spiritualism and connects on a deeper level.

The traditional and modern worldviews are said to constrain adaptation to local interventions, thus constrain the transition towards sustainable dairy farming. On the contrary, the postmodern worldview takes a more instrumental view. It creates technical solutions and scenarios for the future, and the integrative worldview sees sustainable transformation as more abstract and socially constructed (De Witt et al., 2016).

4.3 Data Collection

The research population central to this research are Dutch dairy farmers. In order to gain a rich understanding of the hampering or contributing factors for transition, sustainable and non-sustainable farmers need to be interviewed. However, as came forward in the desk research, a distinction between sustainable dairy farmers and non-sustainable dairy farmers is challenging to address with respect to agroecology, as multiple ways enhance agroecological agriculture. On the contrary, organic dairy farming is a niche and can be seen as the transition pathway for farmers to become sustainable dairy farmers (El Bilali, 2019; Goulet, 2021; Metelerkamp et al., 2020; Smith, 2007). Therefore, organic and biodynamic farmers are interviewed supplementary to non-organic/biodynamic farmers. The non-organic/biodynamic farmers are called 'conventional' farmers further in this research for easy delineation purposes. Of the interviewees, four organic dairy farmers, one biodynamic farmer and eleven conventional farmers are interviewed to understand a broader perspective. Fourteen were males, and one was female, and all of them lived on family farms.

To find suitable participants, a generic purposive sampling method was applied (Hood, 2007). Firstly, through desk research, two conventional dairy farmers have been found on the website of duurzamemelkveehouders.nl. Secondly, the purposive sampling method was executed through convenience sampling and snowball sampling. Convenience sampling is a selection based on the availability of the researcher, and with snowballing, participants help find other suitable participants (Bryman, 2012). A pool of two farmers of a conventional dairy farmer and a biodynamic farmer was found through convenience sampling. Lastly, through snowball sampling, the other eleven participants were found.

The expert consultation and interviews took place from the 6th of April '21 to – 26th of April '21. An overview of the characteristics of interview participants is shown in **Table 5,** respectively. Preventing the occurrence of a language barrier, the questions were asked in Dutch

as it is the native language of the researcher and respondents. The average time of the interviews with the farmers was 83 minutes.

Table 5

Characteristics of the conducted interviews

	Name	Province	Area*	Cows	How?	Date (duration)
F_{C1}	Jan Roelof Jalvingh	Drenthe	30ha	65	Teams	6th April (77 min.)
F_{C2}	Sjoerd van der Helm	North-Holland	80ha	330	Physical	7th April (66 min.)
F_{BD}	Jeroen Konijn	North-Holland	80ha	160	Physical	7th April (95 min.)
F_{C3}	Gerben van Diepen	North-Holland	45ha	80	Physical	8th April (130 min.)
F_{C4}	Reind Katerberg	Drenthe	72ha	230	Teams	8th April (79 min.)
F_{C5}	John	North-Holland	50ha	110	Teams	9th April (67 min.)
F_{C6}	Theo Pronk	North Holland	45ha	70	Teams	13th April (77 min.)
F_{C7}	Wilco Bark	North-Holland	82ha	125	Teams	14th April (115 min.)
F_{C8}	Bouke Caton	North-Holland	70ha	250	Physical	16th April (80 min.)
F_{C9}	Simon Kwantes	North-Holland	55ha	115	Physical	16th April (71 min.)
F_{C10}	Jacob Willig	North-Holland	80ha	150	Physical	20th April (81 min.)
F_{O1}	Jan Jaap Jantjes	North-Holland	68ha	100	Teams	20th April (64 min.)
F_{C11}	Pieter Koopman	North-Holland	46ha	85	Physical	21st April (95 min.)
F_{O2}	Anonymous	North-Holland	200ha	180	Physical	21st April (65 min.)
F_{O3}	Wendy de Koning	North-Holland	105ha	130	Physical	(26th April (78 min.)

Note. The table shows the participants, way of interviewing, date and duration**.** The abbreviations of the letters mean the following: F_C = conventional, F_{BD}= biodynamic, F_O= organic, *Area: own property.

4.4 Research Ethics

For this research, research ethics were carefully considered (Grossoehme, 2014). To address the rights and welfare of the research participants, the researcher included informed consent and secured participants' privacy by signing a consent form developed for this research (see **Appendix D**). Their privacy is secured by making the interviews confidential and, if asked for, anonymous. In case the wish of anonymity, all manner of identifying details have been removed from findings to ensure the confidentiality of the participant (Kaiser, 2009). Thirteen farmers agreed on sharing their full names, one farmer asked for anonymity, and one farmer asked for anonymity of the surname.

Since the participants were interviewed about their worldviews, values and norms, it was important that their rights were honoured. This means that prior to the interview, the researcher

explained the aim and goal of the research, and the participants have received a transcript of their interview. Besides, the date, time and location of the interviews were arranged at the participants' convenience. Additionally, to give some comfort, openness, and sincerity in the conversations, the researcher presented herself as interested and enthusiastic about the subject by personal feeling attached to the subject as her grandfather used to be a dairy farmer.

4.5 Data Analysis

Thematic analysis was used to identify interview responses related to their personal, practical and political sphere. Thematic analysis is an apt approach to find out something about people's worldviews and values (Bryman. 2012). For thematic analysis, the transcribed interviews are coded, and the codes are categorised into the spheres and sub-categories of **Table 4** in section **4.2**. An axial and selective coding method was used, which means that data that belonged to the coding guideline categories were coded accordingly. **Appendix E** shows in detail the developed concepts of codes of each sphere and the number of framers addressing the particular topic, and in **Appendix F**, example phrases of the developed concepts are shown.

In total, 64 different concepts of codes were clustered into the 6, 4 and 3, sub-categories of the personal, practical and political sphere, respectively. In the personal sphere, 30 different concepts were coded; in the practical sphere, 20 and the political sphere 14. Next to these, the following codes were added: "Farmer characteristics" (age, area land use, family business, farm type, managerial position, number of cows) to sort demographic information and farm-intensity, "Personal leverage point", "Practical leverage point", "Political leverage point" if the farmers addressed transition incentives that related to the personal, practical or political sphere respectively.

By identifying each sphere of the dairy farmers, corresponding zones of traction and friction in the transition towards sustainable dairy farming have been found. The data is compared and examined through a reflexive iteration process of visiting and revisiting data and connecting them to emerging insights. Consequently, this led progressively to a refined focus and understanding. See **Appendix H** for guiding principles for reflexive iteration according to Srivastava & Hopwood (2009). The table of the IWF in **Appendix G** is used as an analytical tool to see whether the perspectives of the farmers' worldviews fit within the traditional, modern, postmodern or integrative worldview. The perspectives of the IWF are interrelated and interdependent; therefore, neatly separating was not always possible.

Organising and analysing qualitative data are time-consuming tasks; therefore, NVivo - a qualitative data analysis tool – was used to do this more efficiently (Bryman, 2012). The transcripts will be in Dutch, but the identified key themes of each sphere are translated to English.

4.6 Research quality

In this section, the steps taken to ensure research quality is briefly explained. Appendix I shows a more detailed description of the taken steps. These measures were based on Maxwell's (1992), and Bryman's (2012) quality criteria specialized in quality assurance in qualitative research, focusing on four criteria.

The first criteria is *descriptive validity* which is the factual accuracy of the data analysed for the study and means that researchers' observations are congruent with the participants' views. To assure descriptive validity, interviews have been recorded and are transcribed (Maxwell, 1992; Bryman, 2012). Furthermore, *interpretive validity* means that subjectivism in interpreting the result is avoided (Maxwell, 1992). The researcher kept the interview guide in mind to be persistent in the questions, and the codes were shared with a colleague to avoid subjectivity biases.[6] Thirdly, *theoretical validity* is enhanced by theoretical triangulation by the use of multiple theories in one study. In addition, the researcher used multiple sources of both primary and secondary data. Besides, the researcher approached researchers who have been working with the three spheres of transformation framework in the farming sector and asked for their insight to assure a complete understanding of the framework and used it to construct the interview guide (**Appendix J** shows the characteristics of the consulted experts). Lastly, *generalizability* means the extent to which the research findings can be generalized to the community, organisation, and the sample studied or can be applied to other research settings. Even though these criteria are difficult to assure with qualitative research, the findings will be oriented to contextual uniqueness (Bryman, 2012).

Chapter 5. Results

This thesis aims to understand the zones of traction and friction for Dutch dairy farmers to transition towards agroecological or organic dairy farming. This section first outlines the results from empirical data analysis on the three spheres to which the farmers gave rise. Secondly,

[6] Research ethics were taken into account while sharing the codes with the colleague.

these results are reviewed by a reflexive iteration process to assess which factors create zones of traction and friction.

5.1 Three Spheres of Farmers

The three spheres of transformation framework is a simple tool for understanding farmers deliberate transformation to sustainability. The personal, practical and political spheres capture the breadth and depth of changes needed to realize a particular goal or outcome, such as the transition towards agroecology or organic agriculture in the dairy farming sector. Hence, to structure this section, the personal sphere is first explained, followed by the practical sphere and political sphere. Whereas the spheres are explained separately for the sake of clarity, one should keep in mind that these are not separate entities but parts of an interconnected system acting as a whole.

5.1.1 Personal Sphere

In the following, first, the farmers' shared anthropological perspective is discussed. After that, farmers' ontology, epistemology, axiology and societal vision are elaborated on in that order. Finally, their subjective attitude is assessed by delving into their emotions.

Anthropology

A prominent theme in the anthropological perspective is the human-nature relationship. Nearly all participants (thirteen) gave voice to a vital role nature has in the universe and that *"humanity depends on nature"* (F_{C9}). Additionally, humans are seen as part of the ecosystem where different parts relate to each other yet are unique in themselves (F_{O1}).

An aspect of the human-nature relationship is the level of interference of nature. A shared vision among nine farmers is that humans should not intervene in nature. This opinion is shared on the ground of two different views. Firstly, seven farmers agreed that nature is constantly in development beyond the power of humans. Unfortunately, in the Netherlands, we have come to the point that there exists a culture of constructing 'desire' nature (F_{O1}). At these places, strict rules exist on how to conserve the surroundings. This 'desire' nature is appointed by policymakers or other institutions and results in intervening in the natural process. Secondly, two farmers share this opinion on a more traditional religious understanding of nature as God-created. In light of this, nature is seen as an embodiment of meaningful, imposed order and should be treated with respect. The farmer explains:

> *"I was raised Christian, and we just have the world on a lease, and therefore I think we need to produce differently than in the past. It is for others to judge if we do it right. I take care of food and try to produce in harmony and a good manner."* - F_{C4}

Furthermore, most farmers criticised modern culture's relationship with nature, often characterising this relationship as "separated" or "segregated" from nature. Two factors exacerbate the separation from nature. Firstly, even if people see dairy farming as nature, the urban area advances and creates more disconnection. Secondly, the rise of new technologies intensifies the separation from nature. An example is a farmers' response to the innovative Cowtoilet: "*Finding technical solutions for a cow to urinate on command creates such adistance from human and nature. That is not something we would want to do even though it would result in low emissions."* (F_{C3})

Closely related to the appreciation factor of working with cows is related to what makes the farmers feel good, namely, animal welfare, as F_{O2} states: *"If the cattle are healthy and satisfied, I am; those are the basics of farming."* This sound is resonated because eight farmers label a farmer a 'good' farmer if the farmer is good for his cattle.

Ontology

The ontological view entails how farmers value nature. Five farmers elaborate on the importance of nature which came forward in this remark: *"Everything has to be in harmony with nature, and it starts with the soil. Everything that is good for the soil, is good for the plants"* (F_{BD}). Hence, nature is not instrumental and devoids intrinsic meaning and purpose. Nature is called stronger than us, and consequently, humans must find their way within this power of nature. Finding the way in nature represents the biggest challenge for the farmers (F_{C8}).

Additionally, eight farmers articulated an understanding of nature as being constructed through cultural values and interests. Especially in the Netherlands, nature is created based on cultural values created by human beings (F_{C7}). Considering this, a clear definition of what nature is and what it is about, is missing. According to four farmers, different perspectives on this definition may exist (F_{C8}). For instance, a farmer explains that whereas some people see swamps as nature, others see grassland as nature. Additionally, it raises questions about whether nature is a somewhat subjective concept when putting it this way. As a farmer state:

> *"What do you call nature? Some people do not call farming nature, while farming is all about nature. Without manure, there is no nature, and cows go outside into nature.*

> *Policymakers want to create nature from our land, but farming entails nothing but nature, if you ask me. In the artificial Oostvaardersplassen animals are rotting away, is that what they would like to call nature?[7]"* - F_{C7}

Epistemology

The third perspective in the IWF is a perspective on knowledge and how knowledge can come about: epistemology. Two basic patterns were observed in the epistemological view of the farmers. On the one hand, seven farmers rely primarily on their judgment, feelings, intuition, and experiences. On the other hand, eight farmers tend to acknowledge and value multiple modes of knowing and perspectives on reality.

The seven farmers who rely more on their judgment, feelings, intuition, and experiences see their own experiences in nature, relationships, work, and life are an important way to create wisdom. A crucial task as a farmer is being an 'observer' of his cows and land (F_{O1}). Hence, every farmer should ask himself a vital question: 'What is happening on land, and how do cows respond to the living conditions?'

The other eight farmers mostly use multiple sources and modes of gaining knowledge. The sources include television, internet, radio, Teletext, applications, newspapers and trade journals of the agricultural industry. As a farmer stated:

> *"I am trying to inform myself as broad as possible. General media, websites, food blogs, other websites of which a variety of opinions are shared. I am always curious about other opinions, which give me additional insights. Some of them I take with me, and I use that as input to form an opinion."* - F_{O1}

Despite the broad use of sources, three farmers mentioned being selective in the kind of knowledge they are open to espouse. This selection is based on the type of news that is shared. Besides, sometimes new knowledge awakes 'inner fury' through misleading or incorrect information; therefore, the farmer singles out particular sources (F_{O2}). Selective or not, these farmers try to internalise and integrate their subjective experiences and ideas with scientific understandings.

Furthermore, eight farmers stress that they do not trust science unconditionally since science is constantly developing. In light of this, there is an enormous amount of research on

[7] Oostvaardersplassen is a nature reserve in the Netherlands, which is managed by the State Forestry Service.

new techniques or innovative products within the dairy sector. However, this research is executed by research institutions, governmental organisations or the supplier of those techniques or innovative products. This creates sceptical rationality attitude of farmers, which became evident as a farmer elaborated on the reason why he had shifted in fertiliser use:

> *"Research provided by the seller has shown that this type of fertiliser supports profitable results. However, the seller always thinks his product is good. Now, also other dairy farmers showed good results. We changed products because we felt that the manure was too thin, which runs through the soil too quickly. Consequently, the nitrogen embedded in the manure does not digest as it would otherwise. The year after, I have used another product which resulted in better digestion and separation of urea. Thus, firmly, through self-observing things, we do not just adapt something if it works properly just on paper. It also needs to work out better on the farm. That is how you try to develop it for yourself."* - F_{C11}

Axiology

The fourth perspective is on what a good life looks like and what is valued in life, both in moral terms and quality of life. What stood out in the data is that thirteen farmers acknowledged that the gratification in life goes hand in hand with working with the cattle. Being surrounded by the cattle and managing the cattle is the appreciation factor of life fulfilment. This is shown by a farmer who mentioned that he divested his tulips company to take over the cattle and expand with the available capital (F_{C11}). Another farmer divided the business operations so that he could focus on the cattle (F_{C8}). Besides, a farmer must be an entrepreneur with a heart for the animals to ascertain that he can remain a farmer. As F_{C1} elaborates: *"For the money, you do not have to do it; then you should choose another profession."* Regarding the previous, a farmer explains:

> *"I am a cow person, and if I am bad for the cows, then the cow is bad to me. If the cow is not fit, I am not fit. That sounds a bit soft, but that is how it works. We are business-like, but we have a heart for the cattle. Those are our motivations; everyone can be an entrepreneur, but if you must be an entrepreneur with cows and a rancher, then you have to be an enthusiast."* - F_{C4}

Furthermore, the axiology perspective entails two more dimensions: emphasising independent individuality and the degree of openness to change. Regarding the first dimension, ten farmers showed high value for the freedom of decision-making, flexibility and the variety of farming activities. The high value of freedom comes with entrepreneurship; thus, *"no one is above you"*

(F_{C5}). Additionally, they stress the high degree of independence of being a farmer. Overall, those two factors in their work contribute to the process of personal development in different aspects. Regarding the self-development of the farmer, one farmer states:

> *"[…]and yes, I do a little tinkering of everything; we weld all kinds of things together. You have to be a farmer; you must be the accountant, and in addition, you are destined as the mechanic, welder, plumber, electrician, you name it."* - F_{C1}

In the second dimension of openness to change, nine farmers are willing to change their practices and adapt to developments regarding environmental problems. However, for most farmers, a fundamental feature in this respect is that those changes do not threaten or could be detrimental to their farming operations. This opinion flows naturally from their perspective, in which the border between their professional and private life is seen as not absolute. As a farmer explains, *"[…] you are busy for the next generation to make sure the next generation can continue the farming practices"* (F_{C9}).

Another sound can be heard among three farmers who are open to change with emotional interests as the reason for openness. However, sometimes those pathways are unpredictable and uncertain. They address “being a pioneer' or 'being the first in line' as a motivator to be open to change despite the uncertainty it brings about. Additionally, an organic farmer exemplified the reason for her transitioning to organic farming based on emotional interests. She explains that organic farming fits her ideals. Additionally, from her own experience living in New Zealand and Drenthe, she came across different ways of operating a business (F_{O3}). Besides, the biodynamic farmer exemplified the reason for his transition to organic farming (a prior switching to biodynamic) based on emotional interests. He stated:

> *"There [during his internship in the United States], I saw how large companies produce much milk, while the price keeps getting a little bit lower. At a certain point in time, you noticed that milk prices declined below water prices. If this is the pathway, we will not be able to make a profit in the Netherlands. It is more important to increase the quality than to produce more, more and more. Once we returned from the United States, we dove into organic farming systems."* - F_{BD}

Societal vision

In the societal perspective of the IWF, farmers’ view on how the society should be organised and how environmental problems should be addressed is assessed. First, the role of the farmers

is elaborated on, followed by the role of technology and science. The most prominent role of farmers, indicated by twelve farmers, is as food suppliers. Not just a food supplier, but a high-quality food supplier on which the society depends (F_{C5}). As underlined by a biodynamic farmer that states that in every case or circumstance, all decisions farmers make should contribute to a healthy, high-quality diet.

Besides being a food supplier, the role of the farmer is to provide recreation and education, as indicated by ten farmers. According to two farmers, the recreation provision starts when the cows are outside for grazing. Additionally, it is important to explain where dairy products come from, to command respect firstly, and secondly, to educate and inform children. Also, when there exists ambiguity on how the milk is produced, one farmer explains that he would like to inform policymakers to prevent unfounded decision-making. A farmer elaborates his wish to educate others on the role of farmers:

> *"We produce food that contains a nutritional value different from others that produce food to fill the appetite solely. The explanation of that, that role, also lies with the farmer. That role is becoming increasingly important. Furthermore, to implement that is a challenge, and I like to do that."* - (F_{BD})

Moreover, four farmers identified themselves as landscape conservationists; F_{C9} shared:

> *"Dairy farmers preserve the whole environment here, we mow, and we make sure that the trees, animals and birds are sustained. Let us say goodbye and good luck with the preservation of nature. I'm sure that within one year, all the meadow birds are gone and preserving nature would be unaffordable*."

One farmer (F_{C10}) assigned himself as being a connector in the society between *"the biodiversity, decrease CO_2 emissions, low calve mortality, the whole circle".*

Another observation that came to light is that four farmers have a positive approach and a certain degree of scepticism about humanity's environmental problems. Two farmers question the degree to which certain planetary boundaries are at risk. On the topic of climate change, a farmer briefly explained his doubts: *"We are just on earth for such a short time, what do we know? I am not convinced that climate change is induced by mankind or whether it is just a movement through centuries"* (F_{C11}). Another farmer exemplified that: *"There are graphs that show climate temperatures fluctuating over centuries"*, thereby questioning whether it is just the normal cycle of the earth (F_{C8}). Other farmers expressed their optimism by explaining that

society is formed in such a way and evolves so that eventually, the environmental problems will decrease automatically. Considering this, two farmers foresee the converging of organic farms and conventional farms (F_{C5}; F_{C6}). In respect to the farming sector, a farmer imagines:

> *"Imagine there are 1.6 million phosphate right allowances, and when trading those rights, 20 per cent is depreciated. If this continues for a long time, it eventually decreases the number of cows in the Netherlands. If I adjust my barn accordingly and milk 30 more cows, I have to buy 40 cows. Those come from a barn without low-emissions floors[8]. Consequently, with my low-emission floor, the whole sector improves by these signs of progress."* - F_{C10}

Not all farmers experience environmental optimism and acknowledge the threats to the environment by farmers. However, two organic farmers and two conventional farmers mention the inability of solely dairy farmers to decrease environmental impact. According to those farmers, the vision on agroecology is not sufficient (F_{O2}), and more attention should be paid to industry or other polluting sectors. Additionally, four farmers elaborate that the powerful facet is the worldwide population growth.

A way in which the societal vision appears to come to expression is in its relationship to modern technologies. A farmer expressed his perspective by emphasising that inventions of fertilisers and technologies increased revenue and economic prosperity worldwide (F_{C8}). All farmers argue for the importance of technology in responding to GHG emissions and biodiversity loss. For instance, an organic farmer perceived that, on average, more organic farmers use a milking robot. Additionally, in organic arable farming, the robotisation of weed control is rising enormously (F_{O1}).

Furthermore, the societal vision is expressed in the role science plays in addressing environmental problems. As explained in the epistemological view, eight farmers are somewhat sceptical about the role scientific research should play herein. Science is rejected as the ultimate source of reliable knowledge, and science's claim to exclusively provide objective knowledge is questioned. The sceptical rationality is expressed in their opinion on calculations of nitrogen emissions in the dairy sector and other sectors such as industry. Besides, they feel that the research institutes, such as WUR or governmental bodies, have multiple interests and are biased. Regarding the first statement, a farmer explains:

[8] Low emission floors are floors for the barn that lowers exertion of GHG emissions

> *"Consider aviation; ascending and descending takes a huge amount of fuel, and on the other side of the ocean, the tank is empty. But what happens? Only the emissions of the first 900 meters are being measured. What about the other kilometres, is there no emission at those heights? In this way, I could also create a favourable model."* - F_{C3}

Emotions

During the interviews, various emotions were expressed among the farmers. These emotions ranged from feeling underappreciated and the feeling of being the villain to feeling threatened by future legislation. Considering the latter, eight farmers articulated fear of the consequences resulting from prospective manure policies, thereby feeling insecure about their future as dairy farmers in the Netherlands. At this juncture, comments were made on the prerequisite to emigrate to other countries. A comment was made to illustrate this menace: *"That is what I mean by agroecology, if that means substantial extensification effort, then half of the dairy farmers are forced to emigrate"* (F_{C9}).

The lack of appreciation from society reigns among ten farmers. Thereby they elaborated on the lack of consumer demand for organic milk or their distrust in the willingness of consumers to pay a higher price for sustainably produced milk. Furthermore, five farmers feel suppressed by society and governmental bodies. One farmer elaborates on this aspect: *"Especially negative pressure, what do they want from us? Do they want us to leave the country? Are the policies made to eliminate the farmers, hence, farmers to quit their jobs?"* (F_{C4}). The pressure feeling is not shared among all farmers. On the contrary, one farmer is relatively optimistic about the dairy farming circumstances and feel that the absolute high-pressured sector is not in dairy farming. Yet, this high-pressured sector lies within intensive pig meat production, intensive chicken rearing, or veal farming (F_{BD}).

Furthermore, the feeling of a villain is fuelled by four factors. Firstly, farmers are an easy target to blame for being responsible for the environmental problems. A farmer stated:

> *"With 40.000 dairy farmers, we represent a small number of the Dutch population. Therefore, we are an easy target, we are an easy object. Besides, talking about cows is convenient since they do not talk back. […] I reckon many people just do not know how it works. There is nothing wrong with that. However, there is a vast amount of incoherently rambling and doing by politics. That is something that many farmers are confronted with. Many times, the rambling and doing do not make sense."* - F_{C2}

The feeling of a villain is also expressed regarding the media and political framing, resulting in aggrievances among farmers. *"I do not like to follow the media due to all the dairy farming negativity"* (F_{C8}) and "*What I read in the media, well, they easily point everything to one side"* (F_{C1}). A distressing public image of farming is seen as fuel to failed decisions and policymaking by the government.

Additionally, according to a biodynamic and three conventional farmers, governmental bodies and research institutes do not correctly calculate nitrogen emissions because they are based on models rather than actual emissions. Besides, the emissions by dairy farming are natural in the short cycle, while on the contrary, emissions from industry end in the long cycle. Also, an essential factor is that while measuring the emissions, governmental bodies and research institutes do not consider the carbon uptake by the grassland, which could offset the emitted GHG emissions (F_{C3}).

The last remark on feeling the villain is that according to conventional, organic and biodynamic farmers, the existing policies sometimes feel arbitrary. An example is given on the assignment of places as 'nature', under the guise of beneficial environmental circumstances. When a place is termed as nature, farmers are not allowed to farm surrounding this area. However, the farmers felt this assignation and the ban on farming as disguised assistance to the housing market or infrastructure because houses are allowed surrounding the area (F_{C9}).

Regardless of the underappreciated feeling from society, positive emotion is experienced by eight farmers on the public recognition by providing recreational value for society. One farmer actively puts effort into creating Facebook events. By that, the whole neighbourhood is invited to visit his farm. He embraces these moments and calls it 'great fun' to answer questions and see them happy (F_{C9}).

According to all three organic farmers and the biodynamic farmer, they experienced joy in doing what fits their worldview and values. Thereby, an interesting observation is found regarding manure usage to fertilize the soil and improve the quality of the soil. The organic and biodynamic farmers addressed the importance of the soil and manure multiple times – sometimes even called an essential property of a dairy farmer. According to those farmers, everything starts with healthy soil, from high-quality animal feed to a high rate of biodiversity.

5.1.2 Practical Sphere

The practical sphere represents specific actions, technical interventions, changing strategies and behaviours that directly contribute to agroecological or organic dairy farming. These executed practices can be divided into three aspects: ecological, technical and social practices.

Ecological and Technical Aspects

The desk research gave insight into what directions farmers can go to become more sustainable. Firstly, converting to organic farming encompasses definite requirements which the farmers met. Secondly, **Table 6** summarizes executed ecological and technological and the environmental impacts resulting from the practices, categorized into the three dimensions.

Table 6

Sustainable practices executed by farmers

Dimension	#	Changing practices	Environmental and social impact
Enrichment	3	Construction of herb-rich grassland	Balancing biodiversity
	5	Flower borders	Balancing biodiversity
	9	Meadow bird management	Balancing biodiversity
	14	Outdoor grazing (>720)	Animal welfare, reducing emissions
Utilization	1	Mono manure digestion	Green energy production, better manure/soil quality
	6	Solar panels	Green energy production
	1	Windmill*	Green energy production
Conservation	4	Low emission barn	Reducing emissions
	2	Air washer in the barn	Reducing emissions
	2	Bedded housing	Reducing emissions, animal welfare
	1	Optimize cow feed: urea inhibitors	Reducing emissions
	11	Optimize cow feed: more land-based, less concentrate	Optimise waste, Reducing emissions
	2	Aeration system	Better manure/soil quality, upgrading waste
	13	Less fertilizer use	Balancing Biodiversity, better manure/soil quality
	15	Less antibiotics	Better manure/soil quality

Note. The environmental and social impacts are either explained by the farmers or adopted and supplemented from Galama et al. (2021), Smith et al. (2020), Byrne et al. (2020) and E_4. *Applied for (F_{O3}). Although the farmers explicitly mention these practices, they might apply other practices not shown in this table, or the actual number of farmers applying those practices might be higher.

Next to the executed practice of **Table 6**, a notion shared among almost all farmers is that they diminished the use of antibiotics. Under conventional farmers, this reduction results from the Dutch government's announcement that sets a maximum on the daily dosage use of antibiotics than on sustainability grounds.

Lastly, governmental policies and subsidies as elaborated on in **4.2.2**, such as the dairy law, AMvB grondgebondenheid, or subsidies (Netting scheme, SDE, POP3. SBv and MDV) contribute to the desired outcome of sustainable dairy farming. How the biodynamic farmer puts it: *"In terms of financing, we received a subsidy, the POP3 subsidy. This subsidy comes originally from Europe and the province." (* F_{BD})

Social Aspects

Among the farmers, there exists a high *sense of community* between dairy farmers. The sense of community was illustrated by nine farmers, as they had frequent contact with fellow dairy farmers. The contact emanates in WhatsApp groups, study groups, projects in which they participate and general meetings of institutions or advocacy organisations. Even though the farmers are all milk suppliers, F_{C1} explains that farmers do not identify themselves as competitors. Nine farmers experience the lack of contact in the current COVID-19 situation as a 'loss'. Whereas most farmers – nine - experience a high sense of community, one farmer did not share this sense. He reports on the fragmented society and the role the agricultural dairy sector has in this:

> *"As an agricultural dairy sector, we are also to blame because we are super divided. We should have an association for every dairy farmer. Farmers Defence Force is a great example of an organization that competes aggressively. However, what they are doing is beyond limits; there are conflicting interests even in the dairy sector. There exists extensive and intensive farming, and everyone points to each other. They say that the main problem comes from the South, yet Friesland has the same intensity level. We have experienced mutual problems, and the Farmer Defense Force took advantage of that, that is problematic.[9]"* - F_{C4}

[9] A Dutch farmer activist group

5.1.3 Political Sphere

In the following, first, the cultural system of the farmers is explained. After that, farmers' economic system and political system is elaborated on.

Cultural System

The fundament marks the cultural system of the farmers that most farmers are a family - commercial organization in which decision-making is influenced by multiple generations of a family – supplemented with services from third parties such as contract workers (Van der Peet et al., 2018).

An interesting aspect regarding the cultural system indicated by ten farmers is the mentality of Dutch consumers. A farmer pointed to the nonchalance and spoiled needs of the Dutch consumer. Whereas in the past, consumers needed to travel long distances to find high-quality food, currently, high-quality food is abundant. Besides, in the Netherlands, we have certainty on harvest compared to developing countries. Nevertheless, consumers do not dwell on this aspect (F_{O2}, F_{C11}).

All farmers elaborated on educational aspects concerning educational study groups or the existence of educational institutions. Five farmers highlighted the role education plays and the pitfalls regarding agricultural facets. Firstly, a functional role education has in society is to raise awareness around topics as 'nature' and the entire 'solar system' among children. A biodynamic farmer expressed that this awareness should start in primary school. Next to this, the existing structure around research institutions is touched upon. Research institutions play a prominent role in policy development and regulations.

Intently related to study groups, eleven farmers addressed their positive experience of collaborating with peers to perform more sustainable practices. Several reasons why these collaborations take place are shared among the farmers. Firstly, farmers exchange manure by fodders with arable farmers in the neighbourhood to close the regional nutrient cycle. An example is the exchange of potatoes with silage maize. The dairy farmer deposits his manure on his peers' barley land, and in turn, the dairy farmer buys this barley to feed his cows. Another form of collaboration takes place to add cultural and aesthetic values to the region. A farmer explained:

> *"Our neighbour has a tea garden with whisper boats which is visited a lot. He asked if we would like to rent his land for a fee, and in exchange, our cows could graze on his*

> *land. As a result, the people who visit his area, have a nice, appreciated surrounding."* - F_{C7}

Thirdly, three dairy farmers help arable farmers improve their soil quality and prevent it from disease pressure. The soil degradation and disease pressure arise if the same crop is cultivated every year. Therefore, dairy farmers and arable farmers – in this research, tulip growers, lily growers, celeriac growers - exchange land. Moreover, this exchange allows the cows to have more space to graze.

Economic System

An essential point on how dairy farmers experience the economic system is regarding consumer demand for organic milk. Two-third of the farmer refer to the insufficient demand for organic milk. The explanation here fore is twofold and is culminated from the interviews. Firstly, two farmers pointed out the difference between a citizen and a consumer. In that, "*the citizen appreciates cows in the meadow on a Sunday cycle session, while in the supermarket, nine-tenth of the consumers choose a discount package rather than organic milk"* (F_{O2}). Secondly, the added value of producing organic milk in terms of milk quality is low. The latter is clearly explained by farmer F_{C3}:

> *"[…] Food safety and quality [of non-organic milk] is at such a high level that the difference with organic is neglectable. Would the difference in quality be large, then people are willing to pay for this difference. Nevertheless, milk quality in the Netherlands is relatively high. Hence the price-quality difference is not attractive."* - F_{C3}

Additionally, all farmers utter the role agricultural prices play regarding dairy farming. Eight farmers mention that even though the farmers will receive higher prices for organic milk, the initial investment in organic farming is high due to the structure of the transition period. In this period, the farmer cannot sell the milk for organic milk prices in the first year while confirming the organic farming rules. Closely related to the high initial investment needed to transfer to agroecological or organic dairy farming are the small margins farmers encounte. Even though a farmer acknowledges the benefits of it, the high initial investment and small margins make it unattractive to transit. As a farmer reported:

> *"I am convinced that straw/hay is beneficial for your land. Suppose you combine the straw/hay with solid manure and remove the slurry. Fewer emissions arise. I am*

> *convinced that it is better. However, it increases the costs, which makes it impossible to execute."* - F_{C11}

Or

> *"[…] in the transition period, we are confronted with a vivid increase in costs while the revenues stay the same. This liquidity squeeze for a year and with the prospects that this period will be lengthening is unaffordable. The bill of the transition is solely for the entrepreneur in this way.*" - F_{C9}

Correspondingly to stacking up milk quality against each other, the comparison of in the Netherlands produced products to international produced products. To sum up the experience of eight farmers, they experience a gap in food security, animal welfare (housing requirements, animal friendliness), environmental impacts (GHG emissions), and inspection quality. National produced products are of relatively high standards. Furthermore, the high international demand for Dutch milk is fruited by the quality (F_{C5}).

Furthermore, farmers are highly dependent on agricultural loans. Thus, the position of banks within the dairy food system is a vexed subject among ten farmers. A farmer addressed that in the past, a lot was funded based on collateral, which is favourable as a landowner. However, the return of the farming business is more important, how a farmer puts it: *"[…] banks are more critical to grant a loan to farmers and more risk-averse"* (F_{C1}).

Political System

One aspect shared among eleven conventional and all organic and biodynamic farmers are the lack of a long-term vision of the Ministry LNV. Many dairy farmers state that it is unclear what dairy farming will be in a few years. The quotes: *"It is uncertain what they want, and it does not always feel like they make the appropriate decision. Therefore, I do not know if I have to adapt my business operations or not*" (F_{O3}) and *"Well, with legislation, we never know which direction we have to head to"* (F_{C3}) show that they hold the government responsible for unclarity. Furthermore, nine farmers mentioned that policies change too quickly and four mentioned that often politicians go back on recently developed policies.

Eleven farmers find that the public is too distanced from modern-day farming to have an authentic and realistic picture, and the media proclaims accordingly. This framing is assumed as the "*daunting pleasure of farming*" (F_{C6}). As an organic farmer utters on manure usage:

> *"Manure is magic for the soil. This vision is completely different from the excessive manure problems that the media talks about."* - F_{BD}

Also, the legislation imposed by the Ministry LNV is termed oppressive, and one farmer feels that with every decision he makes, he is being called back (F_{C6}). By the same token, politics are said to be too less represented by farmers (F_{C2}). Thus, four farmers addressed the lack of a decent representation of farmers in politics and decision making. To keep farmers advocacy, these farmers try to actively participate in political engagement and public dialogue through their membership in the board of CONO, the Council of Friesland Campina, agricultural nature conservation or LTO. In addition, some farmers engage politically by protesting. Active engagement and participation are seen as a strength of the dairy sector (F_{C9}). Similarly, how a conventional farmer amplifies this:

> *"As a farmer, we are at the lowest position imposing us to collaborate. As a group, we could countervail power."* - (F_{C7})

5.1.4 Summary Spheres

All in all, the personal sphere of the farmers is somewhat aligned. A general perspective can be seen on the farmers' role in society, the human nature relation and the notion of being a good farmer. Regarding the farmers' role in society to combat environmental problems, two-fold views are visible. Firstly, the degree of environmental problems is questioned. Secondly, the environmental problems are acknowledged; however, the locus on the solutions of the problems should be more directed to other sectors. Furthermore, all farmers expressed emotions. These emotions ranged from feeling underappreciated and the feeling of being the villain, to experiencing public recognition.

Several farmers applied sustainable practices that contribute to the transition towards agroecology. Some practices are induced by legislation, such as restrictions on the exertion of GHG emissions (the dairy law) or antibiotic usage (maximum daily doses restriction), whether other practices are applied by means of other reasons. The reasons to execute sustainable practices will be under analysis in the next chapter on the zones of traction and friction.

To summarise the cultural system of the political sphere, the role of education was highlighted by all fifteen farmers. The role of educational institutions, as well as the existence of study groups, was addressed. Furthermore, agricultural prices weigh heavily in the farmers'

decision-making. Besides, within the political system, profound topics attended to the vision of Ministry LNV, existing policies and the representation of farmers.

5.2 Zones of Traction and Friction

In this part of the research, the three spheres are analysed more in-depth to find the existing zones of traction and zones of friction for Dutch dairy farmers in the transition towards an agroecological or organic dairy regime. Similarly to the elaboration of the three spheres, which are explained one by one for the sake of clarity, the zones of traction and friction per sphere are explained separately. Once again, one should keep in mind that these are not separate entities but parts of an interconnected system acting as a whole. Therefore, where farmers expressed causal or correlations between concepts, these are included within the results narrative below.

5.2.1 Personal Sphere - Analysis

In total, there have been five zones of traction identified and seven zones of friction. A summary of the tractions and frictions is provided in **Table 7** below.

Table 7

Zones of traction and friction in the personal sphere

Personal Sphere	#	Traction	#	Friction
Anthropology	13	Human-nature relationship	8	The notion of being a good farmer
Ontology	9	Value of nature		
Epistemology	8	Internalisation of knowledge		
Axiology	12	Openness to change	10	Independent individuality
Societal Vision			13	Technological optimism
			8	Sceptical towards science
			13	Farmers' role
Emotions	8	Public recognition	12	Lack of appreciation
			15	Feeling the villain

Note. The numbers in the table depict the number of farmers that addressed the concept.

Zones of Traction

Anthropological Perspective

The first identifiable zone of traction within the personal sphere, more specifically in the anthropological perspective, is related to the *human-nature relationship*, elaborated on by thirteen farmers. A positively viewed relationship between nature and humans could positively affect sustainable or organic dairy farming (Abson et al., 2017). Two organic farmers defined

that on a level, they feel one with nature. The other sound is that nature is more robust than humans, and humans should find their way within nature.

Furthermore, five farmers agreed that humanity is too much separated from nature. Whereas humanity lived in unity and synergy with nature in the past, this separation has grown over time. The willingness for more synergy with nature is associated with more agroecological systems that minimize external inputs and enhance ecological interactions (De Witt, Osseweijer & Pierce, 2017). Four farmers explain that the segregation is irreversible due to the growing population.

When it comes to interfering with nature, nine farmers agreed that human should not interfere, either because God created nature or because it is not for us to interrupt the nutrient cycle. Even though the farmers agreed on not interfering with nature on different grounds, generally, not interfering with nature encourages pro-environmental behaviour (De Witt et al., 2016).

Ontological Perspective

In the personal realm, traction occurs by the ontological perspective on the *value of nature.* five farmers highly value nature and four farmers acknowledge that everybody perceives nature differently. The latter, fits in the postmodern worldview and results more often in co-creation and collaborative work to switch to sustainable dairy farming, as the world is in the hands of humanity (De Witt et al., 2016).

Epistemological Perspective

The epistemological perspective of the farmers shows an obvious traction possibility to transit to agroecological or organic farming. Regarding the role of science, eight farmers see their intuition and experiences as at least as necessary as science for gaining knowledge about the world, thereby rejecting science as the only valid knowledge. Besides, farmers often seemed to use different sources and modes of knowledge and internationalise – integrating values, standards and opinions of others in farmers own experience - this knowledge. This fits within the postmodern worldview (De Witt et al., 2016). Moreover, science can make beneficial contributions when society is actively engaged with the implications of technological developments. New knowledge enables farmers to contest powerful interests and stand up to pressure to continue buying chemicals from family members, peers, extension officers, and salespeople (F_{O3}; Gosnell et al., 2020). Concluding, the internationalisation of knowledge

results in a zone of traction as new knowledge informs farmers on novel sustainable practices and their environmental impacts.

Axiological Perspective

Another traction arises in the axiological perspective within the high degree of *openness to change* of twelve farmers. They elaborated on their will to change practices, yet it should fit their farm. Next to the own elaboration of farmers of being open for change, according to Wensing, Carraresi & Bröring (2019), valuing a varied life is a predictor of a high degree of openness. This is also confirmed by ten farmers that appreciated their jobs because *'every day exists of variety of activities'*.

A high degree of openness to change appeared to be a strong positive predictor of pro-environmental behaviour because, generally, those farmers are more excited about novel practices and, therefore, more likely to adopt (Wensing et al., 2019). Thus, the fact that many interviewed farmers were open to change results in an excellent opportunity to transition to sustainable farming (Hedlund-de Witt, 2012).

Emotion

In respect to the emotions encountered by the farmers, one source of traction became evident by conventional, organic and biodynamic farmers. Farmers experienced *public recognition* by citizens due to the outdoor grazing of cows. As outdoor grazing is a crucial aspect when transferring to organic farming – farmers are obliged to double the outdoor grazing hours of cows – public recognition exerts positive attitudes towards organic farming and subsequently stimulate the forethoughts to transit.

Zones of Friction

Anthropological Perspective

The notion of *being a good farmer* is a source of friction in the anthropological perspective. According to eight farmers, a 'good' farmer is not necessarily someone who pulls out all the stops to improve soil quality, decrease nitrogen emissions, or have the highest biodiversity rates. A distinctive observation was that being a good farmer entails *"someone good for his cows"* (F_{C1}). Hence, it is not surprising that to feel good or get fulfilment in life, a farmer's goal is to maintain animal welfare and make decisions that contribute to this. Thereby, six farmers correlate being good for the cow essential to increased productivity.

Nevertheless, this definition of a good farmer does not equal an organic farmer because a conventional farmer can be good for his cows, give them space, have rotating cow brushes, feed them every day, and prevent diseases.[10] This causes less incentive to transition to a sustainable farm because they are already a good farmer in their eyes. It should be said that yet, four farmers mention the additional importance of taking care of the surroundings.

Axiology Perspective

A source of friction arises in the axiological dimension on the notion of *independent individuality*. Ten farmers show a high value on independence and do what they enjoy, fitting in a modern worldview (De Witt et al., 2016). Hedlund-de Witt (2014) reflects a high degree of independent individuality that the values are oriented toward the pursuit of self-interest rather than that they relate to concern for the welfare of other people (Hedlund-de Witt, 2014).

Societal Vision

In the personal realm of the farmer, the *role of farmers* in society could be a source of friction. To the farmers' extent, their primary role is providing milk. Moreover, according to them, the milk in the Netherland is already of high quality, despite being produced conventionally. This poses a threat to their willingness to adopt more sustainable practices to improve milk quality. Furthermore, the least number of farmers called themselves nature conservationists, while this role would contribute to a pathway towards agroecological farming. Thereby, a farmer defined his existence by his social position and achievement, fitting in the modern worldview (De Witt et al., 2016).

Additionally, there exists to a certain degree environmental optimism among four farmers. The sense of urgency and crisis is not yet felt, resulting in a little drive for change. Nature is said to be adaptable and robust, which will recover from the anthropological damage, fitting in the modern worldview (Hedlund-de Witt, 2011; De Witt et al., 2016). Additionally, Lacroix & Gifford (2018) demonstrate that perceived risk of environmental impacts is a predictor of pro-environmental behaviour, such as organic farming. The fact that some Dutch farmers did not perceive a significant risk predicts non-pro-environmental behaviour.

Whereas one organic and biodynamic farmer mentioned that no technical solution exists for environmental problems (but do acknowledge the importance of technology), most farmers were optimistic about *using technology*. This factor clarifies that these individuals do not feel

[10] Rotating cow brushes in the barn increases animal welfare by removing dirt, dust and parasites (Goncu, Yesil, and Yilmaz, 2019).

called to personally contribute or change to be part of the solution (Hedlund-de Witt, 2013). However, technology is not seen as the solution for environmental problems but as a tool to prevent the environment from degradation as much as possible.

The view role of science in combating environmental problems poses a source of friction. Herein, seven farmers tend to trust their judgment, and they are somewhat *sceptical towards science.* Science is said to be corrupted by special interests, such as big corporations. As also acknowledged by a researcher (E_2), who explained that corporate businesses ask for research on sustainability indicators, and Ministry LNV funds this research. In other words, some farmers did not trust the scientific results on environmental change, in its turn leading to no perceived risk nor the incentive to transition towards sustainable farming.

Emotion

An emotion that was felt was the *lack of appreciation* and the *villain's feeling*. Several factors contribute to these feelings. Regarding the lack of appreciation, two factors are identified. Farmers are annoyed by the consumers who do not pay higher prices for their milk yet request farmers to transit to agroecological or organic farming. This creates friction as the farmers relieve themselves from doing so, as the consumer is held responsible (Van der Ploeg, 2019).

Regarding the villain's feeling, four factors heartening this feeling have been identified. Firstly, by distrust in emission calculations resulting in negative conclusions for dairy farmers. Secondly, by 'wrong' framing by politicians and media. Thirdly, by the fact that policies feel arbitrary promoting other 'environmental polluting' industries. For example, they elaborate on the need to emigrate or intensify to execute the dairy farming profession due to the Ministry LNV wants to cut half of the number of cows. Lastly, farmers feel an easy target.

5.2.2 Practical Sphere – Analysis

In the practical sphere, five zones of traction and nine zones of friction are identified. After analysing the sphere, the economic aspects related to the technical, ecological, and social practices became apparent. Therefore, at the bottom of the traction and friction section, the economic aspect is added. This section elaborates on the identified zones of traction and friction as experienced by the farmers. Therefore, the numbers depicted in **Table 8** that show how many farmers addressed a topic deviate from the number of farmers that applied practices, as shown in **5.1.2.**

Table 8

Zones of traction and friction in the practical sphere

Practical Sphere	#	Traction	#	Friction
Ecological	3	Soil quality improvement	6	Risk of animal welfare
	3	Enhancement of biodiversity	3	Positive outcomes not visible short term
Technical			2	Incompatibility of solutions
			1	Pioneer in innovations
Social	10	Sense of community	4	No one to pass down the business
			1	Conform to traditional expectations
Economic	2	Fewer expenses on inputs	8	Availability of land
	10	Compensation by cooperative	2	Higher price per region
			2	With droughts, higher expenses

Note. The numbers in the table depict the number of farmers that addressed the concept.

Zones of Traction

Ecological Aspects

A zone of traction appeared on the *soil quality*, which has been experienced to be improved as elaborated by F_{O3}. Furthermore, F_{O2} elaborated on the improved soil quality after the association for the conservation of farmers and nature (in Dutch: vereniging tot behoud van boer en natuur, VBBM) took samples and tested the soil content. Additionally, F_{C11} used urea inhibitors and found by testing the samples that his sample contained more organic-based nitrogen and less ammonia-based nitrogen compared to the average proportions by farmers that do not use urea inhibitors.

Another source of traction in the ecological aspects also became evident after the farmer (F_{C10}) was approached by his neighbour to improve biodiversity resulting from applying a floral border. Indeed, he noticed an increase in endemic species in his pasture. Moreover, biodiversity increased after meadow bird management (F_{C11}), and an organic farmer explained that he actively participates in meadow bird's conservation, and the number of meadow birds increased yearly (F_{O2}).

Social Aspects

The *sense of community* results in a learning process whereby farmers "*learn from each other and gain knowledge."* All in all, this results in progressive, innovative farmers and the enhancement of sustainable practices. Considering this, farmers share new insights and show each other their farms and property (F_{C6}). A farmer explains:

> *"We are quite in touch [with each other] to gain knowledge to evaluate certain operational aspects on other farms. This is the best way to learn about your farm as well. Things we learn vary from knowledge on beneficial practices for my farm specifically or what can be done to improve business operations?"* - F_{C2}

Economic Aspects

An organic farmer expressed his *reduction of expenses* in fertilizers, pesticides, and antibiotics. Additionally, due to the more land-based characteristic of organic farmers, they can provide their cows with grass from their land and need to buy fewer concentrates (F_{BD}, F_{O2})[11]. Thus, the fact that farming organically reduces farming costs is traction that could stimulate conventional farmers to go organic.

An encouraging observation by ten conventional farmers is their affirmative attitude towards the *compensation programme* of 'On the way to planet proof 'of Friesland Campina or the 'Caring Dairy' programme of CONO. This compensation programme directly influences the development of applying sustainable practices. In that sense, the extra work and costs farmers encounter by investing in sustainable practices are prized, resulting in traction for change.

Zones of Friction

Ecological Aspects

Within the ecological aspect, the farmers experience the *use of antibiotics* as a zone of friction. Four conventional farmers and two organic farmers identified this as a risk because they would not have the necessary tools to intervene in or safeguard the cow's health. Moreover, it requires more meticulous qualities in respect to adequately observing the health risks of the cows. The latter aspects are also shared among the organic and biodynamic farmers. One farmer elaborates:

> "*When farming organically, there are far fewer tools which can be used to respond to animal welfare. In other words, farmers have less ability to correct. They are regularly faced with more difficulty anticipating the long-term consequences. They are not able to correct the consequences without the usage of antibiotics. Moreover, it requires a*

[11] The land-based character entails that the farmer uses the total production of manure on his own land (Silvis et al., 2020)

> *higher level of acceptance that sometimes negative things happen beyond your control. Also, much more secure farming is necessary."* – F_{O1}

Additionally, *short-term benefits* for the soil and production are less visible, therefore hampering change. Organic farmers gave two examples. Firstly, the soil improvement after quitting the fertilisers or pesticide use is not visible in the short term (F_{O2}). Secondly, two farmers were confronted with the fact that their Holstein cows were not robust enough to adjust to the requirements of organic farming (F_{BD}, F_{O3}). Therefore, the farmer needed to either crossbreed between a Holstein and other herds or buy young calves. However, after nine months of pregnancy and a two-year waiting period until a cow can produce milk, it requires patience and trust in the transition process.

Technical Aspects

Within the practical realm, also technical aspects play a crucial role. Some farmers are confronted with the *technical incompatibility* of their intended sustainable investments and what is feasible. Two farmers explained the incompatibility to buy a CowToilet or solar panels (F_{C11}; F_{C1}). Thus, even if farmers want to transition towards more sustainable practices, sometimes they are unable to do so because of technical limitations.

Regarding another technological aspect, a conventional farmer elaborates on his investment in manure mono digestion and his experience with *being a pioneer* in investing in this technology. Regarding the latter, the farmer needed to reinvent the wheel together with the installer to instal the system, which consumed a considerable amount of time and costs (F_{C2}).

Social Aspects

On social aspects, the fundamental of farming businesses, often being a family business, can be friction to apply sustainable farming practices. In this research, all the participated farmers worked on the farm of either their parents or other family members. Considering that they are a family business, three farmers mentioned blocking factors. In the first case, a conventional farmer expressed the lack of incentives on no family member to pass down the business to.

> *"I do not have a manure separator, just a traditional grid. That is the whole point. If a family member wants to take over the business, I might expand a little bit (if there are subsidies available). I would be able to renovate the barn and invest in low emission floors. Now I am in a dilemma [whether I can or want to invest in such practices]."* - F_{C10}

In addition, an organic farmer was confronted with the fact that his farm is a family business. He would like to conform to his family's expectations. After asking if his social network hinders the transition to organic farming, he mentioned:

> *"My father used to have a hard time after finding out my ambition to transit to organic farming. Luckily, this feeling changed to supporting me in this decision. I can imagine his feeling since, to my father, it seems as if I condemn how he farmed. Doubtlessly, this was not the case."* - F_{O1}

Concluding, to transit to organic farming, a farmer requires confidence and a strong sense of the value of organic farming to cope with possible family relation differences. Suppose these are not characteristics of the farmer. In that case, this could thus be a zone of friction, hindering the farmer from transitioning.

Economic Aspects

In the economic aspect, the use of solely *organic concentrates* can result in a source of friction. In prolonged droughts, using only organic concentrates will have a higher financial impact on organic farmers than on conventional farmers. When there are extended periods without rain, a farmer needs to supplement the cows' feed with more concentrates. Organic farmers are restricted to use solely organic feed for the cows, and organic feed is more expensive than other feed. Hence, organic farmers must dig deeper into their wallets in these periods to provide the cows with enough feed. As an organic farmer elaborates on a hurdle in the organic dairy niche:

> *"The last couple of summers led to problems. Droughts are outside our power which makes it more demanding. It is more difficult to find organic feed, it is both more expensive and less produced. […] Hence, we had to purchase it, which was quite an investment compared to conventional dairy farmers."* - F_{O3}

Another source of friction is *acquiring land* to become more land-based and provide more than 65% feed from own land or region, and less than 40% concentrates. As stated before, agricultural land prices are reaching limits, rendering it challenging to buy more land.

Also, two farmers from Drenthe articulated the differences in region-specific soil, water and weed conditions essential to consider in dairy farming practices. This holds that the applicability and outcomes of fertiliser and pesticide use will be limited in some parts of the country where the soil is more fertile with less weed. Therefore, these farmers believe

compensation for transitioning to sustainable practices in dairy farming should be higher for them than the current compensation per litre of milk. A farmer explains:

> *"We are on a sandy soil rather than clay soil that is not fertile and has many weed problems. In order to transit to organic farming, we have to put more effort into the soil without pesticide use which makes the price difference of nine cents not worth it. It would be more attractive to me if I would be on clay ground."* - F_{C4}

5.2.3 Political Sphere – Analysis

The zones of traction and friction within the political sphere can be drawn from the amplification of the political sphere in the previous chapter. In the political sphere, three zones of traction and twelve zones of friction are found. A summary of the tractions and frictions is provided in **Table 9** below.

Table 9

Zones of traction and friction in the political sphere

Political Sphere	#	Traction	#	Friction
Cultural	10	Existence of study groups	5	Lack of sustainability education
	11	Collaboration with peers	10	Dutch Mentality
			6	Sceptical towards research institutes
Economic			8	No compensation through market
			8	Intensification to create future resilience
			4	Organizations in favour of regime
			4	Lack of revenue model
			8	International market
Political	6	Legislation	11	Lack of long term vision
			9	Fast-changing policies
			9	Cumbersome legislation
			4	Unrepresented in decision making

Note. The numbers depict the number of farmers that addressed the concept.

Zones of Traction

Cultural System

A zone of traction to apply sustainable practices within the social dynamics is the farmers' willingness to *collaborate with arable farmers* and start partnerships, emphasised by eleven

farmers. This collaboration results mainly in soil improvement, less waste and optimal use of grassland.

Closely related to the collaboration with peers is the *existence of study groups that* causes traction. Ten farmers elaborated on the positive association they experience regarding experiential education by study groups provided by cooperatives such as LTO or CONO. This connotation comes through sharing current developments regarding policies or economic aspects, sharing technical numbers, and comparing whether sustainable practices generate positive outcomes. Moreover, they build confidence to experiment with novel practices through experiential education, as stated by four farmers. Interestingly, a conventional farmer indicated that the presence of organic farmers in study groups or excursions to organic farms would contribute to his learning process on sustainable practices (F_{C5}).

Political System

In addition to traction zones found in the cultural system, the farmers experienced one point of traction in the political system. Six conventional farmers expressed feeling pressured by the government to conform to more sustainable practices. For example, with the current legislation such as phosphate rights or the dairy law, conventional farming automatically transitions towards organic farming (F_{C5}, F_{C6}, F_{C9}). However, three conventional farmers described how they felt organic farming is the future, underlining that governmental pressure is necessary.

On the contrary, two organic farmers did not feel pressured but conceived the oppressive regulations as challenging and exciting (F_{BD}, F_{O3}). An organic farmer described this as follows:

> *"I do not feel pressure, but our business has a head start because we need less external protein-rich feed, do more outdoor grazing, have lower urea levels, hence, fewer emissions."*

Zones of Friction

Cultural System

Three sources of friction are identified in the cultural system of the farmers. Firstly, *the role of education* is addressed by five farmers, who believe that the educational system is focussed mainly on how to produce milk efficiently. Thereby compromising the importance of, for example, how to apply meadow bird management, how F_{C3} explained: *"Although meadow bird management does not entail rocket science, you have to learn along the way if meadow bird management fits your interests for optimization"*. Additionally, one farmer explained that he

was educated to use fertilizers to optimize revenue and hence, started using fertilizers, while his ancestors quit using fertilizers (F_{C7}). Another example of a pitfall in education concerning the construction of herb-rich grass areas is given, he explained:

> *"Certainly, we have been taught the assumption that herb-rich grass is not desired in the grassland area; however, in the end, the cow is reaching his limits. A farmer in the Flevopolder gave vitamin K from the dandelion extract, which positively contributed to the cow's health. In the end, dandelion in the grassland area is not that bad.*" - F_{C7}

Secondly, six farmers expressed doubts about the *sincerity and independence of research institutes* and questioned their prominent role. Consequently, they struggle with acknowledging the sincerity of published research on environmental impacts, which blocks potential practices that research indicates as sustainable. As one farmer expressed herself on research performed by the WUR on GHG emissions:

> *"Well, to be honest, I think science is coloured. Much research on the consequences of spreading manure above the ground shows that it is not that bad. However, that will end at the bottom of the drawer because it is not conducive to the vision of ministry LNV. I believe science is important, but it is not always fair."* - F_{O3}

Lastly, ten farmers do not trust that there is sufficient demand to pay an extra price for sustainable practices or organic milk within the *Dutch mentality* and market. This holds that these farmers believe it will not be economically worthwhile transitioning to agroecological or organic farming.

<u>Economic System</u>

The economic system is a topic all farmers touched upon. Herein, they mentioned the need for stimulation and financial support to move in a sustainable direction. Five sources of friction are identified. Firstly, the milk prices are not high enough (see **4.2.2.**) to focus their business on agroecological or organic farming. Eight farmers discussed that an even higher price of organic milk is crucial compared to the current regime. They state that due to the finite character of subsidies, *compensation through market* prices is favoured. Whenever a farmer invests in sustainable practices such as low emission floors, the farmers allocate the costs. In this sense, they are the only price takers. As one farmer states about his investment in a low emission barn:

> *"That is the sad part. The price per litre does not increase. I could end up with increased production and, thus, more revenue. However, eventually, I believe that the increase in costs should offset the increase in milk prices. However, that is not the case, and the differences are becoming even smaller."* - F_{C5}

Secondly, eight farmers explained the need to grow by buying more cows to ensure they can render profits in the *future and build the farm's resilience*. This growth is necessary due to the stabilising milk prices and increasing agricultural prices. However, the growth is not a goal but rather a possibility to earn just enough to pay for the costs (F_{C8}). All in all, the farmers experience a necessity to grow in terms of merely to continue making a profit.

Thirdly, the high level of institutionalisation in which companies that sell concentrates or chemical fertilisers established a prominent role in making it more challenging to move away from those products' usage, is acknowledged by four farmers. Thereby these companies operate in *favour of the current regime*. The companies visit farms to sell their product and do not consider environmental consequences. How one farmer puts it:

> *"Well, the entire periphery, chemical fertilise selling companies but especially the concentrate guys. They still mainly think about high production rather than how I think, namely, find the optimum. They have to make a change [so that both production and the environment are taken into account]."* - F_{C1}

Linked to the above discredit towards selling companies is the aversion towards consultancy companies. Farmer F_{C4} articulated the feeling of grudge towards consultancy companies because of the high price of a consult. Consequently, if subsidies are given for sustainable investments, this should be directly distributed to the consultancy company, making consultation on sustainable farming practices too expensive.

Fourthly, as elaborated on by conventional and organic farmers, the economic system lacks a *revenue model* for farmers to provide them with certainty when transferring to an organic dairy farmer. The same holds for applying sustainable practices on the farm level.

Lastly, the low quality of milk from *international markets* compared to the Dutch milk quality creates less incentive to transit to organic farming since the milk has sufficient quality.

<u>Political System</u>

The last system to consider is the political system in which four sources of friction from farmers perspective are observed. Firstly, according to eleven farmers, the objective of the Ministry

LNV and the transition towards organic dairy farming is solely to safeguard only the socio-economic position of the farmers shortly than in the long term. The uncertain future that comes with the short-term focus develops a source of friction (Gosnell et al., 2019).

This *lack of a long-term vision* and uncertainty are worsened by the fast rate at which *policies are changed*. For instance, one farmer, ascribing the role of farmers to combat environmental impacts of farming, is worried to invest in infrastructure because the effectiveness of specific sustainable innovations has been proven not rigid. As a result, there is a risk of not being able to pay off the debt of investment. How F_{C10} elaborated on this aspect: *"[…] But if there are no rigid policies, and a lawsuit results in the government being called back on policies, I am not going to act on this ambiguity as an entrepreneur."*

Thirdly, the facet related to dissatisfaction with politics is the *cumbersome legislation* as identified by nine farmers. One farmer experienced the easiness to be granted a building permit fifteen years ago. In contrast, recently, applying for a building permit is *"more difficult"* (F_{C7}). All in all, the high degree to which policies change over time, and the odd and cumbersome legislation hamper the adjustment of business operations.

Lastly, farmers feel *underrepresented in decision-making positions* resulting in a lack of a broader view by the government. They believe experts of the topic, namely, the farmers, should be included in decision-making. Thus, others sit down on the entrepreneur's chair inadvertently. This source of friction is shared among five farmers.

5.2.4 Overall Conclusion of the Results

This thesis aims to shed light on which factors create opportunities or barriers in the transition towards agroecological or organic dairy farming. It is concluded that, in terms of quantity, most frictions exist in the political sphere (twelve), followed by the practical (nine) and personal (seven) sphere.

In terms of the content of frictions in the personal sphere, the societal vision shows the most frictions regarding the *role of science and technology* in combating environmental problems and *the farmers' role* therein. No zones of friction have been identified in the ontological and epistemological perspectives. The zone of friction that is shared among most farmers (87%) is the role of technology and how the farmer identifies his role.

In terms of the content of the frictions in the practical sphere, economic aspects show the most zones of friction (three), the *availability of land*, the *low price for sustainable milk* and

the *increase in expenses* in case of droughts. Results show that *land availability* is the most significant friction that is shared among farmers (53%).

Likewise, in the political sphere, most (five) zones of friction were identified in the economic system, *compensation through the market, intensification to create future resilience, organizations operating in favour of the regime, lack of a revenue model,* and *international market*. Nevertheless, the political system also shows a high number (four) of friction zones, namely, *lack of a long-term vision, fast-changing policies, cumbersome legislation* and *underrepresentation in decision-making*. Furthermore, the most significant friction shared among farmers (73%) is *a lack of a long-term vision*.

On the contrary, it was established that most zones of tractions exist in the personal sphere (five) and practical (five) sphere, followed by the political (three) sphere. Furthermore, in terms of the content of tractions in the personal sphere, one traction zone was identified in all perspectives but the societal vision. The traction that was experienced by most farmers (87%) was the *human-nature relationship*.

Results also show that in both the ecological aspect, *soil quality* and *enhancement of meadow birds*, and economic aspect, *fewer expenses* and *compensation programs*, two traction zones are found, yet no traction zone was identified in the technical aspect. Furthermore, a *sense of community* and *compensation by cooperatives* is experienced by most farmers (66%).

Lastly, the cultural system shows the most traction zones, *study groups* and *collaboration with peers,* whereas no zone of traction was identified in the economic system. Furthermore, the traction that was experienced by most farmers (73%) was being *open to change*.

Chapter 6. Discussion

Answering the research question in the previous section contributed to closing several knowledge gaps about the hampering and fostering aspects for dairy farmers to transit towards sustainable dairy farming. To better understand the relevance and implications of the research findings within the broader context of the three spheres of transformation framework and leverage points for transitioning, this section will discuss the results with reference to existing literature. First, the main findings of the research are examined and discussed. Secondly, it focuses on the interconnectivity of the three spheres and the implications and limitations of the research. Lastly, the suggestions for further research are presented.

6.1 Discussion of Findings

The three spheres of transformation framework has not yet been applied in the Dutch dairy farming context. Nevertheless, it has shown to leave space for farmers to share what they felt was important. Through that, the spheres of the farmers are scrutinised to understand the main zones of traction and friction. In the next section, the findings are elucidated and substantiated by theoretical insights using the framing of leverage points. Furthermore, it is explored how tractions could be exploited, and frictions could be reduced to facilitate farmers in transitioning to sustainable dairy farming.

6.1.1 Discussion Personal Sphere and Leverage Points

As discussed in academic literature, farmers are often the 'losers' of sustainability transitions (Van der Ploeg, 2020; Vermunt et al., 2020). Therefore, logically, the personal sphere of the farmers entails numerous zones of friction. Worldviews supporting sustainable transition are the traction zones, whereas worldviews not supporting sustainable transition are frictions. This research elaborates further on methods to limit the zones of friction or explore zones of traction.

According to Meadows (1999), to achieve systems change, e.g. transitioning from the regime to the niche agroecological or organic farming, interventions on deep leverage points (worldviews, values and system structures) offers perspectives. In line with this theory, the results of this study support that the worldviews are crucial to consider and determine the rate at which system change is possible. This came forward by observing three conventional farmers perspectives in more depth. All three farmers were open to change and willing to change their farming practices but did not transit to agroecology or organic farming through personal aspects. One farmer did not want to transit due to his drive to derive maximum production (F_{C5}).

Furthermore, F_{C6} has a mindset that is "*not yet ready*" to transit to organic farming, and F_{C3} explained that organic farming should be in one's nature and be a passion rather than economically viable. In addition, systemic change was generated among three organic farmers who chose to transit because farming organically matched their vision on good farming practices. Thus, when there is a power to change the mindset or worldviews, system change is possible.

An aspect that highlights the quintessence to consider more deeply the social aspects and the personal sphere of farmers can be seen by organic farmers' motivations to not transit to biodynamic farming. According to F_{O1}, biodynamic farming entails a whole different view of

the world in a broad context rather than solely in an agricultural context. Correspondingly, something that hampers an organic farmer to transit to biodynamic farming is because it is interpreted as *"too floaty"* (F_{O2}).

Another observation concerns the rigidity of the personal sphere. Even though the personal sphere is said to be rigid in time, it is not static, and values and worldviews can change within an individual's life, over generations and through pivotal events (Kegan, Kegan & Lahey, 2009). The latter can be seen with an organic farmer who observed that genetically modified cow feed did not contribute to cows' health, making her question to continue feeding genetically modified cow feed and transit to organic dairy farming (F_{O3}).

The findings show a relatively modern worldview regarding farmers' societal vision. Technological optimism, scientific scepticism, and the farmers' role in combating environmental problems sustain farming practices from the productivist regime, thus less agroecological farming practices. One opportunity to reduce two zones of friction and exploit a zone of traction lies within the farmers' vision on their role in the society, the lack of feeling appreciated and the source of traction of public recognition. Having said this, emphasising and encouraging their role in society as agricultural nature conservationists could transfer responsible environmental behaviour. Thereby, the enriching dimension of agroecology is supported. Moreover, by stressing this role, a feeling of appreciation could arise, and farmers can encounter more public recognition, resulting in a positive feedback loop. Thus, it can be concluded that for the design of future policy programmes, it seems to be of fundamental importance that farmers' role as active agents concerning nature conservationists should be stressed and that farmers are given a sufficient degree of appreciation for additional services provided (Leichenko, Gram-Hanssen & O'Brien, 2021).

A compelling observation regarding the personal sphere revealed how farmers view the role of science. On the one hand, science is rejected as the sole source of valid knowledge, and farmers are often sceptical about scientific research regarding environmental aspects while scientific research demonstrates the detrimental environmental impacts of dairy farming. This leads to a decreased urge to transit to sustainable practices. On the other hand, this scepticism enriches their knowledge by combining scientific knowledge with their own knowledge from, i.e. experience, leading to pro-environmental behaviour. The IWF allows this finding to exist as it does not entail a binary framework of solely traditional or postmodern perspectives.

At the same time, it must be considered that every farmer is different. Some strive more for conservational values and others for change. Every one of them should get the chance to act according to their inner value portrait. Thus, for farmers themselves, it is helpful to figure out what their inner value preferences are and set their goals accordingly.

6.1.2 Discussion Practical Sphere and Leverage Points

The second part of this research finding focuses on the practical sphere and the related zones of traction and friction. There are more zones of friction than zones of traction within the practical realm of the farmer. Furthermore, economic and ecological aspects cause the most zones of friction and traction, respectively.

When defining leverage points regarding the three spheres of transformation framework, the theory falls short within the dairy farming context. Namely, according to O'Brien (2018) and Abson et al. (2017), changes in the practical sphere, such as setting targets or providing financial incentives within existing structures, are shallow intervention points that can generate beneficial outcomes but, on their own, are unlikely to lead to regime change. However, this study states that interventions in the economic aspects of the practical sphere are essential to achieve regime transition or systemic change. Due to the requirements of organic farming, becoming an organic farmer comes with costs, which created a source of friction for eight farmers. According to them, the transition period is crucial and, when being financed, would give them leverage for systemic change. Likewise, two organic farmers explained that the transition subsidy "*was significant"* (F_{O1}) to bridge the two years. Logically, it is argued that the practical economic incentives are easy points to intervene and facilitate change, and therefore also compelling to consider accelerating the transition in the dairy farming sector.

Next to this, a shallower leverage point is also observed in the economic aspects of the practical sphere. Ten farmers elaborate on their economic incentive to execute sustainable practices, for example, financial compensations for reducing GHG emissions. However, the application of these practices entails incremental changes that do not facilitate a whole regime transition. Hence, interventions on the economic aspects can also be insufficient for farmers' transformation.

The two observations above - the existence of deep and shallow leverage points in the economic aspect of the practical sphere - contribute to the theory of Abson et al. (2017) that states that the most effective places to intervene in a system depend on specific characteristics and the relationships between components.

Another slightly shallower leverage point to intervene in the dairy farming sector, yet vital to consider, exist within ecological aspects. The environmental benefits of agroecological and organic farming are not acknowledged by all farmers, resulting in a barrier in ecological aspects for farmers' to transit. For example, six farmers elaborated on the risk of using fewer antibiotics. Additionally, solely stressed by organic farmers, a source of friction is the lack of short-term benefits when transiting to organic farming. Concluding, most farmers do not see the overall benefit of organic farming concerning the ecological aspects and consequently do not want to transit. In order to reduce this zone of friction, information should be shared on the positive outcomes of organic farming to provide confidence in long-term ecological benefits.

Additionally, it is widely known in the literature that farm characteristics play a crucial role in becoming more sustainable on technological and ecological grounds (Vermunt et al., 2020). However, in this research, eight farmers refer to the availability of land that restricts them to become more sustainable rather than technological and ecological aspects.

6.1.3 Discussion Political Sphere and Leverage Points

Processes of regime lock-ins or zones of friction are captured in the notion of the political system's power that provides stability to the existing regime and defines constraints and possibilities for transformation. The desk research revealed lock-ins regarding the economic and policy dimension of the dairy farming sector, namely, skewed power division, price dependencies, consumers unwillingness to pay a higher price and changing policies.

Corresponding with the literature (Abson et al., 2017), the interviews showed that deep leverage points can be found in the political sphere of the farmers concerning the political system. All farmers elaborated profoundly on the need for clarity by providing long-term goals or coherent, consistent regulations that are currently absent. Nowadays, agricultural policy is aimed at short-term goals and intensive agriculture production. Short-term increase in production cannot be easily united with a long-term vision.

Furthermore, the economic system showed no traction zones, highlighting the significant existence of friction within this system. The development of a revenue model or compensation through the market to facilitate transition is essential for farmers. Agricultural land prices are a barrier to start with organic farming. Given the frictions mentioned above, it is essential to provide farmers with future stability in clear-cut policies and an attractive revenue model. By doing so, a systemic transition towards organic or agroecological farming can be achieved.

Next to the zones of frictions, this research provides relevant insights into the zones of traction in the political sphere. Importantly, eleven farmers elaborated on the existence of study groups in which they gain knowledge from other farmers concerning farming practices. Moreover, it was highlighted by two farmers that the interaction of organic and conventional farmers in study groups could result in positive environmental outcomes. Hence, great opportunity lies within this traction zone by anticipating on this and faciliate study groups with sustainability themes. Finally, the partnerships with arable farmers and the enthusiasm that comes along with the collaboration provide indirect contributions to the desired outcome. Along these lines, the exchange of manure by fodders helps by closing the nutrient cycle, soil improvement, less waste, and optimal grassland use.

6.1.4 Interconnectivity of the Three Spheres

A rich literature on sustainable transition studies describes the importance of traction and friction within the spheres, but the interactions among the three interacting spheres are essential to consider to facilitate change (O'Brien & Sygna, 2013; O'Brien, 2018). For example, behaviours, systems, culture and experiences are interdependent, and worldviews and values influence how systems are viewed, which relationships and goals are deemed desirable and which behaviours are prioritised (Hochachka, 2021; Roberts, 2014). In line with theory, the findings of this research reveal several points of interaction where zones of traction and friction connect two – or more - spheres. In this section, interesting remarks on three zones of friction and five zones of traction are given on the interconnectivity of the spheres.

A source of friction is identified between the practical and political sphere. In economic aspects, to acquire an air washer, manure mono-digestion or other techniques that result in a better environment (practical sphere), an agricultural loan is needed. However, the source of friction arises from banks' increase in criticalness to grant a loan (political sphere). Thereby, farmers need to show high returns in the future. Unfortunately, high returns in the future are difficult to achieve in the case of small-scale enlargements. Consequently, farmers must implement cost-reduction and scale enlargement strategies to be granted a loan, resulting in an intensification of farming and enormous farm-scale enlargement. Furthermore, a farmer elaborates on the risk of staying a small scale-farmer:

> *"The farming businesses that sell milk from 400 to 500 cows, have indoor housing and therefore, run well financially will be granted a loan. On the contrary, a family business close to the village, which citizens consider sustainable, goes bankrupt due to the absence*

of turnover. […] To show high returns, we needed to become very intensive; however, later on, we were able to become less intensive again." - F_{C4}

Besides, many farmers are willing to apply or invest in sustainable farming practices. However, the bank makes it impossible due to strict regulations, such as appraising obligations (F_{C7})

Another source of friction can be seen between the personal and political sphere. The lack of a long-term vision and fast-changing policies, also acknowledged by desk research, generate a high level of uncertainty and unclarity. However, clarity and certainty in policies (political system) are essential for individual farmers to develop their farm business in directions accepted and appreciated by society (public recognition), resulting in the feeling of appreciation (Poppe & Koutstaal, 2020).

Lastly, friction between the personal (axiological perspective) and political sphere (economic system) became apparent. As came forward in this research, most farmers are open to change. However, their will to change seems extensible up to the point where it is no longer possible to combine environmental gains with economic gains. Here, the axiological perspective involving a high degree of openness to change is constraint by the economic system of small or no margins farmers get as price-takers.

On the contrary, traction is fuelled between the personal and practical spheres through improved soil quality. As the biodynamic farmer elaborates on the quality of the soil after the transition: *"[…] Everything should be in harmony with nature and that all starts with the soil. Everything good for the soil, is good for the diversity of plants, furthermore, good for the animals or directly for us".* Moreover, another conventional farmer contests regime concentrates companies after gaining knowledge on the improved soil quality using organic concentrates. Thus, improved soil quality leads to improved human nature relation and knowledge creation on sustainable practices.

The second aspect that can be exploited to accelerate the transition factors in the political sphere nourishes farmers' axiological perspective on the value of farming, namely, the flexibility and the variety of activities that come with dairy farming. Considering this, target policy displays better opportunities for farmers to continue the freedom of decision-making, flexibility and variety in activities, rather than resources-policy. With target policy, goals are set, and the strategies used to get there are upon the farmers to decide, while with resource policy, the government decides which practices should be applied or puts restrictions on

practices to reach particular goals in favour of the environment. A facet supporting the benefits of target policies rather than resource-policies is their affirmative attitude to the compensation programme of the CONO, in which farmers can choose to focus on indicators that fit their ambitions. Likewise, an expert discussed this topic whereby resource policies creates restrictions on farmers entrepreneurial activities.

Furthermore, positive feedback loops arise in the education facilitating role in the society which ten farmers give themselves. This anthropological view of the farmer results in traction in the cultural system in the political realm. Farmers can do a better job teaching students, children or adults on the complexity and resilience of agroecosystems using integrating approaches with a practical and theoretical aspect. At the same time, the possibility arises that the farmers are appreciated more in the society and hence the farmers' willingness to conform to societies expectations to become more sustainable.

Fourthly, traction comes from the existence of study groups in the cultural system of the political realm, which results in collaboration with peers and learning processes in the social aspect of the practical sphere.

Lastly, traction exists between the positive effect of the political system and developments in the practical sphere. Therein, the introduction of regulations and laws to prevent considerable phosphate exertions results in practices by the farmers to accomplish other environmental benefits. For example, the introduction of the dairy law results in the automatic converging of conventional and organic farming. Thereby, farmer F_{C5} mentioned that he diminished the use of fertilisers because farmers in the current regime are slowly being manoeuvred into the direction of organic farming.

All in all, numerous exciting interactions between the spheres are identified, resulting in zones of traction and friction.

6.1.5 Regime Dynamics and Farmers' Experiences

An interesting observation is on controversies on the farmers' perspectives and the investigated regime structures. There exists a knowledge gap regarding the transition period towards organic dairy farming. Due to the requirements of organic farming, this transition comes with costs, which created for eight farmers a source of friction. According to them, the transition period is crucial and should be financially more attractive. Another farmer elaborates on the *"currently no support for farmers who want to transit to organic farming"* (F_{O2}). However, the ministry of LNV does accommodate dairy farmers that consider a transition. Hence, the knowledge gap

became evident. This knowledge gap should be targeted in the communication with dairy farmers and educational programs for farmers to overcome friction regarding high transition costs.

Also, in other research on farmers, the knowledge gap became a bottleneck in the transition towards organic farming. Lauwers & van der Burg (2019) found that the main bottleneck for managing organic matter to capture carbon in the soil is the lack of specific knowledge about how proposed measures meet the Dutch farms' particular type of soil needs. Besides, Kramer et al. (2017) found that an increased knowledge score is the most significant of low levels of antimicrobial use in Dutch husbandry.

6.2 Reflection on Research

In this section, the research draws on the limitations of the MLP and three spheres of transformation framework and explains innovative theoretical contributions of the theories. Similarly, limitations on the research methods are critically discussed, and future improvements are suggested.

6.2.1 Reflection on Multi-Level Perspective

Regardless of the beneficial aspects of the application of the MLP framework, it also poses some complications. A reasonably common implication found in scientific literature is the lack of more profound patterns and linkages underlying sustainability challenges (Abson et al., 2017; Pesch, 2015; Runhaar et al., 2020). Furthermore, three implications of the use of the MLP framework within the dairy farming sector became apparent.

The first implication that came to light regards the exploration of niches, which are the pathways dairy farmers could take to transit towards sustainable dairy farming. While exploring, it became evident that a clear delineation of the dimensions towards agroecology is missing. Having said this, it illustrates that a completely founding translation between niches and regimes appeared to be challenging. Consequently, a distinction between sustainable dairy farmers (niche actors) and non-sustainable dairy farmers (regime actors) is burdensome. This poses a threat to the development of the transition, as transitions occur when niches are enough robust and mature to challenge the productivist dairy farming regime (El Bilali, 2019). On the contrary, organic farming can be defined as a robust niche that is informed, initiated, and designed to respond to sustainability problems perceived in the regime (Smith, 2007).

Consequently, the distinction between the niche and regime concerning organic farming can be easily made.

Secondly, considering the development of the agroecology niche and organic farming niche, Pant (2016) refers to the 'paradox of performing' that involves competing for agroecology and organic farming strategies. This paradox of performing became visible in this research is the controversy on grazing practices. Organic farming requires at least 1440h of outdoor grazing, improving animal welfare and biodiversity. This leads to more field emissions, constraining farmers focussing on the conserving dimension of agroecology. Hence, focussing on one dimension can lead to the loss of niche values of other dimensions or organic farming (Pant, 2016). Thus, this research found that the widespread opportunities of sustainable practices that farmers can take - to be categorised under a niche - makes it challenging to be robust and mature enough to scale up and challenge the regime. An apt approach would be to consider more deeply the internal niche processes in dairy farming transitions.

Despite the similar dairy regime structures of the five dimensions, geographic context and the landscape pressures of farmers vary. Here, the researcher stumbles upon the third implication in applying the MLP framework: the framework's inability to consider geographical aspects in which the farmer is embedded. Akin to literature findings, each region has different ecological challenges and solutions (Vermunt et al., 2021). Two farmers in Drenthe elaborated on their beneficial geographic location regarding collaboration with arable farmers. Furthermore, in North-Holland, F_{C8} explained;

> *"Your surroundings should be in that situation that it is easy to be reached. This location in the polder is not in that position, and there is competitiveness on acquiring land. That is what happens here in Starmeer; there are no organic farms. Pastures, where organisations manage the terrains and rent to farmers, are suitable for organic farming because they can have more land."*

Next to the implications above on the applicability of the MLP framework in this research context, it is widely used by academics and policymakers in transition processes in agri-food sustainability transitions, emphasising the production phase due to beneficial attributes of the framework (El Bilali, 2019). Likewise, the desk research performed, combining primary (expert consultation) and secondary (desk research) data, served as a rigorous analysis of the dairy farming sector through the lens of the MLP by capturing reality in a framework with multiple levels and multiple actors and systems. Hence, it could draw objective implications on real

chances for change. Furthermore, the operationalisation of the sub-categories and concepts were added after theoretical insights and research into the Dutch dairy farming sector (see **Appendix A**). This is beneficial as they offer more refined concepts and an analytical approach to enrich the MLP framework. However, it should be emphasised that these concepts are specialised to the agri-food context and thus, not generalisable for the MLP as such.

6.2.2 Reflection on Three Spheres of Transformation

Before this research, limited academic research existed on applying the three spheres of transformation framework in agri-food context to find hampering or fostering factors for farmers to transit to agroecological or organic farming. In particular, applying the framework in the dairy farming context offered valuable insights into the deeper level of an actor perspective.

However, the use of the framework generates a complication. Naturally, discussing the opinions of farmers adds a layer of subjectivity. Therefore, the findings are not meant to generalise about particular groups nor serve as a solution manual to make farmers transit to organic farming or agroecological farming. Instead, this work shares one angle of the dairy farming story. Nonetheless, the researcher attempted to incorporate the variety of viewpoints of the regime – conventional - and niche - organic and biodynamic - farmers. Moreover, the researcher used the MLP framework to serve as an objective framework to show the dairy farming sector structures and systems to overcome subjectivity implications.

Nonetheless, the framework contributed to understanding the farmers since it considers that transformations are non-linear and approaches transformations as continuously interacting and shaping outcomes. Hence, recognising there is no single way to initiate change, the three spheres of transformation offer guidance for understanding and overcoming complexities that could otherwise hinder sustainable transitions. Power dynamics, worldviews, values and farming practices influence structures, systems, and methods for overcoming adversity. Furthermore, the zones of traction and friction contribute to an understanding of what factors play a role in the farmers' decision making in the transition towards sustainable dairy farming.

Next to the enrichment of the MLP framework in the agricultural context, the operationalisation of the sub-categories within the three spheres of transformation framework is a valuable addition. It contributes to a more comprehensive approach to analytically assess the farmers' perspectives and their zones of traction and friction. Therefore, the three spheres

of transformation framework are enhanced in the dairy farming context and can be generalized to other agricultural contexts.

Although the concept of worldview has not been a focus in existing approaches in the field of environmental behaviour, however, precisely because of its overarching nature (De Witt et al., 2017), it has become particularly suitable to come to a more comprehensive understanding of the zones of traction and friction. Moreover, the categorisation of worldviews in a binary framework is suboptimal. For example, on the one hand, a farmer could have a postmodern worldview in epistemological perspective – e.g. positive attitude towards sustainable transition – but on the other, a traditional worldview in ontological perspective – e.g. keener to non-pro-environmental behaviour. Hence a binary framework cannot account for the cognitive possibility of integrating two 'opposite' perspectives (de Wit et al., 2016; Hedlund- de Witt, 2014). For these reasons, employing the five worldview aspects engendered a more systematic, structural, and comprehensive articulation and investigation of worldviews. Another contribution of the IWF framework is that it does not posit that one worldview is intrinsically "better" than another (Hedlund-de Witt, 2014). Nevertheless, it must be stated that in this research, the five perspectives do not shed light on the content of, and the variations between, different worldviews.

6.2.3 Reflection on Research Methods

Even in the face of the quality measures taken to overcome barriers of qualitative research (see **3.5**), a few limitations should be considered. As is often the case for qualitative studies of this sort, the generalizability in this research is relatively low (Maxwell, 1992). Firstly, the results are based on a relatively small group of participants. This makes the conclusions relevant for the research population. Furthermore, the time and scope in which the study was conducted limited the possibility of replicating the research to increase trustworthiness.

An essential aspect to consider when applying qualitative research is the sample of the research. Regarding this, a limitation of the sample could be that the farmers agreed on participating in this research, which means that the perspectives of less assertive or committed farmers have been left out. Besides, the use of convenience sampling results in a limited control on the sample and non-complete insight into the perceptions of all dairy farmers. Similar to the statement above, sufficient time would allow overcoming these limitations. Next to this, dairy farmers that applied some sustainable practices on the farm view themself already as sustainable

farmers. As a result, finding out the zones of traction and friction for dairy farmers in the transition towards sustainable dairy farming is challenging.

As came forward in this research, region-specific characteristics of the farms determine partly the opportunities for farmers to become more sustainable. However, data analysis have failed to identify the zones of traction and friction per spatial attributes because this research did not analyse farmers' answers separately by region or by farm characteristics.

6.3 Limitations, Strengths and Future Research

A first limitation occurred as a result of the unusual situation of the COVID-19 pandemic. The pandemic affected the data collection method and thereby could affect the study results. Sturges & Hanrahan (2004) found evidence that there are few differences in the responses one gets when asking questions in person or online. Asking sensitive questions by an online tool will sometimes be more effective since participants may be less distressed about answering when the interviews are not physically present (Bryman, 2012). Moreover, an interview by phone or Microsoft Teams allowed the researcher a wide range of possible participants since there is no restriction on the distance.

Nevertheless, it remains unknown if the method affected the results. Sixteen conversations took place through Microsoft Teams (ten experts and six farmers), and nine farms were visited in person. Farm visits were experienced as an added value to understand better what the dairy farming sector entails and create a convenient interview setting for the farmer. Furthermore, the farmers were enthusiastic about showing the farm and surroundings. This allowed the farmers to tell their stories more easily.

A strength of the research is that, to the researcher's knowledge, it is the first research that applied the three spheres of transformation framework to the dairy farmers' perspective. Thereby it subsequently aided the next step into studying the transition towards sustainable dairy farming. However, further research is needed to elaborate on the new findings of this study. More research can be of great value to uncover the points of interest that were revealed in the discussion.

First of all, by presenting the findings of the spheres in terms of zones of traction and friction, various pathways that create traction in the transition towards agroecological or organic dairy farming were shown. Dairy farmers demonstrated a willingness to collaborate with arable farmers, acknowledged an educational role in society, actively participated in study groups and

experienced a high sense of community. Therefore, this research suggests that to scale up agroecological or organic dairy farming, future research can build on these findings by performing a more in-depth analysis of the interplay between the three spheres related to social and/or educational interactions and examine how these tractions can strengthen one another. Knowing this offers possibilities to accelerate the farmers' transition.

Secondly, the current research can function as a starting point for accelerating the transition towards sustainable dairy farming, and future research can gather more insights into other actors' spheres and find shared zones of traction and friction between the farmers and other actors. The shared zones of traction could then be more aligned, and the shared zones of friction could be eliminated. Besides, the controversies on knowledge and knowledge gaps as elaborated on in **6.1.5** can be diminished.

Thirdly, as the research developed, the broad nature of the analysis on the dairy regime and niches proved to be challenging to navigate. Consequently, difficulty in delineating between regime and niches proved to be a limitation in achieving more focused and precise research. Hence, further research is suggested whereby the heuristic framework, introduced by Gaitán-Cremaschi et al. (2019), is used to place and identify farmers as more or less sustainable characteristics. Doing so allows distinguishing between farmers in the dominant food system (the regime), or those that deviate radically from them (niche) or those that share elements of dominant and niche systems (hybrid systems). Consequently, more accurate questions could be asked on hampering or contributing factors in the transition by taking farm-level specifications into account. Subsequently, similarities and differences between food systems could be critically assessed to find possibilities to explore contributing or hampering factors for specific food systems.

Chapter 7. Conclusion

This research aimed to understand where dairy farmers are constrained or supported in the transition towards agroecological or organic dairy farming regarding their worldviews and existing economic, political, legal, social, cultural and practical system structures. As executors of agricultural practices and often neglected in sustainable transition studies, focussing on farmers helps better understand at which points to intervene in the dairy farming regime to accelerate a sector-wide transition. In doing so, empirical results drawn from interviewed conventional, organic and biodynamic dairy farmers are presented in terms of zones and traction

and friction through the heuristic framework of O'Brien and Sygna (2013). This approach generates novel insights into interactions within, across, and among the three spheres of transformation.

Overall, the results of this study indicate that most zones of friction became apparent in the political sphere, followed by the practical and personal sphere. More specifically, frictions related to the political and economic system structures were most apparent. All farmers elaborated profoundly on the need for a long-term vision by the Ministry LNV, together with fixed and stringent policies. Regarding the economic system, the development of a revenue model would facilitate change among the farmers. A grounded observation by this research that offers a positive perspective is the perceived traction zone of peer groups whereby collaborative learning processes have ensued.

Secondly, in terms of the practical sphere, results show that economic incentives provided by corporations and the sense of community that facilitate learning processes contribute to progressive changes in farming practices that support sustainability outcomes. On the contrary, acknowledging the environmental benefits of agroecological or organic farming is low, resulting in a barrier in ecological aspects for farmers to transit. All in all, it is suggested that scaling up sustainable dairy farming requires governance strategies that create future certainty for farmers through progressive policies and mature revenue models. Moreover, the development of mixed study groups to share knowledge must be supported.

Thirdly, results demonstrate that most traction zones lie in the personal sphere related to the worldviews and emotions of farmers. The most significant tractions occurred in the human-nature relationship and openness to change. Regarding frictions, four factors relieve the farmers from responsibility and lead to less perceived risk and incentive to transit to agroecological or organic dairy farming. Namely: (1) the lack of appreciation felt among farmers due to unwillingness of consumers to pay an extra price for sustainable milk, (2) trust in technology in preventing environmental degradation, (3) the view of farmers' role in combating environmental problems, and (4) the sceptical view on the role of science. Thus, it can be concluded that for the design of future policy programmes, it seems to be of fundamental importance that farmers are given a sufficient degree of appreciation for additional services provided and that their role as active agents concerning nature conservationists should be stressed.

In terms of additional insights to facilitate farmers' transformation, existing literature often stresses the need for changes in the personal sphere when discussing sustainable transition. This study acknowledges the importance of such deep leverage points but also emphasizes the need to consider the interconnectivity of the practical and political sphere that constrain the capacity for sector-wide transformations in the dairy farming sector. Furthermore, while these insights contribute to the overall understanding of the farmers' perspectives on sustainable transformation, this research suggests that future research can build on the findings by performing a more in-depth analysis of the interplay between the zones of traction and friction to scale up agroecological or organic dairy farming. Consequently, additional detected deep leverage points can serve as functional building blocks for future intervention while considering the perspectives of the 'losers' of the transition within the dairy farming sector.

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Appendices

Appendix A

Operationalization MLP Framework

Table A1

Concepts of the Dutch dairy regime

Category	Sub-category	Concepts
Landscape-level	Environmental pressure	Pressure by climate change, biodiversity loss etcetera
	Socio-political pressure	Pressure by changing regulations, social movements, ministry vision etcetera
Regime level	Science	Research institutes
		Research focus
		Scientific knowledge infrastructure
		Actors in the science dimension
	Socio-Cultural	Dairy consumers perspective on dairy regime
		Consumer preferences
		Consumer culture
		Actors in socio-cultural dimension
	Technology	Technologies in dairy farming
	Policy	Developing policies and regulations
		Subsidies
		Actors in the policy dimension
	User & market	Dairy farming suppliers
		Agricultural prices
		Actors in dairy user & market regime
Niche level	Dairy practices	Practices favouring sustainable outcomes
	Ministry LNV	Vision of ministry
	Technologies	Technologies favouring sustainable outcomes
	Dairy business operations	Organic/biodynamic dairy farming

Appendix B

Specification on Desk Research data

The databases which have been consulted are Google Scholar, Web of Science, and the WUR repository. The WUR repository covers publications of universities as well as grey literature published in all kinds of trade journals; hence, it covers a complete, comprehensive academic output (WUR, n.d.). Furthermore, data is collected from statistical websites such as Agrimatie and CBS. If a search for a concept, as operationalized in Appendix A, such as user & market, resulted in a limited amount of results, snowballing was used. The snowballing entailed that references of relevant publications were used to contribute to a comprehensive outline of the dairy farming sector. Keywords were 'sustainable dairy farming', 'dairy farming the Netherlands', 'dairy farmers' or similar search terms used in Dutch. Most data gathered is used as input for the interview guide (before the interview) and during the interview itself when formulating follow-up questions.

Table B1

Analysed document for content analysis

Documents	#	**Information gathered from and value of data source**
Scientific Documents	47	• Research on environmental and socio-political landscape pressures on the Dutch dairy farming system. • Research that discusses user preferences & industry culture, industry & culture, scientific knowledge & technology, and policy • Research that investigates sustainable pathways in the dairy farming sector • Journals: *Agricultural Systems (1), Agricultural Finance Review (1), Antipode (1), Basic and Applied Ecology (1), Environmental Science (1), Environmental Development and Sustainability (1), Environmental Innovation and Societal Transitions (3), Food Policy (1), Frontiers of Agricultural Science and Engineering (1), Irish Veterinary Journal (1), International Journal of Agricultural Sustainability (1), Journal of Cleaner Production (1), Journal of Dairy Science (2), Journal of Animal Science (1), Organic Agriculture (1), People and nature (1), Sustainability (2), Technical Forecasting and Social Change (1), Technology in Society (1), Technology Analysis & Strategic management (1), The Journal of Peasant Studies (2)* • Research Institutes/departments*: Louis Bolk Institute (1) Wageningen Livestock Research (5), Wageningen Economic Research (8), Wageningen*

		Environmental Research (2), Wageningen Plant Research (1), Wageningen University & Research (4),
Policy/White Paper Reports	10	• Socio-political pressure • Policy dimension • Dutch Ministry LNV vision and organic dairy farming • Dairy system structure and actors
Websites	16	• Websites of relevant actors in the dairy farming system provided information on those actors.
Statistical Outcomes	4	• Environmental pressures • Industry & industry culture
Forwarded Ref	2	• Industry & industry culture published by Louis Bolk institute
Expert Consultation	7	• Environmental and socio-political landscape pressures on the Dutch dairy farming system. • Existing technologies • Dairy system structure and actors • Relevant to gain a comprehensive understanding of the dairy farming system and entailed information on the broader dairy farming system context. • Comparing the information shared by experts enables the researcher to cross-validate what became apparent by desk research and address inconsistencies.

Note. Documents, number of documents or consulted experts, information gathered per data source, within brackets is number of articles.

The expert consultation took place from March '21 – April '21. The conversations with the experts within the Dutch dairy sector were held in Dutch. Considering the lockdown restrictions due to the COVID-19 pandemic during data collection, the conversations with the experts were held remotely using internet calling software instead of face-to-face.

Table B2

Consulted experts

#	Name	Company	Title	Date (duration)
E_1	Anonym	WUR	Researcher	10th March (31 min.)
E_2	Anonym	UU	Prof. dr. veteranian	17th March (29 min.)
E_3	Anonym	WUR	Researcher	17th March (36 min.)
E_4	Anonym	Van Hall Larestein	Professor	18th March (35 min.)
E_5	Anonym	Rabobank	Theme manager sustainability	18th March (28 min.)
E_6	Anonym	Anonym	Advisor Agriculture & Food	19th March (29 min.)

E_7	Anonym	Van Hall Larestein	Professor	24th March (32 min.)

Appendix C

Interview Guide Farmers

Hello,

Thank you for participating in this interview. I would like to record the interview, if you approve so. I have a consent form with me, signed by me and my supervisor in which I secure your privacy. After the interview, you can decide whether you want to be anonymised or not. For my research, I have talked to some experts to get the bigger picture on the dairy farming sector and what a likely transition is within the dairy sector. I want to understand your perspective on this vision and what is needed for you to change. The questions are drawn from a framework and entail personal questions as well. I would like to stress that there are no wrong answers!

Table A4

Interview guide developed for Dutch dairy farmers

Part	Name	Question
Introduction		Could you please briefly introduce yourself? (Name, Age, years working on the farm)
		Could you tell me something about your daily operations?
		Could you tell me something about your farm; family company, area, amount of animals, people working on the farm?
Practical and Political Sphere	**General**	Have you changed your operations in the last ten years? If yes, why did you change?
		Do you currently face problems in dairy farming? If yes, how did they come about?
	Ecological and Technical	Have you changed the technologies you use in dairy farming in the last ten years? If yes, why did you change?
		Did you change anything in the last ten years regarding fertilization, antibiotics or pesticide practices? If yes, why did you change?
		Do you perform sustainable practices in your farming business to decrease ammonia emissions? If yes, which one? If not, why not?
		Do you perform sustainable practices in your farming business to enhance biodiversity? If yes, which one? If not, why not?
		Do you perform other sustainable practices that benefit the environment? If yes, which one? If not, why not?

	Economic	What would help you/is helping you to make changes towards sustainable agriculture regarding your economic situation?
		What would hinder you/ is hindering you from making changes towards sustainable agriculture regarding your economic situation? *(mention the increasing value of agricultural land, increasing costs of labour etc. in the prospect of stable milk prices)*
	Political	Do you think that the vision of the ministry of LNV to work towards agroecology is feasible? If yes, why? If no, why not?
		What would help you/is helping you to make any changes towards sustainable agriculture regarding policies? *(if not mentioning anything, talk about the available subsidies)*
		What would hinder you/is hindering you from making any changes towards sustainable agriculture regarding policies?
		Do you feel pressured by sellers, buyers, supermarkets, or other actors to change sustainable agriculture practices?
	Cultural	Are there people/institutions/networks in your surroundings who would help you/helped you to make any kind of changes?
		Are there people/institutions/networks in your surroundings who hinder you/are hindering you from making any kind of changes towards sustainability?
		If sustainable: 'what does your neighbour say about your transition? Or conventional farmers?'
Personal Sphere	**Ontology**	What do you like the most about living on the farm? And why?
		What do you see as the role of nature?
	Epistemology	Are you a member of a farmer organisation? If yes, why? If no, why?
		Do you talk a lot with fellow farmers? If yes, what about? If not, why not?
		Do you follow media and politics a lot? If not, why not? If yes, why?
		Through which channels do you gain knowledge?
	Axiology	What gives a fulfilment in life? And as a farmer?
		Are you open to contribute to agroecology?
	Anthropology	What standards and values make a farmer a good dairy farmer?
		How do you see the human-nature relation?
	Societal vision	Do you think the society around dairy farming is organized properly? If yes, explain why? If no, how would you change it?
		Do you think that environmental problems and issues (GHG emissions, biodiversity loss, acidification etc.) are addressed in a proper way? If yes, explain why? If no, how would you change it?
		How do you see your role and identity in society? And as a farmer?

		Do you think your role as a farmer can play a role in addressing those environmental issues?
		Do you think technology and science can play a role in combating environmental problems?
5. Closing section		How do you think we can reach the goal towards sustainable dairy farming?
		Do you have some comments regarding the topic of the interview?
		Do you have any other comments which might give valuable insights on the transition to sustainable dairy farming?

Note. The questions are based on insights of three experts and the three spheres of transformation framework.

Appendix D
Consent form

Figure D1

Consent form

GEHEIMHOUDINGSVERKLARING PERSOONSGEGEVENS

INTRODUCTIE

Deze verklaring beschrijft de taken en verantwoordelijkheden van de Universiteit Utrecht, Heidelberglaan 8, 3584CS, Utrecht in deze gerepresenteerd als 'Ontvangende partij'. Dit ten behoeve van werkzaamheden voor de master scriptie met als onderwerp 'de transitie richting duurzame veehouderij' ('Het Doel'), overeenkomstig de Algemene Verordening Gegevensbescherming (AVG) met de betrekking tot de persoonsgegevens ontvangen van 'Verstrekkende partij'. Partijen worden niet beschouwd als gezamenlijke data controllers in de zin van artikel 26 van de AVG.

VERKLARING

1. De Ontvangende partij verklaart dat de persoonsgegevens in elke vorm, die direct of indirect toegankelijk is vanuit de Verstrekkende partij aan de Ontvangende partij in relatie met het Doel strikt vertrouwelijk zal worden behandeld. De Ontvangende partij verklaart dat deze niet zonder uitdrukkelijke toestemming van de Verstrekkende partij op te slaan of te delen met derde partijen. De data mag gebruikt worden binnen de master scriptie, opdat gegevens gebruikt kunnen worden voor onderzoek en analyse, mits aan punt 2, 3 en 4 wordt voldaan.

2. De Ontvangende partij implementeert en onderhoudt passende technische en organisatorische maatregelen om de persoonsgegevens te beveiligen die in overeenstemming zijn met de toepasselijke privacywetgeving en de richtlijnen van de lokale gegevensbeschermingsautoriteit. Passende technische maatregelen zijn hierbij dat de data enkel op de laptop van de onderzoeker staat met een antivirus software. Bovendien wordt de data niet (of in een beschermde) online omgeving gebruikt. Een organisatorische maatregel is dat de data op de laptop van de onderzoeker staat waarbij alleen de onderzoeker toegang heeft door middel van een veilig wachtwoord.

3. In het geval dat de Ontvangende partij op grond van de wet, regelgeving of gerechtelijk bevel verplicht wordt om persoonsgegevens openbaar te maken of te delen, dan zal de Ontvangende partij de Verstrekkende partij op de hoogte stellen, voor zover wettelijk vereist.

4. De Verstrekkende partij heeft het recht de Ontvangende partij te verzoeken om inzage te verlenen in de verstrekte persoonsgegevens en/of deze te verbeteren, aan te vullen of af te schermen, en voor zover mogelijk in het kader van het Doel te verwijderen.

5. De Ontvangende partij zal, indien gewenst door de Verstrekkende partij, de persoonsgegevens anonimiseren. Bovendien zal de Ontvangende partij herleidbare persoonsgegevens wissen en de profielgegevens enkel bewaren zolang noodzakelijk is voor het onderzoek, indien gewenst door de Verstrekkende partij.

Op deze verklaring is uitsluitend Nederlands recht van toepassing. Als er geschillen ontstaan, dan kan dit in eerste instantie intern worden gemeld bij de functionaris gegevensbescherming van de UU. Mocht van daaruit geen gewenste, passende oplossing komen, verklaart de Verstrekkende Partij de exclusieve bevoegdheid van het Gerechtshof van Utrecht, gevestigd te Utrecht, Nederland.

Utrecht University	Verstrekkende Partij
24 / 03 / 2021	___ / ___ / _____
Naam student: Kim Boswijk	Naam:
Naam begeleider: Brian Dermody	Functie/rol:
Handtekening student, begeleider:	Handtekening:

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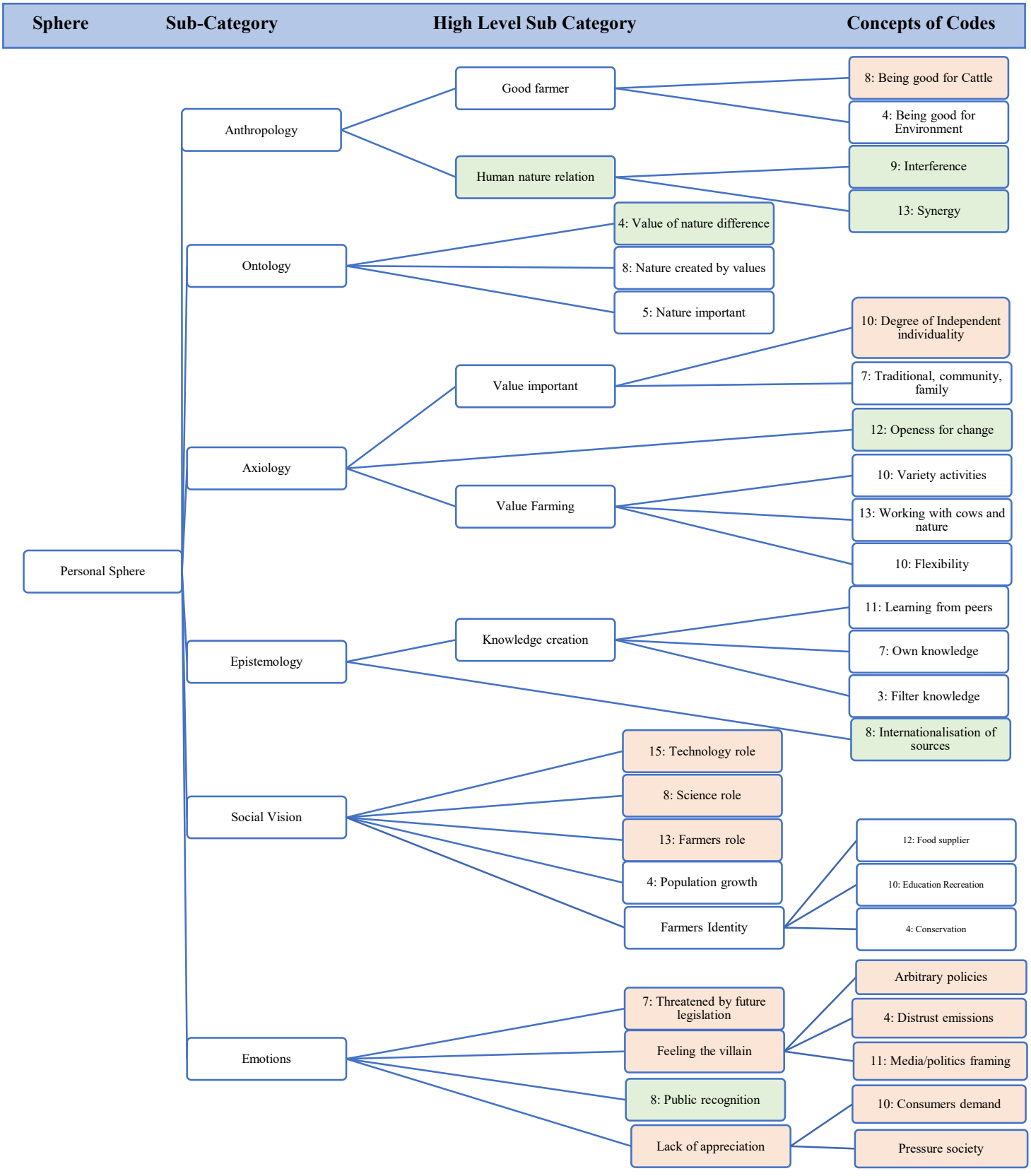
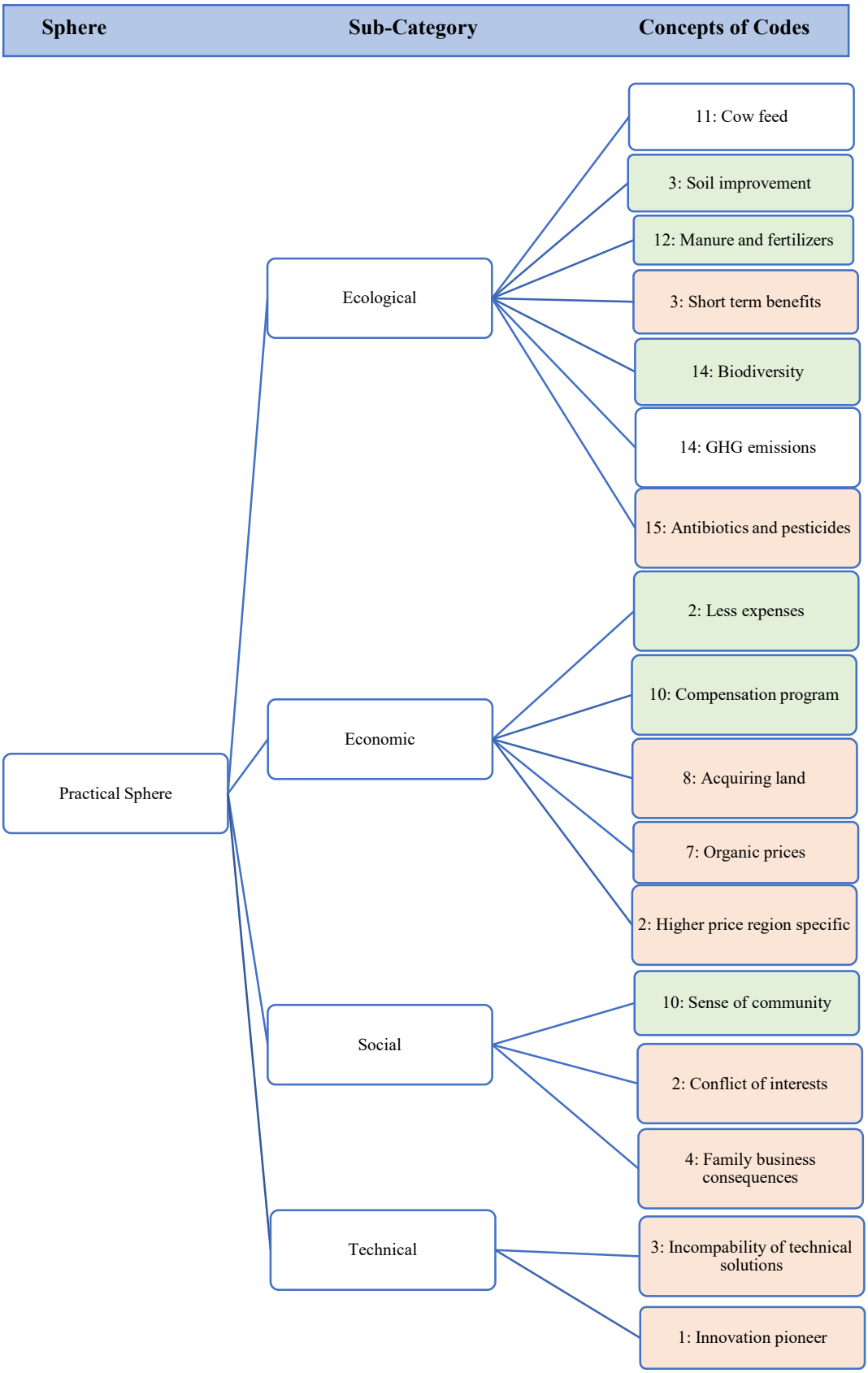
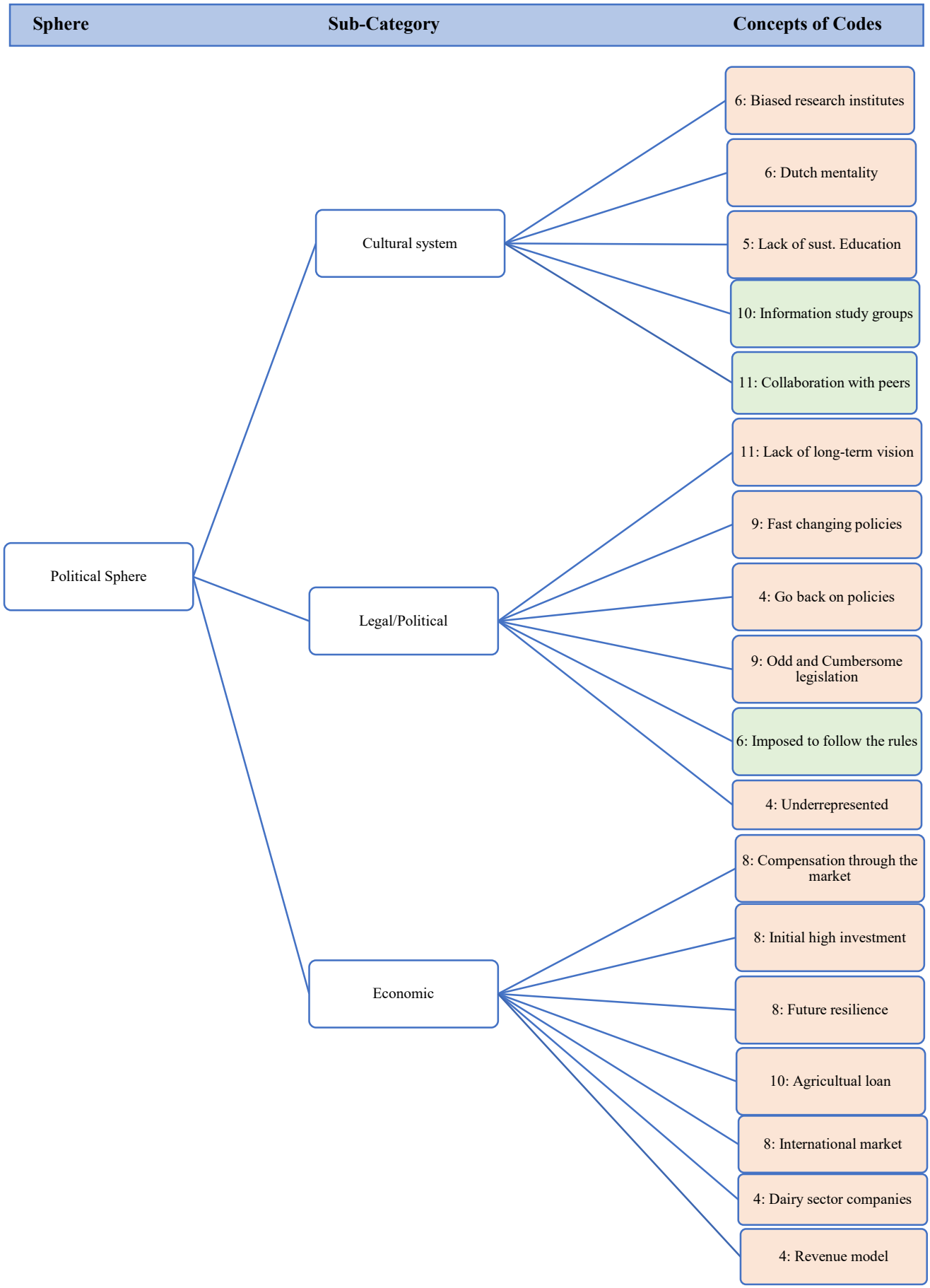
Appendix E
Concepts of Codes

The numbers depict the number of farmers that addressed a concept. Moreover, the red and green shaded concepts are the zones of friction and traction.




Sphere
Sub-Category
Concepts of Codes
Practical Sphere
Ecological
Economic
Social
Technical
11: Cow feed
3: Soil improvement
12: Manure and fertilizers
3: Short term benefits
14: Biodiversity
14: GHG emissions
15: Antibiotics and pesticides
2: Less expenses
10: Compensation program
8: Acquiring land
7: Organic prices
2: Higher price region specific
10: Sense of community
2: Conflict of interests
4: Family business consequences
3: Incompability of technical solutions
1: Innovation pioneer


Sphere
Sub-Category
Concepts of Codes
Political Sphere
Cultural system
Legal/Political
Economic
6: Biased research institutes
6: Dutch mentality
5: Lack of sust. Education
10: Information study groups
11: Collaboration with peers
11: Lack of long-term vision
9: Fast changing policies
4: Go back on policies
9: Odd and Cumbersome legislation
6: Imposed to follow the rules
4: Underrepresented
8: Compensation through the market
8: Initial high investment
8: Future resilience
10: Agricultual loan
8: International market
4: Dairy sector companies
4: Revenue model

Appendix F

Coding Guideline

Table F1

Coding Guideline

Personal sphere	Sub-Category	Example phrase	#
Anthropology	A good farmer: being good for cattle	*"For me, it means that the animals are healthy" - F_{C6}*	8
	A good farmer: being good for environment	*"[...] a farmer might be bad if it is a mass on his pasture. The one that produces the most is not necessarily better" - F_{C7}*	4
	Human nature relation: interference	*"I think that with a mono manure digester, essential parts from the manure are separated, which should not be the case. With this machine, the circularity of nature is disturbed" - F_{O3}*	9
	Human nature relation: synergy	*"[...] a technical solution by commanding the cow to pee makes us even more distant from nature. That's the point when I think. This could not be the purpose" - F_{C3}*	13
Ontology	Aesthetics value of nature difference	*"In the end, it is all about the taste. Some people call grassland nature. Some call tundra's nature." - F_{C8}*	4
	Nature created by values	*"[...] well if I apply a flower border, I would want to see it because it does not have value if I have to walk into the bush to see biodiversity"- F_{C10}*	8
	Nature important	*"Everything has to be in harmony with nature, and it starts with the soil. Everything that is good for the soil, is good for the plants" - F_{BD}*	5
Axiology	Feeling good: Degree of independent individuality	*"I'm my own boss, I make the decisions and can do that independently" - F_{C4}*	10
	Feeling good: Traditional value, community, family	*"Well, my children make me doubtlessly the happiest" - F_{C1}*	7
	Value of farming: variety activities	*"Variety of the seasons, working with animals, the machines and taking care of the pasture" - F_{C9}*	10
	Value of farming: working with cows and nature	*"The thing I like the most is being with the cows [...] "- F_{C11}*	13
	Value of farming: flexibility	*"You can work independently. You can do whatever you like. It is a profession of freedom and flexibility" - F_{C5}*	10
	Degree of openness to change	*"As a farmer, we are eager to change, but it should with within the boundaries" - F_{C6}*	12
Emotions	Threatened by future legislation	*"[...] the manure policy could be a threat for us. On other aspects, I do not experience a threat because we own agricultural land" - F_{C11}*	7
	The need to emigrate	*"I feel notably negative pressure. What do they want from us? Do you want me to emigrate? Do you want us to vanish?" - F_{C4}*	3
	Pressured feeling	*"The government demands a lot, and therefore, you need to work progressively in this profession to keep your head up. That is why my daughter dove in the healthcare, to start a care farm in the future."*	5
	Public recognition	*"[...] As long the cows are outside grazing, I experience public recognition"- F_{C11}*	8

	Lack of appreciation	*"We find that we are succeeding on some and fails on other heads. Hence we have a lot to talk about" - F_{C2}*	10
Epistemology	Knowledge creation: learning from peers	*"New insights, we visit other pastures and walk around, everybody has his own inputs and advice" - F_{C6}*	11
	Knowledge creation: own knowledge	*"We did a test on the pasture with liquid manure, which was supposed to be better for the smell and emissions. We are not able to prove if it worked, but at least we can observe, and we know exactly what we feed the soil" - F_{C7}*	7
	Knowledge creation: filter knowledge	*"I stay up to date, but I filter pretty much information through the news app [...] - F_{C2}*	3
	Internationalisation sources	*"I always try to inform myself as broad as possible. General media, websites, food blogs, websites in which different opinions are shared. I am always curious to new knowledge to eventually form my own opinion" - F_{O1}*	8
Societal vision	Technology role	*"Yes, I am sure about that. The technique is continuously in development with new ideas, provided that the technologies are tested" - F_{C10}*	15
	Science role	*"[...] science is too much focused on number rather than actual observations, science can help but is not the decision making factor" - F_{O1}*	8
	Farmers role in combating environmental problems	*"I think we can contribute [...] a lot of other practices in industry increased while the farming industry decreased already in GHG emissions, so I think the industry is the problem" - F_{C8}*	13
	Farmers identity: food supplier	*"As a farmer, we are food suppliers" - F_{O3}*	12
	Farmers identity: education, recreation	*"I think that I recreational give people joy with the meadow birds and cows" - F_{O2}*	10
	Farmers identity: nature conservation	*"[...] It is not just food supplying, but also landscape and environment" - F_{O1}*	4
	Environmental optimism	*"we move automatically in the direction of agroecology, I do not know how it will be concrete, but we will follow" - F_{C6}*	4
	Population growth	*"Everybody has to be careful; however, the fact is that we are with many people, which is too much for this small piece of earth" - F_{C11}*	4
Political Sphere			
Cultural system	Biased research institutes	*"How research institutes present their findings to the outer world, depends on the source" - F_{C8}*	6
	Dutch mentality	*"the citizen appreciates cows in the meadow on a Sunday cycle session, while in the supermarket nine-tenth of the consumers choose a discount package rather than organic milk" (F_{O2})*	10
	Education: lack of proper education	*"[...] Teachers do not know what to do on MBO schools, and on level two, pupils are in school for a too-short time frame in order to develop sustainability knowledge as well [...]" - F_{C2}*	5
	Education: Information sharing in study groups	*"Well, that is the effect of a study group. We have a fanatic supervisor who encourages us to develop sustainably" - F_{C5}*	10
	Collaboration with peers: fodder exchange, soil fertility, cultural value	*"I think that collaboration with peers could be more improved in order to farm more sustainable" - F_{C5}*	11

Legal/Political	Framing by media and politics	*"[...] an excellent example is on recent Facebook posts. The soil was covered with oil, and on Facebook, they pointed at us, the farmers, to be the response, but the people do not have any clue where they talk about [...]* - F_{C4}	11
	Lack of long term vision	*"If the government has a clear vision of where we have to be in five years, not every two year new policies, then we can invest in future developments"* - F_{C10}	11
	Fast changing policies	*"That is exactly the problem, a multiannual plan. Currently, every year changes. I am happy that the barn is built because I do not know if I would be in that position at this moment"* - F_{C7}	9
	Go back on policies	*"I am not convinced regarding the last odd circumstances. Eventually the air washer was not able to use to lower emissions. Well as an individual entrepreneur, such an investment is huge"* - F_{C11}	4
	Odd and Cumbersome legislation	*"I wanted to quite but with the legislation it did not fit. In January I tried to quit and to do so I had to request before April in order to get a surcharge. In the end I was too late and now it can just quite in January"* - F_{C2}	9
	Distrust emission calculations	*"There is too much ammonia that evident, however, if you look around, there are less cows than 100 years ago [...] that is politics because if you look at air transport or industry, their emissions are NOx and much worse but those numbers aren't shared"* - F_{O1}	4
	Imposed to follow the rules	*"I adjust to the rules because they are imposed by the government. I can try to resist but that doesn't make sense. Sometimes imposing rules is good in order to make people to change"* - F_{C8}	6
	Underrepresented	*"[...] they should not sit down on the entrepreneurs' chair, then we take the wrong path!"* - F_{C7}	4
Economic	Compensation through the market	*"Ideal would be from market prices rather than subsidies"* - F_{BD}	8
	Consumer demand	*"There has to be a willingness to pay which is a problem in the Netherlands"* F_{C3}	10
	Initial high investment	*"[...] at this moment the transition period is two years in which we are not allowed to sell the milk for organic prices. This means that we would have a large increase in expenses but the revenue doesn't increase"* - F_{C9}	8
	Intensification for future resilience	*"Something which entails all time, farming becomes more expensive and therefore you need to grow to build future resilience"* - F_{BD}	8
	Agricultural loan	*"I think a lot of dairy farmers want to change practices but the banks need to move with the farmers. For instance, we had to appraise everything because my parents are stepping out of the business, however, the taxation is really expensive"*- F_{C7}	10
	Revenue model	*"Everything is related to the development of a revenue model"* – F_{BD}	4
	Dairy sector companies	*"Here people visit the farm and try to sell their concentrates but when I ask them what is inside the products, they don't share the answer"* - F_{O3}	4
	International market	*"We produce high quality milk and the consumer should be happy with that. People ramble about buying products a broad but they will never have the Dutch milk quality"* - F_{C5}	8
Practical Sphere			
Ecological	Cow feed	*"We try to get as much protein from the land as possible, we are land-based"* - F_{C10}	11

	Soil fertility: soil improvement, short term benefits	*"The VBBM tries to prove how careful you treat your soil and I help them by giving samples of my land" - F_{O2}*	11
	Biodiversity	*"People call me crazy if I tell them that meadow birds lead the company but it pays off enormously!" - F_{O2}*	14
	GHG emissions	*"Currently we are building a new barn which is a low-emission barn. We will have a low-emissions floor resulting in lower ammonia emissions" - F_{C5}*	14
	Antibiotic and pesticides	*"[...] in the past we used antibiotics before dry-off, currently we use it only curative" - F_{C1}*	15
	Manure and fertilizers	*"Injection of manure has disastrous consequences for the soil. The salt extracts the oxygen, consequently wrong bacteria are grown in the ground" - F_{C11}*	12
Economic	Agricultural prices: Less expenses, acquiring land	"That is the problem, currently the price of concentrates is 30 euro while 25 years ago it was 14 gilder" - F_{C1}	15
	Organic prices	*"if it is possible to earn enough, than I would not exclude the possibility of transition towards organic farming" - F_{C10}*	7
	Compensation program	*"The compensation at CONO is a bit higher than Campina and we get compensated for additional sustainable practices, that stimulates of course to apply them" – F_{C5}*	10
Social	Sense of community	*"I supervise 25 other dairy farmers to combat sustainability problems" - F_{C4}*	10
	Conflict of interest	*"where my aversion comes from towards organic farming is that some who transit to organic farming, look down on the conventional farmers. That is when I come to the point of anger" - F_{C2}*	2
	Family Business consequences	*"I don't have a manure separator, just a traditional floor. That is the point I want to address, if I could pass down the family business, I might do some investments towards sustainability" - F_{C10}*	4
Technical	Incompatibility of technical solutions	*"With retrospect I think we built the barn too early. I considered it (low emission barn) but we have partly an old barn and new barn, technical it would be too much effort"- F_{C3}*	3
	Innovation Pioneer	*"[...] we would like to lead the way in this transition. Instead of being imposed by rules, we are ahead of them" - F_{C2}*	1

Appendix G

The IWF ideal-typically Constructs

Table G1

Integrated worldview framework with Ideal types

	Traditional	Modern	Postmodern	Integrative
Anthropology	- Human being subject to God-created natural order - Life purpose by social roles *"nature should be left alone"*	- By mastering nature, human being can find freedom - Self-optimizing and independent *"humans are smarter than nature"*	- Human being as part of larger complex natural systems - Unique individual "nature is more perfect than made by human"/ *"nature should be left alone"*	- Humanity in unity and synergy with nature - Life purpose to serve the whole
Axiology	- Materialist value orientation - Emphasis on family, community	- Competition, economic opportunities, and growth are emphasized - Emphasis on independent individuality	- Global justice, social and environmental dimensions are emphasized - Openness to change	- Emphasis on embedded, relational individuality
Epistemology	- Trust in: uncertain, medical profession, religious organizations	- Trust in: science and technology - Industrial perspective - Emphasis on reality as objective knowable	- Trust in: NGO's, environmental, and consumer organizations - Agroecological perspective,	- Triangulation of authority (scientific, subjective knowing and spiritual)
Ontology	God's creation that humans can use but not interfere	- Nature is instrumental - Resources for exploitation	- Nature is complex, interrelated, fragile - Cultural and emotional value of nature	- Nature is intrinsically valuable
Societal vision	Technological intervention in nature a priori unacceptable. However, sometimes willing to accept risks for economic competitiveness	- Technological intervention in nature is promising: "technological optimism" - Environmental problems and other risks will be solved or managed through	- Technological intervention in nature not reprehensible per se. - Emphasizes uncertainties and risks. Stresses the need for	Increasing emphasis on services, creative industries, and social/sustainable entrepreneurship

		the further development of science and technology - Industry is seen as key driver of innovation. - Emphasis on economic potentials. - Preference for market based solutions	public consultation, regulation	

Note. Adopted from De Witt et al. (2017), De Witt et al. (2016), and Hedlund-de Witt (2014).

Appendix H

Guiding principles

Table H8

Guiding principles for reflexive iteration

Questions	Goal
What are the data telling me?	Explicitly engaging with theoretical, subjective, ontological, epistemological, and field understandings.
What is it I want to know?	According to research objectives, questions, and theoretical points of interest.
What is the dialectical relationship between what the data are telling me and what I want to know?	Refining the focus and linking back to research questions.

Note. Questions that served as the framework for the data analysis. adopted from Srivastava & Hopwood (2009).

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Appendix I

Steps Taken to Assure Research Quality

Table I8

Steps taken to assure research quality

Implication	Description	Quality assurance
Descriptive validity	This means that the analysed data is factual accurate for the study and that researchers' observations are congruent with the views of the participations. The data should reflect participants' words and actions (Maxwell, 1992).	• The conversations with the consulted experts will be recorded, if approved by participants, and afterwards the researcher summarized the conversation. • Almost all interviews with the farmers are recorded and those are literally transcribed. • The research shared transcripts with farmers to assure that the researchers observations are congruent with the views of the participants. • If the farmers had comments on the transcripts, the researcher adopted the comments before analysing the results. • Only one interview has not been recorded, yet the researcher also took measures to ensure the descriptive validity of findings. Directly after the interview, the researcher summarized the information shared by the farmer and eventually shared the notes. Afterwards, the researcher and farmer called to go through the document and brought about some nuances when necessary.
Interpretive validity	This means that subjectivism in interpreting the results is avoided (Bryman, 2012; Maxwell, 1992)	• This is assured by carefully listening and just talk as much as was required to facilitate the informants' ability to answer. However, the researcher kept the interview guide in mind to be persistent in the questions and makes sure all necessary information to understand the three spheres of transformation of the farmer, are gathered.

		• If the researcher faced some uncertainty in understanding the words of the participants, the researcher asked for an explanation. • The researcher asked a colleague to check the codes of two interviews to avoid researcher-biases. • The transcript and coding process took place within two weeks after the interview took place.
Theoretical validity	Theoretical validity refers to the validity of concepts used and to evaluate whether the explanation used to justify the relationships among concepts are in line with reality (Maxwell, 1992).	• In addition, the research uses multiple sources of both primary and secondary data. These methods ensure greater quality of research findings (Ezzy, 2001; Flick, 2004) and overcomes challenges to single-theory bias (Hussein, 2009). • The researcher is not always in the best position to know what knowledge is needed and that there is a need to learn from doing practice and/or from involving practitioners in shaping the research (Fazey et al., 2018). Therefore, The interview guide is partly constructed based on the desk research to gain a wider understanding of the theory used. • The researcher is not always in the best position to know what knowledge is needed and that there is a need to learn from involving practitioners in shaping the research (Fazey et al., 2018). Therefore, the interview guide is constructed with answers found on the SQs which is gathered through involving experts, which are used as input for the third and fourth section in order to explore the farmers practical and political spheres. • The researcher approached researchers who have been working with the three spheres of transformation framework and asked for their insight to assure a full understanding of the

		framework and use this for the construction of the interview guide.
Generalisability	This means that the research findings can be generalized to the community or to other research settings.	• Sustainability transition studies struggle to connect with disciplines to quantitative methods and to generate generic insights beyond single cases (Hansmeier et al., 2021). • Nevertheless, the researcher tried to find accurate participants (regime or niche) to assure that the findings are oriented to contextual uniqueness and will be significance of the aspect of the social world being studied (Bryman, 2012).

Appendix J
Characteristics Participants

Table A9. Characteristics of Consults.

Name	Institution	Professions	Duration
Catherine day	Stetson University	PhD. Geography	24e of March (33 min.)
Ana Mahecha Groot	Food & agriculture Organization	Consultant Adaption plan Agriculture	26st of March (75 min.)
Hannah Gosnell	University of Colorado	PhD. Geography	2nd of April (41 min.)