An impact assessment of

potentially radical niche developments

in the Dutch dairy sector

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Abstract

The current research aims to develop a method to assess the impact of potentially radical niche developments by analysing this specifically for the case of the Dutch dairy sector. With knowledge on the potential impact of niche developments on the sociotechnical system of the Dutch dairy sector, the stakeholders of both the dominant regime and of the niche developments might be better able to work towards a more sustainable dairy sector. The current research is organised in three different parts. First, the dominant regime of the Dutch dairy sector, its state and its issues are analysed with the use of path dependency theories. Path dependency theories can show the potential lock-in of the dominant regime and show the need of pressure from outside the regime level to change the system to a more sustainable form. Second, the focus of the research is on two specific niche developments: Muufri and Remeker. Muufri and Remeker are selected for the research because both niche developments address the sustainability issues of the dominant regime and both niche developments are potentially radical. Muufri presents a different method to produce milk by genetically modified yeast and Remeker presents alternative methods and organisation of dairy processing by producing specialty cheese products. Both Muufri and Remeker can be considered "full" niches according to the theory on mechanisms of niche development. However, Muufri is still developing its products, while Remeker has been producing cheese for years already. Thirdly, the potential impacts of Muufri and Remeker on the dominant regime of the dairy sector are assessed for the coming five to fifteen years. The impact assessments are performed using a focus group and the concepts on niche-regime compatibility and sociotechnical translations. The focus group considers the impact of Muufri to mainly be the start of a debate on the origins of our food before Muufri will have a more substantial impact. The potential impact of Remeker is considered by the focus group to be a situation in which Remeker and a multitude of other similar niche developments producing speciality dairy products would form the regime. This situation would take longer than five to fifteen years to develop; although it could be that this situation has started to develop for several years already. Finally, the impacts of potentially radical niche developments addressing sustainability issues in general are discussed. These specific niche developments show the dominant regime and society that it is possible to organise, in this case, the dairy sector differently. The existence of the niche developments contributes to the pressure on the dominant regime next to the pressure of the landscape level to address the sustainability issues of the dairy sector in the Netherlands. Furthermore, the current research shows that the analytical framework used did not succeed in presenting suitable methods to assess the impact of potentially radical niche developments. The current research is exploratory, but succeeds in showing why it could be interesting to perform further research into the impacts of potentially radical niche developments.

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1. Introduction

The world population is growing, which results in an increase of food supplies needed to meet the demands of the future (Godfray et al., 2010). This development requires an increase in sustainably produced food to ensure sufficient and safe food in the future. In the Netherlands, the dairy sector accounts for one-sixth of the total food production in euros. In total, there are 18 thousand dairy farms in the Netherlands, which house 1.6 million cows who produce 12.7 billion kilograms of milk annually. Furthermore, the dairy sector provides 45 thousand full-time jobs, a substantial amount of the approximately 100 thousand full-time jobs in the entire agriculture, forestry and fishery sector (Roland Berger Strategy Consultants, Nederlandse Zuivel Organisatie, & ZuivelNL, 2015; UWV, 2015). These statistics highlight the importance of the Dutch dairy sector for the Netherlands. The dairy sector is a large and influential sector in the Netherlands, which therefore plays part in providing the food demands of the future.

The Dutch dairy sector has a rich history in providing people with a broad variety of nutritious food products and continues to do so. The current system of the Dutch dairy sector is a result of innovations and developments during the late 19th and 20th century. What started with the formation of small dairy cooperatives with small factories focused on producing only a few products has resulted in mainly one large and some smaller cooperatives producing a broad range of products that are distributed globally (Reinders & Vernooij, 2013; Roland Berger Strategy Consultants et al., 2015). These developments have had many advantages for the Dutch dairy sector but have also brought challenges. The advantages being the growth and prosperity the Dutch dairy sector has experienced during the last century, both in the Netherlands and abroad (Reinders & Vernooij, 2013). The challenges that are faced by the dairy sector today are related to all three aspects of sustainability; to economic, ecological and social themes (Boogaard, Oosting, & Bock, 2008). Sustainable development is defined by the United Nations as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland Commission, 1987). The Dutch Dairy Association (Nederlandse Zuivel Organisatie, NZO) and the Dutch Federation of Agriculture and Horticulture (LTO Nederland) have started the Sustainable Dairy Chain initiative in 2011 to ensure a “future-proof and responsible dairy sector”. This initiative focuses on four main goals or challenges: climate-neutral development, continued improvement of animal health and animal welfare, retention of pasture grazing and conservation of biodiversity and the environment (Reijs, Doornewaard, Jager, & Beldman, 2015). This demonstrates some of the challenges the dairy sector is dealing with, as well as the focus of the Dutch dairy sector itself to ensure its sustainability.

Most research and innovations are focused on finding and implementing solutions or improvements within the dominant dairy system in the Netherlands (e.g. Augustin, Udabage, Juliano, & Clarke, 2013; Jong, 2013; Krebbekx, Wolf, Enkhuyzen, Lambregts, & Steerneman, 2009). This is also demonstrated by the focus of the Sustainable Dairy Chain initiative as mentioned above (Reijs et al., 2015). However, in contrast to the dominant system of dairy processing in the Netherlands, technological novelties and emerging niche developments can be identified. These niche developments often provide solutions to the problems rising in the more dominant and mainstream dairy sector or are even established specifically as an opposite movement to the dominant system. The small scale of niche developments allows them to reconsider the system of the dominant dairy sector and might provide them with the flexibility to present a more sustainable and new system of

dairy processing. Therefore, these niche developments are possibly better able to provide potential solutions in ensuring the growing world population with nutritious food in a sustainable way in the future than the current system of the dairy sector is (Ingram, Maye, Kirwan, Curry, & Kubinakova, 2015; Whitmarsh, 2012).

The current research analyses niche developments that address the current issues of the dominant dairy sector by providing insights into novel ways of dairy processing. Subsequently, the current research assesses the potential impact of these niche developments on the current sociotechnical system of the Dutch dairy sector. The research focuses on novel ways of the processing of dairy specifically, since interesting niche developments can be identified in this part of the dairy chain. Furthermore, innovations at the farm level for example have already been researched (eg. Wolleswinkel, Roep, Calker, Rooij, & Verhoeven, 2004). The niche developments that are of interest for the current research are the niche developments that are developing specifically as a completely different or counter movement to the mainstream dairy industry.

The current research aims to contribute to the understanding of the potential impact of radical niche developments on a current sociotechnical system by analysing this specifically for the case of the dairy sector in the Netherlands. With knowledge on the potential impact of niche developments on the sociotechnical system, both stakeholders of the sociotechnical system and of the niche developments could become more aware of the current status of both niches and regime and their possibilities for the future. The following main research question is used for the current research:

How can potentially radical niche developments impact the sociotechnical system of the Dutch dairy sector to become more sustainable?

To gain insights into these phenomena, a multidisciplinary approach is used. The technical aspects of the innovations in the niches are discussed and subsequently, the potential impacts of the niche developments on the dairy system are discussed from a sociotechnical perspective. With this approach, a unique contribution to existing research can be made.

This report presents the results of the research, which are organised into seven different chapters. This first chapter, which is about to come to an end, entails the introduction. In the second chapter, the analytical framework is discussed which includes the theoretical concepts that are used and consulted throughout the current research. The third chapter presents the three research sub questions that are formulated and the methodology used for the current research. The fourth chapter discusses the status of the sociotechnical system of the Dutch dairy sector and subsequently the fifth chapter discusses the selected potentially radical niche developments and their statuses. The sixth chapter presents the results of the impact assessments of the niche developments in dairy processing on the sociotechnical system of the Dutch dairy sector. Finally, the overall conclusions are discussed in the seventh chapter, which also includes a discussion of the research and recommendations for further research.

2. Analytical framework

This second chapter explores and discusses the concepts relevant to and used in the research presented. The concepts of sociotechnical systems and some of the concepts of the multi-level perspective are used throughout the complete research and are discussed first in Section 2.1. Subsequently, the different concepts that are used for specific parts of the research are discussed. Section 2.2 discusses the analytical concepts used to analyse the current dominant sociotechnical system, Section 2.3 discusses the concepts used to analyse the niche developments and finally, Section 2.4 discusses the concepts used to assess the potential impacts of the selected niche developments.

2.1 Sociotechnical systems

The current research focuses on relations and movements within the sociotechnical system of the Dutch dairy sector from a multidisciplinary approach. The concept of sociotechnical refers to the interrelatedness of 'social' (of people and society) and 'technical' (of machines and technology) (Walker, Stanton, Salmon, & Jenkins, 2008). A sociotechnical system is defined as a system that contains both social (human-related) and technical (non-human) elements that fulfil a societal need or common goal (Geels, 2004; Papachristos, Sofianos, & Adamides, 2013; Read, Salmon, Lenné, & Stanton, 2015; Walker et al., 2008). Geels (2005) explains that sociotechnical systems consist of many aspects "including technology, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks and supply networks". Furthermore, he argues that "sociotechnical systems are actively created, (re)produced and refined by several social groups" and that "their activities reproduce the elements and linkages in sociotechnical systems" (Geels, 2005). The concept of a sociotechnical system thus explains the extent and the interrelatedness that a sociotechnical system entails.

2.1.1 The multi-level perspective

For the current research, the three levels as introduced by the multi-level perspective are used to be able to distinguish movements within sociotechnical systems based on their scale. The different levels distinguished in the multi-level perspective are (1) niches, (2) sociotechnical regimes and the (3) sociotechnical landscape. Innovations are able to emerge within the niches, the regime entails the dominant institutions and technologies, while the landscape represents the external environment outside the influence of the niche and regime actors (Geels, 2002; Geels & Schot, 2007; Whitmarsh, 2012). Figure 1 provides a visual model of the multi-level perspective theory, it visualizes how niches develop and how the different levels interact and relate to each other.

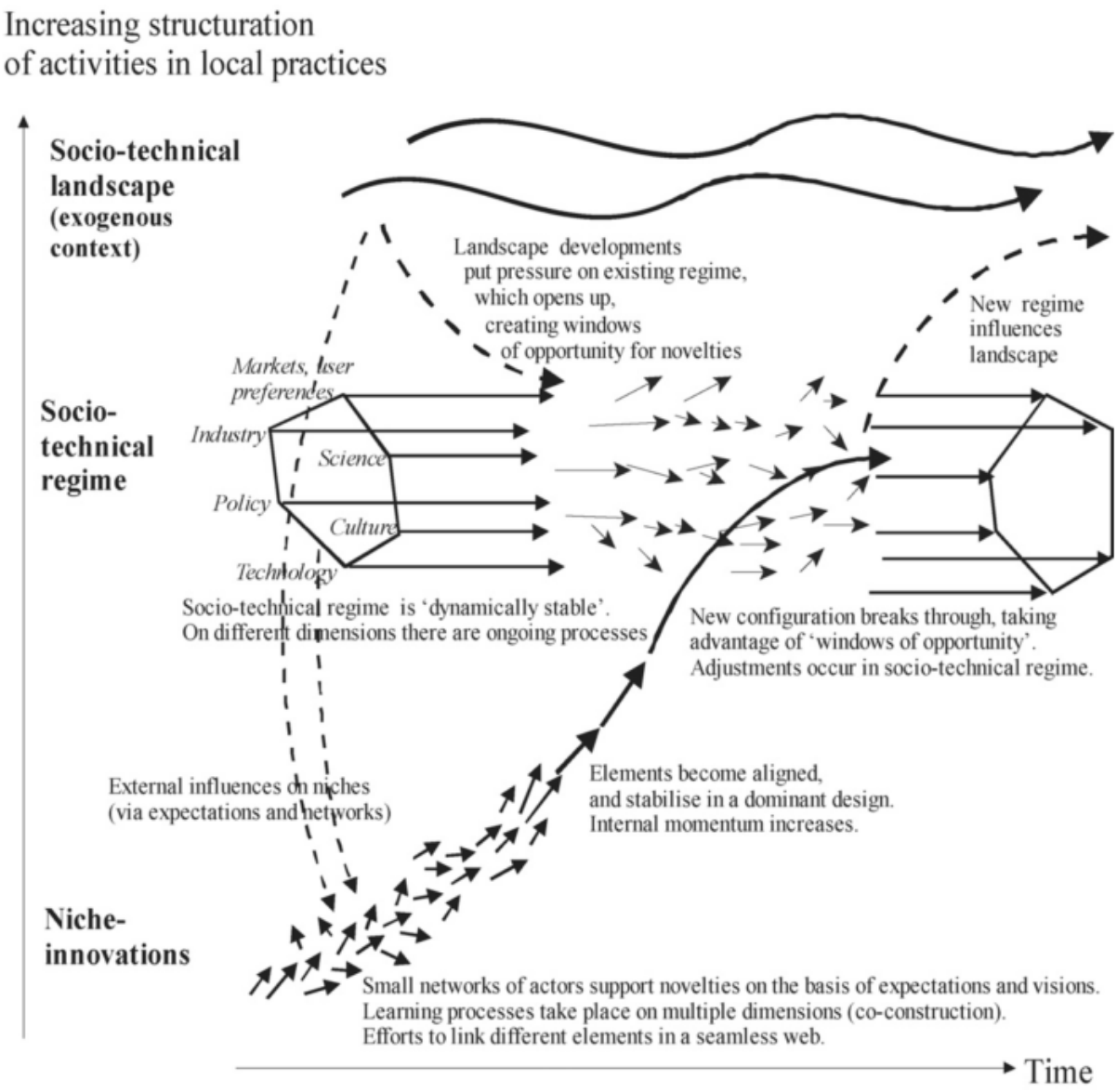

Figure 1: A multi-level perspective on transitions (Geels & Schot, 2007).

The multi-level perspective is applied to understand sociotechnical transitions and is best used in hindsight (Flinterman, Roep, & Luijer, 2013; Geels & Schot, 2007; Grin, Rotmans, Schot, Geels, & Loorbach, 2010; Whitmarsh, 2012). Since the current research focuses on potential impacts of niche developments in the future, only the typology of the different levels is used. Furthermore, sociotechnical transitions are defined as "changes from one sociotechnical regime to another" (Geels & Schot, 2007), which includes "substitution of technology, as well as changes in other elements" (Geels, 2002). The niche developments could have an impact on the sociotechnical system and on specific stakeholders within the system or landscape without causing a complete sociotechnical transition. Therefore, the multi-level perspective alone does not suffice for the analysis envisioned for the current research since also potential smaller effects are of interest, while the typology of the different levels of the multi-level perspective is still useful.

As argued by Geels and Schot (2007), the regime level equals the concept of organisational fields. Therefore, the regime used in the current research is regarded to entail the mainstream and

dominant dairy sector including "key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar products" (DiMaggio & Powell, 1983). Furthermore, a niche is defined as "a space in which a new technology is protected from the harsh selection environment while it strengthens itself, through learning processes, for example" (Cecere, Corrocher, Gossart, & Ozman, 2014). This definition is focused mainly on the technological aspects of a niche, while the current research is also interested in other aspects of niches. The levels of the multi-level perspective will be used throughout the research to ensure a consistent use of concepts for the difference in scale of movements within the sociotechnical dairy system in the Netherlands.

2.2 Analysis of the sociotechnical system

To be able to discuss the niche developments within the appropriate context it is necessary to elaborate first on the current sociotechnical system of the Dutch dairy sector. Only when the characteristics of the dominant dairy sector are known, the differences between the niches and the regime can be recognised. Only when the current challenges of the dominant dairy sector are known, the solutions offered by the niche developments can be assessed. The current status of the sociotechnical system is analysed with the concept of path dependency taken into consideration.

2.2.1 Path dependency

Path dependency theories, in general, acknowledge the notion that past events influence the decision making of the future and the availability of choices. In short, path dependency emphasises that "history matters" (Dobusch & Schussler, 2013; Sydow, Schreyögg, & Koch, 2009). The theories on path dependency originate from economic studies, but are now used also in organisational and management studies (Dobusch & Kapeller, 2013). The concepts are applied to diagnose path dependency at the organisational or market level depending on the field (Sydow et al., 2009), but are used to identify the historical influence in the formation of a sociotechnical system in the current research. Figure 2 illustrates the process of path dependency and shows that Sydow et al. (2009) consider three different phases in the process of organisational path dependency. The first phase is the "Preformation Phase" which includes the period of time when there is still a large range of options. The grey cloud of Phase I in Figure 2 symbolises that even during this first phase with a seemingly unlimited amount of options, the history of the sociotechnical system or organisation matters and already limits the available range of actions, although to a small extent. The second phase, the "Formation Phase", is characterised by the emergence of a dominant path, the availability of the amount of actions decreases and this contributes to the irreversibility of the path. The transition from the first to the second phase can be determined by a so-called "critical juncture" which is the moment where the organisation or system enters a self-reinforcing process. For example, the start of the farmers' cooperatives could be such a critical juncture for the Dutch dairy sector. The third phase is the "Lock-in Phase" and this phase illustrates that one specific action pattern has become dominant, flexibility has been lost and even new entrants are influenced by the dominant system. Dobusch and Kapeller (2013) also identify three different phases in the constitution of a path, although the naming differs, the phases resemble those of Sydow et al. (2009). The first phase they consider to be "the contingent phase of path emergence and creation", the second phase includes self-reinforcement or positive feedback and the third phase includes a stable outcome or lock-in.

In short, the availability of choices is large in the beginning of the process, while later on the range of options decreases because of decisions made in the past, which influences the flexibility of the system. This process of decreasing flexibility due to actions in the past, mainly associated with the second phase, can be described by different terms. The terms most used are “increasing returns”, “self-reinforcement” or “positive feedback” (Dobusch & Kapeller, 2013). Although these terms do seem to describe similar processes, not all can be used interchangeable (Dobusch & Kapeller, 2013; Dobusch & Schussler, 2013).

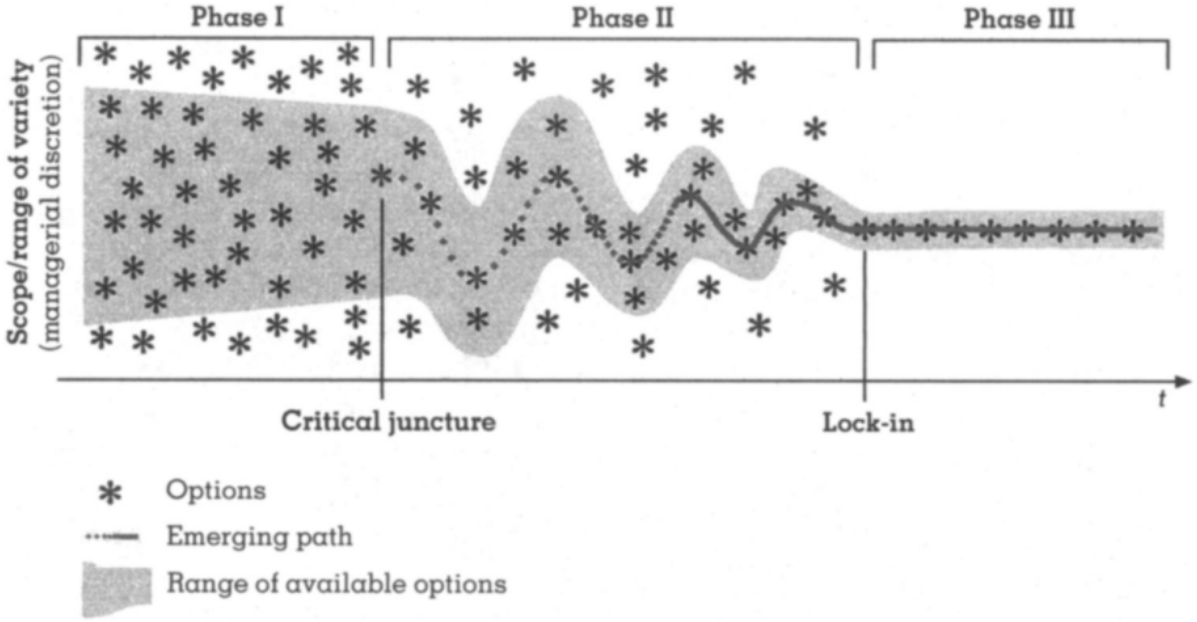

Figure 2: The constitution of an organisational path (Sydow et al., 2009).

Performing a path dependency analysis can be done both qualitatively, in the form of a case study, and quantitatively (Sydow, Windeler, Müller-Seitz, & Lange, 2012). A quantitative or detailed analysis is beyond the scope of the current research. The concept of path dependency is used to analyse whether the current sociotechnical dairy system lacks certain flexibility caused by the phenomena described by path dependency theories. The events that have contributed substantially to the current construction of the dairy sector have simultaneously increased the path dependency or lock-in effect of the sociotechnical system. When a certain lock-in can be determined, the lock-in could result in the need for pressure from outside the regime to induce a change within the sociotechnical system (Morone, Lopolito, Anguilano, Sica, & Tartiu, 2015). Next to the pressures caused by changes in the sociotechnical landscape level, niche developments can also contribute to the pressure needed for the locked-in sociotechnical system to change (Smith, 2007). A similar process is also described in the theories of the multi-level perspective, as can be seen in Figure 1. However, the multi-level perspective focuses mainly on the pressures needed from the landscape level in order to start a complete sociotechnical transition (Lopolito, Morone, & Sisto, 2011). During the current research, we are also interested in the pressures from outside the regime that do not necessarily lead to a complete transition. Path dependency theory is used to explain the current status of the sociotechnical system of the Dutch dairy sector because the theory can explain the decreased flexibility of the sociotechnical system as well as show the need of the niche developments to add pressure and show potential alternatives to the regime.

2.3 Description of the niche developments

More information is needed about the niche developments to be able to properly assess the potential impact of the niche developments on the sociotechnical system of the dairy sector in the Netherlands. To be able to describe the different characteristics of the niche developments that are of importance in a structured way, concepts on the mechanisms of niche development are used.

2.3.1 Mechanisms of niche development

To be able to properly identify the status of the niche developments, theories are adopted from the area of Strategic Niche Management. This field of research identifies three different mechanisms that contribute to the status of niche developments. Lopolito et al. (2011) summarises these three mechanisms as being (1) willingness, (2) power and (3) knowledge while Hermans et al. (2013) explains the mechanisms as (1) the articulation and subsequent convergence of visions, (2) the building of social networks and (3) learning and experimentation. Although the phrasing is very different, the mechanisms are similar. The first mechanism of willingness or the convergence of actor's visions entails the actors and "the degree to which their strategies, expectations, beliefs and practices go in the same direction" (Hermans et al., 2013). A shared vision among actors is important for defining clear action steps in the development of the innovations that the niche development is based on. The second mechanism of power or the building of social networks emphasises the need of different powerful actors with different resources and knowledge. A broad and diverse network enhances the chance of success for a niche development. The third mechanism of knowledge or learning and experimentation ensures that the shared vision is tested and improved and experience is gained on the practical implementation of the innovations. This learning can occur both individually as well as collectively (Hermans et al., 2013; Lopolito et al., 2011). Based on these three mechanisms and the absence or presence of them, a categorisation can be made of different stages of niche development and the corresponding niche status (see Table 1). As is presented in Table 1, for niche development consecutive "a shared vision has to be present, the right actors are to be involved and finally the experimentation and learning can start" (Hermans et al., 2013).

Table 1: Stages of niche development (Hermans et al., 2013; Lopolito et al., 2011).

	Stage I	Stage II	Stage III	Stage IV
Niche mechanism				
Willingness or Convergence of expectations	Absent	Present	Present	Present
Power or Networking with relevant actors	Absent	Absent	Present	Present
Knowledge or Learning and experimentation	Absent	Absent	Absent	Present
Niche status	**Absence**	**Embryonic**	**Proto-niche**	**Full**

Although the mechanisms discussed can also be quantitatively identified, the current research only uses these concepts qualitatively to ensure that no important characteristics are overlooked when discussing the niche developments. The statuses of the niches are taken into consideration in the assessment of the impact the niche developments could have on the regime.

2.4 Impact assessment of the niche developments

After both the sociotechnical system and the niche developments have been analysed and discussed, the interactions between the regime and the niche developments can be analysed. There is a broad range of literature originating from different research fields about the potential impact of (technological) innovations. However, this literature is often focused on advising specifically policymakers or businesses on how to deal with innovations and is therefore less focused on the potential future outcomes of innovations on the sociotechnical system from a sociological perspective. This section discusses some of the main concepts as discussed in innovation literature and explains which aspects of the concepts are and are not of interest in the current research.

2.4.1 Technology assessment

A concept primarily focused on advising policymakers and society about the possible consequences of a technological innovation is technology assessment. Since the emphasis of the concept of technology assessment lies so strongly on the advising of policymaking, only some specific aspects of the concept are of interest for the current research. The importance of the aspect of advising is also emphasised when Grunwald (2009) explains what characterises technology assessment: "its specific combination of knowledge production (concerning the development, consequences and conditions for implementing technology), the evaluation of this knowledge from a societal perspective, and the recommendations made to politics and society." Historically, a technology assessment entails "a knowledge based form of advice, analysing and evaluating actual and potential societal impacts of technological innovation in an organised way" (Bechmann, Decker, Fiedeler, & Krings, 2007). Since then different forms of technology assessments have been constructed and used. There is no specific method for performing a technology assessment and the use of specific methods differs per form of technology assessment (Grunwald, 2009; van Eijndhoven, 1997). The focus that the different technology assessment methods have in common is the focus on the assessment of technological innovations only. Since we are also interested in less technological based developments of the niches, the focus on the technological innovations is an aspect of technology assessment that does not comply with the focus of the current research. An aspect of technology assessment that is of interest for the current research is the concept of assessing the potential impact of an innovation in advance. During the current research, we also try to assess potential future impacts of an innovation beforehand. Similar to a technology assessment, in the current research knowledge is evaluated, but with a focus on the impacts on the sociotechnical system of the dairy sector instead of society as a whole.

2.4.2 Radical innovations from a business perspective

Not all literature on the potential future impacts of innovations is aimed at supporting politics or society, there is also research performed on this issue from a management or business perspective. However, similar to the literature on technology assessment, also only some specific aspects of the literature on the impact of innovations from a business perspective are useful for the current research. The literature from a business perspective evolves for example around disruptive or radical innovations or technologies and is mostly focused on these concepts from the perspective of an individual company or its management (Colombo, Franzoni, & Veugelers, 2015; Danneels, 2004; Govindarajan & Kopalle, 2006; Hang, Chen, & Yu, 2013). Some of the definitions of the concepts also

show the focus on the business perspective. For example, Danneels (2004) defines a disruptive technology as "a technology that changes the bases of competition by changing the performance metrics along which firms compete". Other definitions that are applied to business related challenges could also be used in more general situations. For example, Colombo et al. (2015) discuss that "radical science provides new insights and elaborates new concepts that depart significantly from past paradigms" and they define radical innovation as "innovation that breaks established rules". However, when the assessment of such radical innovations or technologies is discussed, the focus is mainly on how businesses can anticipate on these radical or disruptive innovations (eg. Govindarajan & Kopalle, 2006; Hang et al., 2013). Because of the strong focus on individual businesses, the methods used are not suitable for assessing the potential impact of radical innovations on a complete sociotechnical system. However, similar to research on the concepts of radical innovations, we are also interested in how radical innovations could change established rules and the relations between companies of the established regime. Also similar is the desire to analyse the tensions around radical innovations in advance and not in hindsight.

2.4.3 The multi-level perspective

A framework that focuses, as we do in the current research, also on disruptive innovation but not from a business perspective is the multi-level perspective that has already been discussed. As explained, the multi-level perspective is focused on complete transitions between regimes and analyses this in hindsight (Geels, 2002), therefore not all concepts of the multi-level perspective are suitable for the current research. Also, research related to the concepts of the multi-level perspective, such as on technological or societal transitions or sociotechnical transition pathways, is focused on analysing complete transitions from a historical perspective (Berkers & Geels, 2011; Geels & Schot, 2007; Haan & Rotmans, 2011). The concepts of the multi-level perspective that are of interest to the current research have already been discussed.

2.4.4 Sociotechnical translations and niche-regime compatibility

Overall, theories and methods on the potential impact of niche developments on a sociotechnical system that take into account also tensions that do not result in complete transitions are scarce. However, the interest of the current research is specifically also in the tensions that do not necessarily result in complete transitions. Smith (2007) shows a similar kind of interest in his research on sociotechnical translations between green niches and sociotechnical regimes. He presents some interesting conclusions, which are of relevance to the focus of the current research. Using case studies, he identifies different kinds of translation processes between the different sociotechnical situations in the niche and in the regime. He summarises these in the following three translations:

1. "Translating sustainability problems, i.e. how problems in the regime inform the guiding principles creating the niche.
2. Translations that adapt lessons, i.e. reinterpreting elements of socio-technical practice in the niche and inserting them into regime settings, or modifying the niche in the light of lessons learnt about the regime.
3. Translations that alter contexts, i.e. changes that bring the regime closer to the situation that pertains in the niche, or vice versa."

Furthermore, Smith (2007) explains the concept of “green niches” and defines green niches as niches that “are informed, initiated and designed in response to sustainability problems perceived in the regime”. These green niches correspond to the niche developments of interest in the current research. He further argues that because these green niches have been created as opposites of the dominant regime, this makes it more difficult for green niches to diffuse into the dominant regime. Also, Ingram et al. (2015) discuss the difficulties of the development of niche initiatives that are radically different than the regime. They have concluded that the “compatibility of niche and regime is indicative of potential niche influence on the regime.” When a niche development has limited compatibility with the regime, the niche development is more likely to have less potential for growth, diffusion and linking with the regime (Ingram et al., 2015). The concepts about sociotechnical translations and niche-regime compatibility are the main focus of the analysis of the potential impact of niche developments on the dominant regime since these concepts are suitable for analysing potential niche-regime interactions in advance and since these concepts are not focused on informing businesses or policymakers solely.

3. Methodology

Based on the main research question as presented in the introduction and with the insights of the analytical framework as described in Chapter 2, three research sub questions are formulated. These sub questions ensure a thorough and well-structured analysis of the main research question.

The main research question, as presented in the Introduction, is:

> How can potentially radical niche developments impact the sociotechnical system of the Dutch dairy sector to become more sustainable?

The following research sub questions are formulated:

1) What are the main sustainability issues of the dominant regime of the Dutch dairy sector and how can the potential locked-in state of the dominant regime be explained?
2) What potentially radical niche developments can be identified and why are these niche developments potentially radical?
3) How can the impact of the potentially radical niche developments be assessed and what impact could the niche developments have on the dominant regime of the dairy sector?

This chapter discusses the different methods used for each research question. Section 3.1, 3.2 and 3.3 discuss the methods used for the first, second and third research sub question respectively.

3.1 Analysis of the sociotechnical system

The first research question focuses on the sociotechnical system of the Dutch dairy sector, its issues and its current state. A sociotechnical system, in general, is defined as a system containing both social and technical elements that fulfils a societal need or common goal. A sociotechnical system is a broad concept that mostly emphasises the interrelatedness of social and technical aspects (Geels, 2004, 2005; Papachristos et al., 2013; Read et al., 2015; Walker et al., 2008). Because a sociotechnical system is such a broad concept, the first research question and its methods focus on specific elements of the sociotechnical system of the Dutch dairy sector. The current research is interested in niche developments in the dairy processing industry specifically and their potential impact on the dairy sector in the Netherlands. Because of the interest in niche developments in dairy processing specifically, the first research question focuses more on the issues and the current state of the dairy industry instead of on other specific aspects of the dairy sector in the Netherlands.

The mainstream and dominant dairy sector equals the concept of the sociotechnical regime level of the multi-level perspective. Therefore, the focus of this chapter lies on the dominant regime level, which equals the concept of organisational fields including “key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar products” (DiMaggio & Powell, 1983; Geels & Schot, 2007). The focus of the first research question is mainly on:

- The established Dutch dairy companies;
- The dairy farmers supplying to these companies;
- The consumers of dairy products;

- The organisations in which dairy farmers, consumers or companies have organised themselves;
- The regulatory agencies that provide regulations for the dairy sector;
- The research agencies involved in dairy research;
- The technologies used in the dominant dairy sector;
- And the cultural meanings of the dairy sector in the Netherlands.

The current dominant sociotechnical regime of the Dutch dairy sector, its issues and its state are analysed with the use of theories on path dependency. Path dependency theories can explain the current lock-in of the sociotechnical Dutch dairy system and can show the need for pressure from outside the regime level to encourage the system to enhance the sustainability.

A desk study is used to determine the path dependency of the dominant sociotechnical regime. More specifically, the desk study is used to learn about the current main issues of the dominant Dutch dairy sector and about the developments in the past that have contributed to the current potential locked-in state of the regime level. The time and resources of the current research are limited. Therefore, we decided to focus on the historical events that seem to have contributed to the sustainability issues. The aim of the first research question is not to explain the complete history and path dependency of the dominant regime. The aim is to show that the dominant regime is potentially in a state of lock-in and to explain the sorts of processes that could have contributed to the lock-in by discussing the path dependencies of the sustainability issues of the dominant regime.

As part of the desk study, first a summary of the history of the Dutch dairy sector is drafted. From this summary, the historical developments relevant to the current sustainability issues of the dominant regime are derived. Several specific historical developments were selected to be of use for the current research. The specific historical developments are discussed and analysed. It is possible that other historical developments can be identified to be relevant next to the historical developments discussed by the current research. However, as explained, the aim of the current research is to show processes that could have contributed to the potential lock-in of the dominant regime. For this aim, it is sufficient to only discuss a few specific historical developments.

The desk study of the first research question mostly consists of a literature research and furthermore the opinions of Jos Lankveld on the subject were consulted. Jos Lankveld has had a long career in the Dutch dairy sector, both at dairy companies and at dairy research institutes. After his retirement, he became a professor by special appointment at Wageningen University & Research centre. The conversation with Jos Lankveld has contributed to the insights as part of the analysis of the first research question. The results of the analysis of the sociotechnical regime, its issues and its locked-in state are presented in Chapter 4.

3.2 Selection and description of the niche developments

The second research question focuses on specific niche developments that present novel ways of processing dairy. For the current research, we decided to select two niche developments of which the potential impacts are assessed to ensure that a thorough analysis is possible. We decided to choose only two specific niche developments to ensure that with the limited time and resources the niche developments could still be analysed and assessed properly. In case more niche developments

would have been selected and analysed, it could not be ensured that all niche developments are analysed and assessed properly. For the selection of the two specific niche developments, two important criteria were used.

First, the current research values the importance of sustainability because of the need to provide a growing world population with sufficient food. The sustainability of niche developments can be difficult to determine because niche developments only operate on a small scale. Because the niche developments are small scale, the sustainability of the novel ways of dairy processing on the scale of the regime level is difficult to assess. Therefore, the criterion of sustainability is applied to the niche developments by assessing whether the niche developments provide answers to the current sustainability issues of the dominant regime. The niches that are selected address one or multiple sustainability issues of the dominant dairy sector in the Netherlands.

Second, the current research is specifically interested in niche developments that are potentially radical. The radical aspect of the niche developments is of importance because radical niche developments have more potential to impact the regime level. When a niche is very compatible with the regime level, chances are that the regime will just incorporate the practices of the niche development without the regime being actually challenged (Ingram et al., 2015). We consider a niche development to be radical when the novel ways of the niche development have the potential to significantly challenge and change the current organisation of the dominant sociotechnical regime of the Dutch dairy sector.

A few less important criteria were furthermore used to select the niche developments for the current research. Only niche developments are selected that revolve around cow milk, since the regime level of the dairy sector in the Netherlands also mainly revolves around cow milk. Also niche developments abroad are considered for the current research. The Dutch dairy sector is a global player and novel ways of dairy processing developed abroad also could have the potential to impact the Dutch dairy sector and the Dutch dairy market.

Several websites on dairy, sustainable food and/or dairy farming are explored to find current niches in dairy processing developing in the Netherlands and abroad. The websites were explored for (news) items on dairy innovations, novel ways of dairy processing or novel ways of organising dairy farms or dairy processing. Also several researchers of Wageningen University are consulted on their knowledge of the existence of potentially interesting niche developments in dairy processing. Finally, two niche developments are selected that focus on developing innovations for different parts of the dairy processing process. The two niche developments are also selected because they are able to represent more niche developments with similar novel ways of dairy processing. The first niche development is Muufri, which presents a different method to produce milk by using modified yeast. The second niche development is Remeker, which presents alternative methods and organisation of dairy processing by producing speciality cheese products.

To analyse the second research question a desk study is performed. As part of the desk study, multiple sources of information are used to be able to describe the novel ways of dairy processing of the niche developments. These sources of information include scientific literature, news websites, online blogs and personal conversations. The technical principles on which the novel ways of dairy processing are based are explained, although information can be scarce because of the novelty of the

niches or of the technical innovations the niches are developed around. Theories on the mechanisms of niche development are used to gain insight into the current status of the niches. The results of the second research question are presented in Chapter 5.

3.3 Impact assessment of the niche developments

The third research question focuses on the interactions between the two niche developments and the dominant regime of the Dutch dairy sector. The interactions that are of interest are the interactions when for example ideas or technologies of the niche or regime inspire the other, or when the niche or regime inspires or pressures the other to change and adapt. The third research question is interested in all kinds of interactions that realistically could take place between the niche developments and the dominant regime in the future.

An assessment of the potential impact of the niche developments on the sociotechnical regime is not productive without determining the timespan of interest. The suitable timespan for the assessment is determined by consulting theory and case studies on the multi-level perspective. Several researches have applied the multi-level perspective in historical perspective to different cases of regime transitions. These case studies show that a complete regime transition takes decades (eg. Berkers & Geels, 2011; Geels & Schot, 2007; Geels, 2002, 2005). The current research does not aim to assess a complete regime transition by the niche developments, but rather aims to assess the interactions of the niche developments with the dominant regime. The timespan of interest for the analysis is therefore limited to the coming five to fifteen years.

To analyse the third research question a desk study, a focus group and a personal conversation are used. The desk study includes the use of different theories as well as the insights of the analyses of the first and second research question. The most important theories used to answer the third research question are the theories on sociotechnical translations between green niches and sociotechnical regimes and the concepts on niche-regime compatibility. Furthermore, the concepts and methods of technology assessment, radical innovations and the multi-level perspective are also taken into consideration. Since the theories on the interactions between niche developments and the regime are limited, a focus group and a personal conversation are performed next to the desk study.

The methods used for conducting the focus group are further explained in the following section, Section 3.3.1. The use of a focus group for the current research also complies with some of the methods used for technology assessment (Grunwald, 2009). Next to the focus group also Jan Dirk van de Voort of Remeker is interviewed to gain insight into his experiences and his thoughts on the impact of Remeker. The personal conversation has also contributed to the assessment of the potential impact of specifically Remeker on the dominant regime. Unfortunately, Muufri was not available to cooperate with the current research. The results of the third research question are presented in Chapter 6.

3.3.1 Focus group methods

The third research question of the current research is focused on the potential impact of two niche developments on the dominant regime of the Dutch dairy sector. A focus group is conducted to gain

insights into what stakeholders of the sociotechnical system and related societal groups consider the impacts of the two niche developments in the future could be. A focus group method is defined as "a research technique that collects data through group interaction on a topic determined by the researcher" (Morgan, 1996). Sutton and Arnold (2013) discuss the purpose of a focus group being "to acquire as much information as possible from a group of experts on a given topic", which is achieved by allowing participants to interact in a structured manner. There is no specific method for conducting a focus group. The methods used depend on the aim of the research (Morgan, 1996; Sutton & Arnold, 2013). Although Fern (1982) has shown that more ideas are generated through individual interviews than by the use of focus groups, for the current research we still prefer to conduct a focus group instead of interviews because of the additional value of the group's interactions. Since the sociotechnical system also consists of multiple actors and the interaction between them (Geels, 2005), a focus group is considered to be more appropriate and representative. A focus group allows the participants to react to the statements of other participants directly (Frazier et al., 2010). Furthermore, when a focus group is conducted it is possible for the participants to reach a consensus on the subject or the occurrence of a conflict can be observed, which are valued characteristics of a focus group for the current research (Morgan, 1996; Sutton & Arnold, 2013).

Since the current research has limited resources and time, only one focus group is organised. The group consists of four persons and is guided by two moderators. One of the moderators manages the discussion between participants, while the other moderator notes the remarks of the participants in a structured manner. The participants of the focus group are people with experience in the dairy sector and who are interested in the research subject. Frank Verhoeven grew up on a dairy farm and now owns "Boerenverstand", a consulting bureau that advices on issues of sustainable farming (Boerenverstand, 2016). Guido Sala is a researcher at Wageningen University & Research centre who focuses, among other subjects, on dairy science. Koen Mulder is a Dairy Science and Technology student at Wageningen UR and runs "Raw Milk Company", a small dairy factory producing dairy products of raw milk, together with his parents (Raw Milk Company, 2016). Sietske Klooster has a background as a designer and choreographer and is the initiator of "De MelkSalon", a project that aims to contribute to transforming the agro-food sector "towards a sustainable relation system from production to consumption" (Klooster, 2016). The focus group is performed in Dutch, since the focus of the current research is specifically on the Dutch dairy sector only and the participants are all Dutch people involved in the Dutch dairy sector. The results of the focus group are used to gain insights into what stakeholders of the sociotechnical system and related societal groups consider to be important aspects of the niche developments and how the participants think the niche developments can impact the dominant Dutch dairy regime. The intention of the focus group is to gain exploratory results; therefore, one focus group can already appropriately contribute to the current research.

The discussion of the focus group was divided into three main parts. The first main part was on niche developments in general. The focus group participants were asked to think about, write down and subsequently discuss the characteristics they believe a niche development needs to be impactful. The second part of the discussion included the impact assessment of Muufri. The impact assessment of Muufri consisted of a short discussion on the advantages and disadvantages of Muufri, the discussion of a scenario in which Muufri would be extremely successful and a discussion of a realistic scenario of the impact of Muufri for the coming five tot fifteen years. The third part of the focus group discussion included the impact of assessment of Remeker, which was organised the same as

the discussion on the impact assessment of Muufri. First the advantages and disadvantages of Remeker are shortly discussed, followed by the discussion of a scenario in which Remeker would be extremely successful and a discussion of a realistic scenario of the impact of Remeker for the coming five tot fifteen years. More information on the exact organisation and questions of the group discussion can be found in the Appendix.

4. The potential lock-in of the dominant regime

This chapter discusses the results of the first research question, which focuses on the main sustainability issues and the current state of the dominant sociotechnical regime of the Dutch dairy sector. This chapter discusses the idea that the dominant regime and its issues are in a state of lock-in. As discussed in the analytical framework, a locked-in state means that one specific action pattern has become dominant, flexibility has been lost and even new entrants are influenced by the dominant system (Sydow et al., 2009). The idea that the dominant regime of the Dutch dairy sector is locked-in is based on the argument that the dominant regime cannot overcome its own issues. Therefore, to illustrate the current locked-in state of the dominant regime the sustainability issues of the dairy sector and the path dependency of the sustainability issues are discussed.

Another argument supporting the idea of the current locked-in state of the dominant regime of the Dutch dairy sector is the entanglement of different aspects of the dominant regime. Developments in the organisation of the dairy sector, the technologies used, the related regulations and the markets addressed have influenced each other over the years. The interactions and entanglements between the (1) organisation, (2) technology, (3) regulations and (4) markets of the dominant regime have resulted in the current lock-in. Currently, the four aspects are dependent on each other and therefore lack the flexibility to change and adapt. The path dependency analyses of the sustainability issues show some of the important interactions between the organisation, technology, regulations and markets of the dairy sector in the Netherlands that have led to the dependency between the four aspects.

Overall, this chapter presents an exploration of the idea that the dominant regime is in a state of lock-in. The current sustainability issues of the dominant regime and the processes that contribute to the inability of the dominant regime to overcome the issues are discussed. The aim of specifically discussing the lock-in state of the sustainability issues is to make an argument for the lock-in of the complete dominant regime. First, the current issues of the dominant regime are discussed in Section 4.1, subsequently it is discussed how these issues historically could have evolved in Section 4.2 and finally an interpretation on the overall path dependency of the dominant regime is presented in Section 4.3. Concluding remarks on the first research question are discussed in Section 4.4.

4.1 Current sustainability issues of the dominant regime

The current sustainability issues of the dominant regime are discussed in this section. The sustainability issues and this section are sorted into the three aspects of sustainability. The three aspects of sustainability are economic, ecological and social sustainability.

4.1.1 Economic sustainability issues

Although the economic sustainability of the dairy sector is not on the agenda of the Sustainable Dairy Chain initiative (Reijs et al., 2015), still the economic aspects of the Dutch dairy sector are important for the sector to be viable and sustainable. The past two years the dairy sector has had to deal with decreasing prices of milk and dairy products and the prospects show that the prices will not be increasing soon (Rabobank Food & Agri, 2015).

Since the abolition of the European milk quota system in 2015, the European dairy industry is dependent on the international dairy market without the support of the European Union. The international dairy market is a volatile market, which presents difficulties for the Dutch dairy industry to adjust to this international market (Roland Berger Strategy Consultants et al., 2015). Another factor that contributes to the current low milk prices is the Russian boycott of European food products, including dairy products. The dairy industries that were exporting to Russia have had to find new markets for their products (Nederlandse Zuivel Organisatie, 2015).

With the prospect of the abolition of the milk quota system, many farmers made investments to enlarge their dairy farms. However, because of the current low milk prices, the farmers have difficulties repaying their investments. Many dairy farmers are therefore currently financially struggling (Jacobsen, 2016; Schreijer-Pierik, 2016).

4.1.2 Ecological sustainability issues

The ecological sustainability issues that the dairy sector is currently dealing with are mostly related to the emissions of greenhouse gasses and energy use (Krebbekx et al., 2009). Also the first goal of the Sustainable Dairy Chain initiative, climate-neutral development, focuses on greenhouse gas emissions and energy use (Reijs et al., 2015). Worldwide the dairy sector is responsible for 3% of the greenhouse gas emissions, which is twice as much as the total emissions of the whole aviation sector (Ministerie van Economische Zaken, 2016).

For the dairy processing industry, the challenges are to save energy and to use sustainable energy sources, to be more efficient with raw materials and to organise more sustainable transport (Nederlandse Zuivel Organisatie, 2015; Reijs et al., 2015). For the dairy farmer, the challenges are to make use of sustainable energy sources or to produce more sustainable energy at the farm and to find sustainable and reliable sources for the feed, possibly closer so less transportation is needed (Krebbekx et al., 2009; Ministerie van Economische Zaken, 2016). Part of the greenhouse gas emissions and energy use issues are related to the production of cow feed. Currently, most soy for the feed for the cows is produced in South America on fields created at the expense of nature reserves, such as rainforests. One of the goals of the Sustainable Dairy Chain initiative, conservation of biodiversity and the environment, is mostly focused on investing in responsible soy to solve the problems related to soy production.

Overall it can be said that for most of the issues related to greenhouse gas emissions and energy use solutions are developed. However, there are also persistent problems such as the methane gasses produced by the cows and other environmentally damaging effects of cow's manure (Ministerie van Economische Zaken, 2016).

Two other goals of the Sustainable Dairy Chain initiative, continued improvement of animal health and animal welfare and retention of pasture grazing, are focused on issues concerning the welfare and health of the cows. The main issues of animal health and welfare are related to antibiotic use and to pasture grazing of the cows (Reijs et al., 2015).

To prevent outbreaks of animal diseases cows receive preventive doses of antibiotics. However, this preventive use of antibiotics brings risks of the evolution of resistant bacteria, which could also be a risk for the public health (Ministerie van Economische Zaken, 2016). Pasture grazing provides the

cow more space and the opportunities to behave more natural (Ministerie van Economische Zaken, 2016). However, it becomes more difficult for the farmer to provide pasture grazing for his cows when the number of cows on a single farm increases. Overall, the amount of pasture grazing has decreased during the past years (Reijs et al., 2015).

4.1.3 Social sustainability issues

The fact that the Dutch dairy sector has to deal with social sustainability issues becomes also evident from the motivation of the goal of the Sustainable Dairy Chain initiative to maintain pasture grazing. As part of the reasoning for the goal to maintain pasture grazing the "image that society has of the Dutch dairy sector and its products" is mentioned. The image of dairy products and the dairy sector has been the focus of the Dutch dairy sector already since the 1930s and continues to be an aspect that the sector is focused on (Krebbekx et al., 2009; Nederlandse Zuivel Organisatie, 2015; Reijs et al., 2015; Reinders & Vernooij, 2013; Roland Berger Strategy Consultants et al., 2015).

The pasture grazing of cows is something the Dutch population expects from the dairy farms and accomplishing this helps improving the sustainable and animal friendly image of the Dutch dairy sector (Krebbekx et al., 2009). Also the image of the nutritive value of dairy products continues to be an aspect that the Dutch dairy sector is focused on. By informing people of the nutritional value of dairy products and by developing healthier products, for example by lowering the salt content in cheese, the Dutch Dairy Association hopes to improve the image of dairy products and their nutritive value (Nederlandse Zuivel Organisatie, 2015; Roland Berger Strategy Consultants et al., 2015). Not only among consumers the nutritional value of dairy products is questioned, also among medical and nutritional experts there is currently a debate on the potential health advantages and disadvantages of including dairy products in the human diet.

All the different issues together could threaten the survival of each stakeholder of the dairy industry and dairy farms in the Netherlands, which would result in large issues for the social sustainability of the Dutch dairy sector and the Netherlands. In the Netherlands, farms are mostly inherited and have been in the families for years (e.g. Remeker, 2016). Taking over a farm is a complicated process that includes the need of large financial investments. When the farms are not viable and sustainable or when no family member wishes to inherit the farm, this threatens the long-term continuity of the dairy farms in the Netherlands.

Furthermore, one major stakeholder, FrieslandCampina, processes over three quarters of the total milk production in the Netherlands, which means that many stakeholders of the Dutch dairy sector are dependent on FrieslandCampina (Reinders & Vernooij, 2013). In case the continuity of FrieslandCampina would be threatened, this would also directly threaten the survival of all the stakeholders dependent on FrieslandCampina. Since the dairy sector contributes to the Netherlands on many aspects, it would have far stretching consequences in case the continuity of the dairy sector would be vulnerable and questionable.

The Dutch dairy sector provides the Dutch population with products that contribute to a healthy diet, since milk contains a high amount of nutrients with a relatively low caloric value for a good price (Roland Berger Strategy Consultants et al., 2015). The Dutch dairy industry also contributes to the Dutch economy and provides about 45.000 direct fulltime jobs (Roland Berger Strategy Consultants

et al., 2015; Witteveen, 2013). Furthermore, the dairy sector and its products are part of the Dutch culture; the average Dutchman consumes about two glasses of milk per day and abroad the Netherlands is associated with images of cheese girls in traditional costumes (Roland Berger Strategy Consultants et al., 2015).

4.2 Path dependency analysis of the sustainability issues

Geels and Schot (2007) explain that a regime can stabilise the existing path by for example "cognitive routines that blind engineers to developments outside their focus, regulations and standards, adaptation of lifestyles to technical systems, sunk investments in machines, infrastructures and competencies." The processes that stabilise an existing path simultaneously contribute to the lock-in effect. This section explores whether processes have taken place that have contributed to the path dependency and lock-in of the sustainability issues of the dominant regime. Only specific historical events that might have contributed to the lock-in of the sustainability issues are discussed. This section is not a representative overview of the complete history of the dominant regime of the Dutch dairy sector.

Similar to the previous section, this section is sorted into the path dependencies of each of the three sorts of sustainability issues. Overall, the aim of this section is to show what kind of processes might have happened in the past that potentially could explain the current lock-in of the sustainability issues. The locked-in state of the sustainability issues could be seen as an argument for the lock-in of the complete dominant regime.

4.2.1 The economic sustainability issues

The main economic sustainability issue of the dominant regime is the decreasing price of milk and dairy products. When the history of the Dutch dairy sector is taken into account, it can be concluded that specific past events might have contributed to the current economic situation of the dominant regime. This section explores whether developments of the past have resulted in the difficulties the dominant regime has to overcome its economic issues. This section focuses on explaining past developments based on the interactions between the aspects of organisation, technology, regulations and markets of the dominant regime. As explained, the growing entanglement of the four aspects could equal a growing path dependency.

First, an early situation of the dominant regime is considered to explain a starting position of the economic developments, which does not imply that there were no economic developments prior to this situation. The situation of the (1) organisation, (2) technology, (3) regulations and (4) markets of the dominant regime before the First World War was very different from the current situation. Shortly, some elements of the four aspects are discussed to give an impression of the specific interaction between the four aspects of the dominant regime before the First World War.

- **Regulations**: There were no regulations yet that influenced the amount of milk production or the dairy products markets (Reinders & Vernooij, 2013).
- **Markets**: The markets of dairy products offered three sorts of products to its consumers. Depending on the demand, milk was either sold as consumption milk or processed into butter or cheese. Butter and cheese were produced from the leftover milk that was not

drunk. Farmers would profit more from selling consumption milk than butter or cheese, so the farmers preferred to sell their milk as consumption milk (Lankveld, 2012; Reinders & Vernooij, 2013; J.M.G. Lankveld, personal communication, June 1, 2016).

- **Technology**: The milk had to be transported to the consumer or the factory, but the technology limited the transportation times of the milk. Milk could only be transported for about one and a half hours because of spoilage (Reinders & Vernooij, 2013; J.M.G. Lankveld, personal communication, June 1, 2016).
- **Organisation**: Figure 3 and Figure 4 show the butter and cheese factories in the Netherlands in 1903 and 1906 respectively. As can be seen, most factories were in rural areas and in the urban areas surrounding the big cities there were less or no factories (Lankveld, 2016; J.M.G. Lankveld, personal communication, June 1, 2016).

Figure 3: The butter factories in the Netherlands in 1903 (Lankveld, 2016).

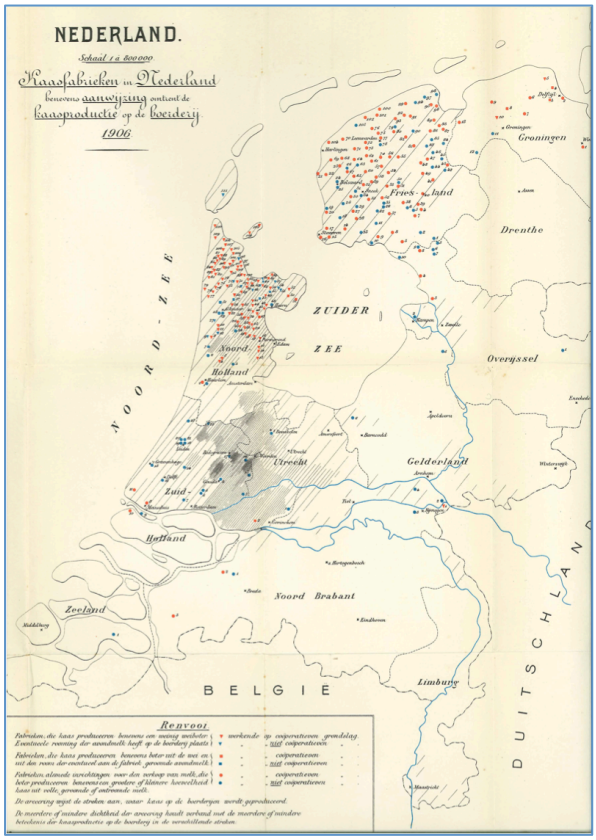

Figure 4: The cheese factories in the Netherlands in 1906 (Lankveld, 2016).

The specific interaction between the four aspects resulted in the specific situation of the economic developments before the First World War. In the urban areas farmers had enough customers, so they could sell almost all their milk as consumption milk all year round. The farmers preferred to sell their milk as consumption milk, because they would profit more. In the rural areas there were not enough customers to sell all the milk as consumption milk, especially in the summer when the cows produced most milk. Thus, more factories were needed in the rural areas to process the milk. The factories had to be build in close proximity of the dairy farmers, because the milk could not be transported long (J.M.G. Lankveld, personal communication, June 1, 2016). The situation before the First World War shows some clear interaction between the organisation, tecnology, regulations and markets of the dominant regime.

The specific interaction between the organisation, technology, regulations and markets is not rigid and changes. For example, several technological developments between the 1950s and the 1970s caused changes in the organisation of the dairy factories. Due to the cooling of the milk at the farm, the milk tank and the retrieval of the milk by car, it became possible to transport the milk a lot further within the maximum of one and a half hours because of spoilage. Because the milk could be transported further, the farmer had more choice to which factory he wanted to sell his milk, a choice that was mainly motivated by the price the factories paid for the milk. Therefore, the factories that paid lower prices for the milk received less milk. Subsequently, these factories were not able to invest anymore and finally had to close or merge with bigger factories (Lankveld, 2016; Reinders & Vernooij, 2013). This example shows that developments in one aspect can change the whole interaction between the four aspects of organisation, technology, regulations and markets.

After the Second World War, the dominant regime went through some significant changes, which infleunced the economic sitation also. Developments in specifically the aspect of regulations changed the economic situation of the dominant regime. After the Second World War the guaranteed price for milk was introduced with which the government interfered with the dairy market. The goal of the introduction of the guaranteed milk price regulations was to ensure the availability of sufficient food products for the Dutch people (Reinders & Vernooij, 2013). The guaranteed milk price made it profitable for the dairy farmers to produce a lot of milk despite the actual demand for these large amounts of milk, which resulted in large surpluses of butter and milk powder. National marketing campaigns were started to increase the milk consumption among Dutch consumers. It was argued that an increase in milk consumption could contribute to an increase of milk prices and a decrease of the milk surplus. Although the campaigns were quite popular, they did not increase the milk consumption (Reinders & Vernooij, 2013). Overall, it was no surprise that the guaranteed milk price was a regulation that could not be maintained by the government.

In 1984 the guaranteed milk price regulations were replaced by the European milk quota system, which limited the amount of milk that the dairy farmer was allowed to produce. Because of the lower amount of milk production due to the milk quota, more higher value dairy products were produced and the export of cheese increased (Reinders & Vernooij, 2013). By 2015 the milk quota system had been in place for over thirty years. Even though the milk quota might have been quite successful in reducing the surpluses, the regulations could not be maintained forever in a more globalised world with global markets.

The regulations of the guaranteed milk price and the milk quota both directly influenced the dairy markets. Next to the influence of the regulations on the markets, the regulations also influenced the organisation and technology of the dairy sector. Because of the regulations, the dairy sector very much focused on efficiency and scale. The focus on efficiency led to for example the mergers of dairy factories, to the development of efficient technologies and also more higher value dairy products were produced (Reinders & Vernooij, 2013; J.M.G. Lankveld, personal communication, June 1, 2016). These examples show that a change in regulations introduced changes in the organisation, technology and markets of the dominant regime as well.

Recently, the regulations changed again when the milk quota system was abolished in 2015. In the years leading to the abolition of the milk quota system, many farmers and factories made preparations and investments to be able to upscale their milk production and processing right away

when the milk quota system was abolished (Koster, 2016). The current low milk prices are probably not what the farmers and factories had hoped to encounter with the abolition of the milk quota system. Furthermore, the low milk prices might make it difficult for farmers and factories to repay the large investments they made.

Over the years, the interaction between organisation, technology, regulations and markets of the dominant regime became more entangled. Some of the situations as discussed above show the dependency of the organisation, technology, regulations and markets on each other. The complete dairy sector has developed around the specific interaction and entanglement of the organisation, technology, regulations and markets. Next to the entanglement, other processes might have contributed to the potential lock-in of the economic issues. It is likely that many processes can be identified for different areas of the dairy sector; the following two processes are mere examples of the sorts of processes that might have contributed to the lock-in of the economic issues.

One of the processes that could have contributed to the locked-in state of the economic sustainability issues of the current Dutch dairy sector is the fact that milk is a product that cannot be adjusted easily and quickly to market demands. The farmer is dependent on the cows for the production of milk, the farmer cannot deliver more milk than the amount the cows produce at that time and it takes time for the farmer to adjust the number of cows at the dairy farm. In case more milk is produced than the demand, the farmer makes less profit while his costs remain the same. Because the farmer cannot easily and quickly adjust the milk production, the milk production is often not well adjusted to the actual demand for milk and dairy products. The misalignments of the milk production with the demand for dairy products can further enhance the price increases or price decreases (Roland Berger Strategy Consultants et al., 2015).

Another process that could have contributed to the lock-in state of the economic sustainability issues is that the dairy sector might have unlearned how to anticipate the market. There have been regulations in place in the Netherlands and Europe that have interfered with the dairy market since before the Second World War. During the Great Depression regulations were introduced to lower the milk production, after the Second World War the guaranteed milk price was introduced followed by the European milk quota system in 1984 (Reinders & Vernooij, 2013). For almost a century the Dutch dairy sector did not have to deal with the volatility of the market since there were always regulations that had operated as safety nets for the Dutch dairy sector. Maybe the Dutch dairy sector has to learn again how to anticipate its dairy production to the volatility of the now global market. Maybe this process explains why dairy farmers in the Netherlands keep producing more milk even though the value of their milk keeps decreasing (Schaftenaar, 2016).

4.2.2 The ecological sustainability issues

For the ecological sustainability issues, it is more difficult to analyse the interactions and processes that have contributed to the development of the issues, because the ecological issues are also formed outside of the dominant regime. Developments within the entire sociotechnical system, also at the landscape level, contribute to the issues of the dominant regime. Especially because the standards of what is ecological sustainable are not formed within the dominant regime, but outside of it. The media, opinion leaders, radical organisations or niches, and many more parties play a role in shaping the views of the public and the dominant regime on certain issues and also on these

ecological issues. Therefore, it is difficult to assess which developments of the dominant regime have contributed to the ecological issues, since also many processes outside of the regime of the Dutch dairy sector have played a role.

The main ecological sustainability issues are emissions of greenhouse gasses, energy use and animal health and welfare. Some developments within the dominant regime that might have contributed to the ecological issues are discussed. Also for the ecological issues, this includes the interactions between the organisation, technology, regulations and markets of the dominant regime. The interactions that are discussed in Section 4.2.1 as part of the path dependency analysis of the economic sustainability issues are also taken into account.

Differences can be identified when the current organisation of dairy farms is compared to an earlier situation. Most dairy farms started out not specifically as dairy farms, but the farmers performed multiple forms of farming. Over the years farmers specialised their farms more towards one form of farming and also specialised dairy farms started to evolve (Lankveld, 2012; Reinders & Vernooij, 2013). After the Second World War, the plans and regulations of the Minister of Agriculture were focused on ensuring the availability of sufficient food products. The focus of the regulations and also of the dairy sector began to lie on the amount of milk production and efficiency (Reinders & Vernooij, 2013). For example, also in the breeding of cows the milk yield became the primary focus of selection from a scientific perspective during the late 1940s (Theunissen, 2012).

With the focus shifting so much to production amounts and efficiency, it could be that the farmers lost their focus on diversity and the health of their animals and their land. Also many new technologies at the farm were introduced since the 1950s, which decreased the amount of time the farmer spend with his cows, as is presented in Figure 5 (Schot & Bruhèze, 2000). The technologies that shortened the time needed for the farmer to spend with his cows might have contributed to the farmer losing contact with the cows. This process could have contributed to the animal health and welfare issues the dairy sector is currently dealing with. With the focus on efficiency, it could be that farmers have made adjustments to their farms in the past that turned out to be not so animal friendly by current standards. Also the focus has been on the production amounts and efficiency already since after the Second World War, which is a very long time. It could be that current farmers do not have the knowledge and experience to focus their farms on anything else but the production amounts and efficiency despite the health and welfare of the animals or the land.

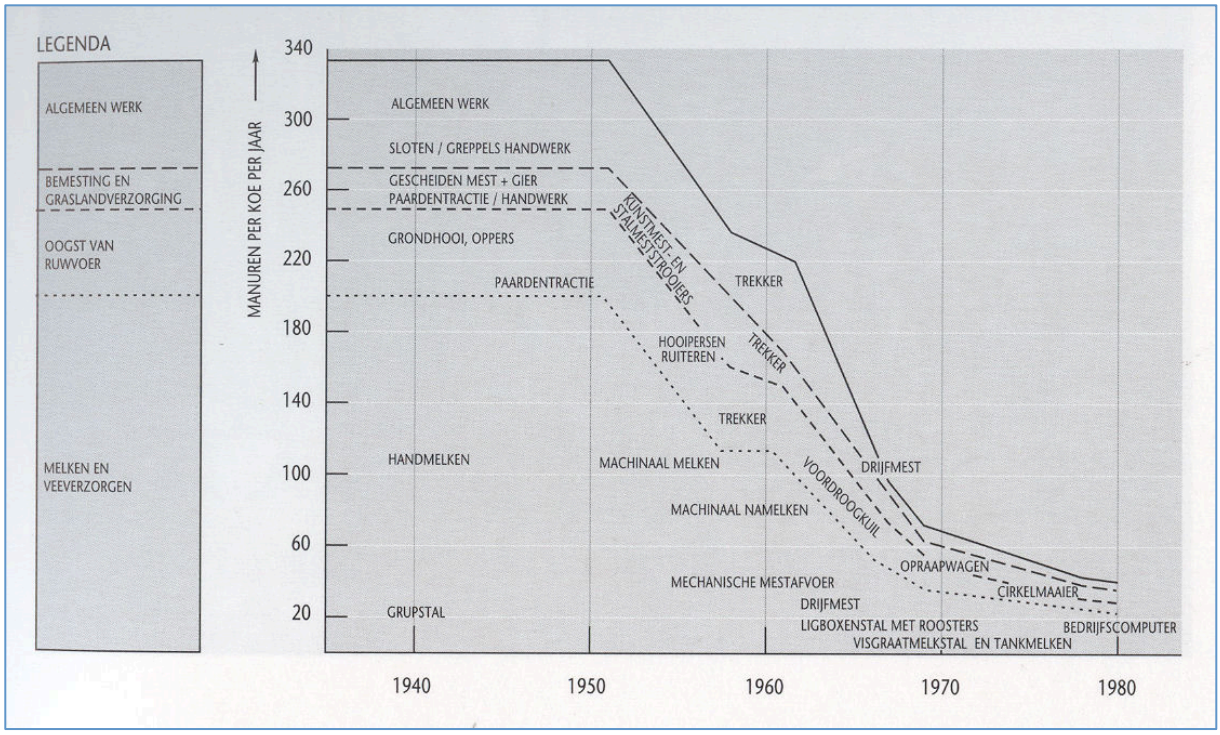

Figure 5: The development in the amount of labour required at the dairy farm in the period of 1940-1980 in the amount of hours per cow per year. On the left side the required labour activities are listed with from top to bottom: general labour, fertilisation and grassland care, harvest of feed, and milking and care of cattle (Schot & Bruhèze, 2000).

Another development that took place is the importing of soy feed for the cows from South America. The importing of soy feed not only threatens the nature reserves in South America, but also the long and far transportation of the soy comes at the cost of the environment (Ministerie van Economische Zaken, 2016). The importing of soy feed could also be the result of the strong focus on efficiency and scale of the dominant regime. The soy is imported despite the negative ecological impact, which is probably due to economic costs. Also other issues evolving energy use or greenhouse gas emissions could be the result of the strong focus on efficiency and scale despite the ecological costs.

4.2.3 The social sustainability issues

The main social sustainability issues are the image of dairy products and the vulnerable continuity of the Dutch dairy sector. The path dependency of the issues related to the image of dairy products is difficult to analyse for similar reasoning as the difficulties with the ecological issues. The image of something is not formed within the organisation or regime, but outside of it at the landscape level. The analysis of the interactions and processes that have contributed to the image issues of the dominant regime is, therefore, limited. The issues related to the vulnerable continuity of the Dutch dairy sector are not as strongly affected by developments outside of the dominant regime only.

It seems that the image of dairy products was not an issue in the early times of the dominant regime of the dairy sector. During the late 19th century and the beginning of the 20th century, milk was considered to be a good and nutritious food, especially for children and sick people. For example, when the milk was diluted with water it was considered to be a good replacement for mother's milk for babies (Lankveld, 2012). However, currently the image of dairy products is an issue that the

dominant regime is focusing on. The past decades the dairy industry has marketed dairy products for their health benefits and has provided the consumer with information on the nutrients in dairy products. Despite all the efforts of the dairy industry, the consumption of dairy products has decreased. Improving the image of dairy products is currently still a focus of dairy organisations (Nederlandse Zuivel Organisatie, 2015; Reinders & Vernooij, 2013).

To solve the issue of the image of dairy products the dominant regime has used different strategies. As already discussed, the dominant regime tries to inform the consumer of the health benefits of their products. Furthermore, the dominant regime has also developed dairy products addressing the concerns of consumers, such as for example low fat dairy products (Nederlandse Zuivel Organisatie, 2015). However, the existence of such products as low fat dairy might give consumers the impression that normal dairy products are for example too fat to be healthy. When the dominant regime informs consumers on the health benefits of dairy products and simultaneously develops products addressing the health concerns, this could be seen as conflicting. The conflicting message of the dominant regime might confuse consumers and have a negative influence on the image of dairy products. Furthermore, also scientists and experts currently question the nutritional value of dairy products, which does not help the dominant regime with this social sustainability issue.

Overall, the social sustainability issue of the image of dairy products is difficult to explain based solely on developments of the dominant regime because the image is not formed within the dominant regime. The interactions between the organisation, technology, regulations and markets of the dominant regime that have contributed to the image issues are also less clear. The social sustainability issue of the vulnerable continuity of the dominant regime provides more opportunity to analyse. When it comes to the issues of the continuity of the dairy sector in the Netherlands, multiple processes could have played a role.

Over the years the amount of dairy cooperatives or companies has decreased a lot due to more and more mergers or acquisitions (Reinders & Vernooij, 2013). These mergers were initiated because of the need and preference to enlarge the production, become more efficient and make use of the benefits of economy of scale. As discussed, the focus on efficiency and scale could be a consequence of regulations such as the milk quota system. Currently the many mergers have resulted in a few big players in the Dutch dairy sector on which many stakeholders depend. This dependence on a few big players might make the dairy sector and its long-term continuity vulnerable. In case one of the big players struggles financially or encounters any other problems threatening its existence, simultaneously the continuity of many stakeholders becomes vulnerable. Also since the dairy sector has focused already for years on efficiency, it is questionable whether even more efficiency can be reached (Jacobsen, 2016).

Another process that might have contributed to the vulnerable continuity of the Dairy sector is the financial consequences of the European milk quota system. The milk quota system limited the amount of milk that the dairy farmer could produce. Each farmer had the right to produce and supply only a specific amount of milk. When a farmer wished to produce more milk, the farmer had to buy or rent the quota of another farmer. This happened often; especially when farmers quit dairy farming these farmers would sell their quota to other farmers wishing to enlarge. However, the problem here is that the dairy farmer had to spend a lot of money on these milk quota and that that

money could thus not be used to invest within the dairy sector. The process of money leaving the dairy sector could have contributed also to the current issues of continuity of the dominant regime.

Overall, the continuity of the dairy sector in the Netherlands also relates to the economic sustainability of the sector. The uncertain continuity of the dairy sector, similar to the economic sustainability issues, is the result of specific interactions between the organisation, technology, regulations and markets of the dominant regime. The specific interactions that have led to the economic issues have already been discussed more elaborately in the section on the path dependency analysis of the economic issues and similar interactions have contributed also to the development of the issues of the continuity of the dairy sector.

4.3 Potential path dependency of the dominant regime

The dominant regime of the Dutch dairy sector currently deals with several sustainability issues. The previous section discusses some of the processes and interactions that could have contributed to the lock-in of the sustainability issues. This section attempts to derive the path dependency of the complete dominant regime from the analyses of the sustainability issues. Only specific historical developments are studied for the path dependency analyses of the sustainability issues. Therefore, it is difficult to derive the path dependency of the complete dominant regime based on the analyses of the sustainability issues only. The path dependency analysis that is presented here is just a suggestion of the potential path dependency of the dominant regime.

4.3.1 The preformation phase

The preformation phase is the first phase of path dependency and includes the period in which there is still a large range of options, although the choices made are already somewhat influenced by the specific history of the organisation or system (Sydow et al., 2009). When the history and the developments of the dominant regime are analysed, it seems that the preformation phase took place in the period before the Second World War. Since 1870 dairy factories were established, it was then that the industrialisation reached the dairy sector. The processing of dairy moved away from the farms and to factories (Lankveld, 2012; Reinders & Vernooij, 2013). There was still a lot to develop and there were still a lot of options on how to develop the dairy industry and sector further, which is characteristic of the preformation phase. Slowly, the path of the regime of the Dutch dairy sector started to take form; most factories were cooperatively organised, more processes were mechanised and the first regulations were introduced (Lankveld, 2012; Reinders & Vernooij, 2013).

4.3.2 The formation phase

The formation phase or the second phase of path dependency is characterised by the emergence of a dominant path during which the available amount of options decreases and the irreversibility of the path is created (Sydow et al., 2009). Some of the sustainability issues of the dominant regime started to develop after the introduction of the new plans for agriculture after the Second World War. Regulations were introduced to ensure the Dutch population with sufficient food. These regulations included the guaranteed milk price (Reinders & Vernooij, 2013). As also discussed in the analyses of the sustainability issues, the regulations could have contributed to the focus on efficiency and scale that the dominant regime developed. Some of the sustainability issues find their origins in the strong

focus on efficiency and scale. The specific focus on efficiency and scale of the dairy sector has affected and still affects the path of the dominant dairy sector. Therefore, the regulations introduced after the Second World War mark the transition from the preformation to the formation phase for the dominant regime. The introduction of the regulations after the Second World War and can be considered to be the "critical juncture".

4.3.3 The lock-in phase

The lock-in phase is the third and final phase of path dependency and includes the period in which one specific pattern has become dominant. By then flexibility of the system is lost and even new entrants are influenced by the dominant system (Sydow et al., 2009). In the case of the dominant regime of the Dutch dairy sector flexibility was almost literally lost by 1984. The European milk quota system legally limited the milk production and farmers lost the choice of how much milk they wanted to produce. Therefore, also the dominant regime of the dairy sector was limited in the amounts of milk that could be processed. New entrants in the dairy sector could not start without obtaining milk quota and thus new entrants were influenced by the regulations, even outside of the dominant regime, which is characteristic for the lock-in phase.

Because of the milk quota system, the dominant regime focused even more on efficiency and scale, which further influenced the path of the dominant regime. Even when the milk quota system was abolished, the focus on efficiency and scale of the dominant regime did not change. Also the sustainability issues caused by the focus on efficiency and scale did not solve with the abolishment of the milk quota system, as is discussed in the previous section. That the issues caused by the milk quota system did not solve after the abolishment of the quota indicates that the path developed during the years of the milk quota system still continues. The introduction of the milk quota system has started the lock-in phase, but the abolishment of the milk quota has not ended the lock-in; the path of the dairy sector is still dependent on and influenced by the focus on efficiency and scale.

More recently, farmers and companies have made large financial investments to enlarge their production as soon as the milk quota system was abolished. These financial investments further contributed to the lost flexibility of dairy farmers and the dairy industry. Taking both the continued focus on efficiency and scale and the financial investments made into account, it is not surprising that the dominant regime might have lost the flexibility to find solutions to the sustainability issues. The loss of flexibility is also a strong argument for the lock-in of the dominant regime of the Dutch dairy sector.

4.3.4 Reflection on path dependency

Both in the analyses of the developments of the sustainability issues and the path dependency of the dominant regime the influences of the landscape and the niche level on the regime are noticeable. It seems that the development of a path is not just caused by decisions and events within the dominant regime, but just as much by developments at other levels. The image of dairy products is a clear example of an issue that did not develop within the dominant regime only. Also the decreasing dairy prices and the environmental issues are sustainability issues that have developed because of the interactions between the regime level and the landscape and niche levels.

The theories on path dependency mostly focus on the decisions and events that occur within the organisation or regime. The interactions outside of the regime are not taken into account by path depended theories. This case shows that path dependency theory might be missing an element that takes into account the very significant interactions between the regime or organisation and its environment. Also decisions or events outside of the regime level can contribute to the path development, the decreasing amount of choices and eventually the lost flexibility of the regime.

4.4 Conclusion

In the above sections the results of the first research question are presented. The first research question focused on the dominant regime, the issues of the dominant regime and the potential lock-in of the dominant regime. The dominant regime is currently a sector focused on scale and efficiency. As discussed, the idea of the potential lock-in of the dominant regime is based on two arguments. The first argument defends that when a lock-in of the sustainability issues of the dominant regime can be determined, this could indicate the lock-in of the entire dominant regime. The second argument defends that the potential lock-in of the dominant regime can also be derived from the dependence of the different aspects of organisation, technology, regulations and markets of the dominant regime on each other. The four aspects keep interacting with each other over the years. The interactions could eventually lead to a situation where an individual aspect can no longer be changed because of the specific dependence of the individual aspect on the other aspects. It shows a loss of flexibility of the dominant regime in case the different aspects of the dominant regime are dependent on each other, which also indicates a state of lock-in.

The path dependency analyses of the sustainability issues of the dominant regime have shown processes that might have contributed to the potential lock-in of the issues. Overall important processes that have played a role in most of the discussed sustainability issues are the lost flexibility due to financial investments and the strong focus on efficiency and scale of the dominant regime. Furthermore, it could be that individuals that did not agree with the situation of the dominant regime have already stepped out of the regime over the years, either by quitting the dairy sector completely or by creating an own niche development (J.D. van de Voort, personal communication, June 27, 2016). Therefore, the dominant regime consists now mostly of people agreeing with the current practices and maybe lacking the urge to make the needed changes to solve the sustainability issues of the dominant regime.

The potential lock-in of the dominant regime presents a possible need for niche developments. The dominant regime might have difficulties to develop solutions to its sustainability issues because of its state of lock-in. Similar processes that have contributed to the lock-in might also make it difficult for the dominant regime to find and implement solutions. Niche developments can provide insights, inspiration or solutions to the sustainability issues of the dominant regime.

5. Muufri & Remeker: two potentially radical niche developments

This chapter discusses the results of the second research question, which focuses on the two selected niche developments. The novel ways of dairy processing that Muufri and Remeker are based on are discussed as well as the sustainability issues of the dominant regime that Muufri and Remeker address. In Section 5.1 Muufri is discussed and Section 5.2 discusses Remeker. In both Section 5.1 and Section 5.2 first a general description of the niche development is provided, subsequently the four aspects of organisation, technology, regulation and markets are discussed for the niche developments and finally, the technical specification of the niche development's innovations are discussed. Theory on the mechanisms of niche development is applied to Muufri and Remeker to evaluate the current status of the niche developments in Section 5.3. Concluding remarks on the second research question are discussed in Section 5.4, as well as why Muufri and Remeker are considered to be potentially radical niche developments.

5.1 First niche development: Muufri

Muufri is a start-up company currently based in San Francisco, California, USA. In the spring of 2014, Isha Datar of New Harvest reached out to Ryan Pandya and Perumal Gandhi, two people who never met before but shared the idea of making milk in cell culture to ensure the growing global population of nutritious and sustainable food. Together they started the project that is now known as Muufri. Quickly after they started their research into the possibilities of producing milk in cell culture they received funding and laboratory space, which further accelerated the growth of the project into the established start-up it is now (Barrie, 2014; Datar, 2015). At the moment Muufri aims to have their product available and on the market by the end of 2017.

Muufri aims to produce milk from cell cultures, which results in a vegan milk similar to cow milk but without the sustainability problems of the dairy farm. Muufri believes it can replicate the six proteins and eight fats in cow milk that are responsible for the flavour and function of cow milk according to Muufri. Milk consists of two different sorts of proteins, whey proteins and casein. At Muufri, yeast cells are inserted with the genes for casein and whey proteins and these yeast cells are grown in large stainless steel tanks to brew milk. The modified yeast cells ferment simple sugars into the specific milk proteins. Subsequently, the yeast and the milk proteins are separated. The fats that are needed for the Muufri milk are sourced from plants and also slightly modified to resemble the specific fats of cow milk. The minerals, such as calcium and potassium, and the sugars are separately purchased. The proteins, fats, water and other components are then combined to produce the actual milk. The milk produced by Muufri can also be used to produce other dairy products such as cheese, yoghurt or cream since it is molecularly identical to milk from cows (Anderson, 2014; Barrie, 2014; Datar, 2015; Qiu, 2014).

Figure 6: Mock-up of a Muufri milk carton (Barrie, 2014).

At first, Muufri might appear to be yet another alternative product for cow milk. Many alternative dairy drinks, such as soy or almond milk, are already available and also quite successful (Australian Food News, 2016; Streur, 2016). However, there are some aspects of Muufri that differs the milk product from other alternative dairy drinks. Muufri aims to replicate the precise formula of cow milk instead of offering an alternative version of milk. By replicating the cow milk the product can also be used to produce dairy products, such as cheese or yoghurt, which is not possible with other alternative dairy drinks such as soy or almond milk according to Muufri. Also other alternative dairy drinks are known to have a different taste than that of cow milk, while the Muufri milk product is working towards a taste and mouth feel that is exactly similar to that of cow milk (Datar, 2015; Nguyen, 2014).

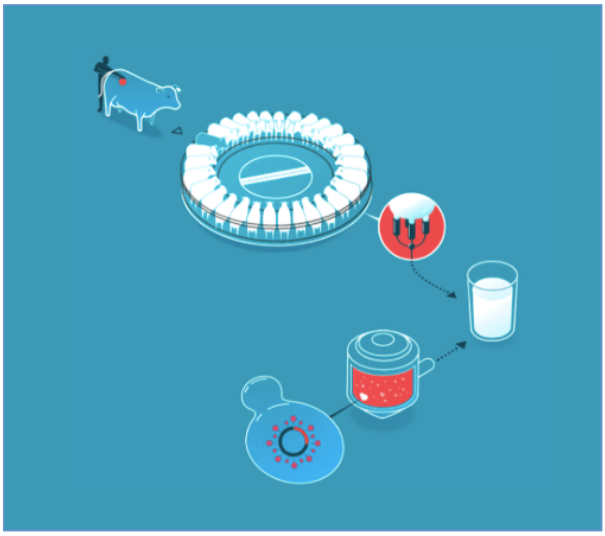

Figure 7: Above the current process of milk production is depicted and below the proposed process of milk production by Muufri (Datar, 2015).

The milk produced by Muufri with the help of modified yeast provides solutions to several of the problems the dairy sector is dealing with worldwide and in the Netherlands. First of all, a clear benefit for the environmental sustainability is the aspect that no cows are needed to produce the milk. No animals at all are involved in the process of producing Muufri's milk; only some cow's genes are needed for the modification of the yeast. All issues related to the farming of cows are eliminated from the process of milk production. Furthermore, the elimination of animals from the process also results in the fact that there is no opportunity for contamination of the milk by bacteria or blood and pus from the cow. Since there is no of contamination of the milk, also less pasteurisation is needed and a longer shelf life of the product is possible. Using yeast for the production of milk has many advantages. The use of yeast makes it easier to ensure a more stable supply of milk, since environmental factors or diseases cannot directly influence the production of the milk. Furthermore, a yeast is a much more simple organism than a cow. Founder of Muufri Perumal Gandhi has pointed out that it can be considered to be quite inefficient to make "an entire cow to make just the milk" since "you're giving it all this feed and water, and most of it goes towards growing legs, growing a head, growing a liver and lungs – just living" (Qiu, 2014). Yeasts double every couple of hours, do not require as much land and water and produce less waste. Also by composing the milk from different sources for each of the milk components it is possible to change the exact composition of the milk. Lactose could be replaced, which makes the milk also suitable for the majority of the population who are lactose intolerant. The proportions of the components could also be altered easily to obtain the exact preferred milk for different applications for example, something that is not as easy with cow milk (Anderson, 2014; Datar, 2015; Qiu, 2014).

Overall, Muufri is still in a start-up phase and therefore the interactions among the organisation, technology, regulations and markets of Muufri are not yet as extensive as they are and have been for the Dutch dairy sector. Because Muufri is still organised as a start-up company with no product on

the market yet, it makes sense that there is no technology fully developed and regulations introduced yet. When Muufri is compared to the dominant regime of the Dutch dairy sector on the four aspects of organisation, technology, regulations and markets, it becomes clear that also the differences are not fully known yet because of the start-up status of Muufri. The technology of modified yeast that Muufri is based on is definitely different than the technology that the dominant regime is based on. Because of these different technologies, Muufri is able to explore different markets than the regime is, for example the vegan market. However, it is not clear yet whether these differences will lead to differences between Muufri and the dominant regime in organisation and regulations also.

5.1.1 Technical specifications of the innovations

This section discusses the technical background information of the innovations on which Muufri is based. First, the composition of cow milk is discussed to show the complexity of cow milk and the potential difficulties of replicating it. Subsequently, the yeast modification is discussed and possible reasons why Muufri has chosen this method specifically.

Milk composition

Muufri aims to develop a product that is molecularly identical to cow milk. Cow milk has a complex composition and a high nutrient density (Jong, 2013a; Lankveld, 2016). The main components of cow milk are water, fats, proteins and sugars (Gall, 2013; Lankveld, 2016). The composition of cow milk in percentages is presented in Table 2.

Table 2: The composition of cow milk (Gall, 2013)**.**

Milk ingredient	%
Dry matter	13
Fat	3.4 - 5.4
Protein	3.5 - 4.0
Sugar	4.6

The fats occur in the form of droplets dispersed in the aqueous phase of the milk. The total lipid content depends on a variety of factors, including the breed, health and diet of the cow, but in general ranges between 3 to 5%. Most lipids are in the form of triacylglycerols, about 98% of the lipids in cow milk are these triacylglycerols of which the exact content may differ. The fats in milk act as a carrier for vitamins, provitamins and flavour compounds (Gordon, 2013). The protein content in milk is around 3.5 to 4%. The proteins in milk consist of 80% casein and 20% whey protein. There are different sorts of casein, which are subdivided in α-, β-, γ- and κ-caseins. The whey proteins include β-lactoglobulin, α-lactalbumin and some bovine serum albumin and immunoglobulin. The exact protein content depends on many factors, it can for example depend on the cow, breed, feed or season (Kukovics & Németh, 2013). The most dominant sugar in cow milk is lactose, which constitutes more than 80% of the sugars in milk. The lactose in milk is an energy source, but also the reason that many people around the word are not able to consume milk. Over 75% of the adult population worldwide is lactose intolerant, which is caused by loss of lactase activity (Crisà, 2013). Next to the main macronutrients in cow milk, the fats, proteins and lactose, milk also contains essential micronutrients such as minerals and vitamins (Gaucheron, 2013; Graulet, Martin, Agabriel,

& Girard, 2013). This short and general description of the composition of milk already gives an impression of the complexity of milk. The complexity of milk might be a challenge that Muufri faces in reaching their goal of producing a product that is similar to cow milk from a molecular point of view or at least for the consumer not noticeably different from cow milk.

Yeast modification

Small molecules can be produced by chemical means, but most proteins are too complex to synthesize chemically. Also milk proteins are very complex and therefore can only be produced by living systems (Gerngross, 2004). Microorganisms are widely used to produce specific sorts of proteins that are of medical or industrial interest. Bacteria are used to produce proteins and are very efficient in producing proteins, but bacteria are not able to perform some post-translational processing such as folding or glycosylation (Idiris, Tohda, Kumagai, & Takegawa, 2010). Yeasts are able to produce proteins including these post-translational modifications and yeasts offer more advantages; yeast can grow rapidly on simple media and are very suitable for genetic modification (Idiris et al., 2010; Kim, Yoo, & Kang, 2015). Overall, yeasts are very suitable to produce the proteins needed for the product that Muufri envisions.

5.2 Second niche development: Remeker

Remeker is the organic farm cheese produced at the farm "De Groote Voort" in Lunteren, The Netherlands. The lands of "De Groote Voort" have been in the family Van de Voort for centuries, the current farm was built in 1925. Peter van de Voort, born in 1926, led the farm during times of great change in the dairy sector. He also made the decision to introduce the Jersey cow at the dairy farm. His son, Jan Dirk van de Voort, is now in charge of the farm with his family. He introduced more changes to the dairy farm and converted it to an organic dairy farm. Since 1992 Jan Dirk and his wife started developing the Remeker farm cheese (Boerderijzuivel Delft, 2016; Boxtel, 2011; Remeker, 2016a, 2016d).

Figure 8: The Remeker cheeses (Remeker, 2016f).

The Remeker is cheese produced at the farm De Groote Voort from the raw organic milk of their own Jersey cows. Remeker produces three sorts of cheeses that differ in the duration of the ripening time. The "Remeker Pril" is a young cheese that is ripened for about three months, the "Remeker Ryp" is a more matured cheese that is ripened for 8 to 9 months and the "Olde Remeker" is ripened for 16 months. The milk for the cheese is processed raw to keep the enzymes in the milk in an active state, which contributes to the taste development of the cheeses during ripening (Remeker, 2016d). The cheeses have a very special naturally based rind, which Remeker has developed by itself. The natural rind made of ghee also greatly contributes to the distinct taste of the Remeker cheeses (Hettinga, 2015). Remeker has won several prices for the cheeses as well as for the innovation of the natural rind (Remeker, 2016d). Because the Remeker cheeses are such specialities,

customers are willing to pay significantly more money for the Remeker products (Agrarisch Ondernemer, 2016). Furthermore, Remeker has developed a special warehouse for the cheeses to ripen in. This warehouse is produced with natural materials and based on natural processes. The warehouse serves as a trial for the natural ripening of cheeses with a naturally based rind (Remeker, 2016e).

Figure 9: Jan Dirk and Irene van de Voort with their Jersey cows (Natuur & Milieu, 2016).

The Remeker cheese is inseparable from the dairy farm "De Groote Voort". Also at the farm a lot of innovative processes take place. One of the first big changes that have started the many developments that have taken place at De Groote Voort was the introduction of Jersey cows by Peter van de Voort at the dairy farm instead of the generally used Holstein-Friesian cows. Jersey cows are small, brown cows that are very efficient; with relatively low needs the cows produce much milk (Kristensen et al., 2015). The milk of Jersey cows contains higher amounts of carotene and calcium and contains the right protein for cheese production. The son of Peter van de Voort, Jan Dirk, later converted the mainstream dairy farm to an organic dairy farm. With the introduction of the organic farm practices, also other developments were slowly introduced. The family van de Voort for example decided to no longer use antibiotics for their Jersey cows, to keep the horns of the cows, to feed the cows with fresh feed of grains only and to leave the new-born calves for three weeks with their mother (Boxtel, 2011; Remeker, 2016c).

With the practices of the Remeker cheese production and the farming practices of the organic farm De Groote Voort many sustainability issues of the mainstream Dutch dairy sector are addressed. At the farm, there is a great emphasis on the important role of the land and the soil (Remeker, 2016b). Therefore, De Groote Voort addresses environmental sustainability issues by ensuring the health of the land, also according to organic farm practices. Furthermore, animal health and welfare issues are addressed since no antibiotics are used, the horns are kept and the calves stay with the mother cow for three weeks. Overall, the Remeker and De Groote Voort provide work and income for five families, which show that the Remeker cheese production also addresses economic sustainability issues (Spiksplinternieuws, 2016).

Since Remeker has been producing cheese for several years already, some interactions can be identified among the organisation, technology, regulations and markets of Remeker similar to the sorts of interactions that take place in the dominant regime. Remeker and De Groote Voort are uniquely organised in how the land and cows are treated. Because of this unique organisation, the Remeker cheese also has a unique flavour. In addition to the unique organisation Remeker has developed some unique technology around the natural rind, which also contributes to the unique flavour of Remeker. With the unique flavour and organisation of Remeker, Remeker is able to address specific and different markets. Remeker sells their cheeses now mostly to customers interested in speciality products with a unique taste and unique story (J.D. van de Voort, personal

communication, June 27, 2016). Overall, Remeker differs from the regime on all the aspects of organisation, technology, regulations and the markets.

5.2.1 Technical specifications of the innovations

This section discusses the technical background information of the innovations on which Remeker is based. Only the characteristic innovations of the Remeker cheeses are discussed and not the characteristics and innovations of the farm De Groote Voort, since the focus of the current research is only on niche developments in dairy processing and not in dairy farming. It is discussed how the composition of Jersey's milk differs from the milk of the cow breeds generally used and how the Jersey's milk contributes to the speciality of the Remeker cheese. Subsequently, the natural rind of the Remeker is discussed and how this natural rind of ghee contributes to the speciality of the Remeker cheese.

Composition of Jersey's milk

The general composition of cow milk is already discussed and it is mentioned that the exact composition of milk depends also on the breed of the cow. The Jersey cow generally produces different amounts of milk and the milk also has a different composition than other dairy cow breeds. In a study by Coffey et al. (2016) the milk yield was the lowest for the Jersey cows in comparison with Holstein and Friesian cows. However, Kristensen et al. (2015) concluded in their study that the Jersey cow has a high efficiency in comparison with Holstein-Friesian and other dairy breeds and crossbreeds, meaning that the Jersey cow produces relatively high amounts of milk components for the amount of feed it consumes. The fat and protein concentration is highest for Jersey cows (9.4%) in comparison with Holstein (7.8%) and Friesian (7.9%) cows (Coffey et al., 2016). Also Auldist et al. (2004) measured higher concentrations of most milk components, "including protein, casein and fat", for Jersey milk in comparison with Friesian cows. Furthermore, there are differences in the fat composition of Jersey milk, Jersey cows produce milk with higher contents of short-chain fatty acids and more saturated fatty acids in comparison with Holstein-Friesian, Meuse-Rhine-Yssel, Dutch Friesian and Groningen White Headed cows (Maurice-Van Eijndhoven, Bovenhuis, Soyeurt, & Calus, 2013). These differences also result in differences during the cheese making process as explained by Auldist et al. (2004); "Jersey milk coagulated faster and formed firmer curd than Friesian milk". Overall, these aspects and differences in the composition of Jersey's milk make it very suitable for producing the speciality cheese products of Remeker.

Natural rind of ghee

Ghee is the Indian version of clarified butterfat and is mostly produced from cow milk. Traditionally, ghee was produced by heating butter or cream over an open fire until the water had boiled off and was mostly used for cooking and frying (Mortensen, 2016). Ghee approximately consists of 99% fat, 0.3% protein and 0.3% water (Kwak, Ganesan, & Mijan, 2013). In the Netherlands, ghee is also known as butter oil (Ten Have, 2011). Remeker uses self-produced ghee to provide the cheeses with a natural rind instead of the generally used plastic coatings (Remeker, 2016d; Ten Have, 2011). This not only provides the Remeker cheeses with a natural and edible rind, the ghee also contributes to the flavour of the cheese by migrating slightly into the cheese (Hettinga, 2015; Ten Have, 2011). In Remeker cheeses with the natural rind of ghee even odour components have been detected that are normally present in blue cheeses (Hettinga, 2016).

5.3 Statuses of Muufri and Remeker

This section discusses the mechanisms of niche development and the niche statuses of Muufri and Remeker. The first mechanism of niche development is willingness or the convergence of expectations, the second mechanism of niche development is power or networking with relevant actors and the third mechanism of niche development is knowledge or learning and experimentation (Hermans et al., 2013; Lopolito et al., 2011). First, the mechanisms of niche development and the niche status of Muufri are discussed in Section 5.3.1 and subsequently of Remeker in Section 5.3.2. Section 5.3.3 discusses some reflection on the theory of the mechanisms of niche development.

5.3.1 Status of Muufri

This section discusses the status of Muufri by explaining the three different mechanisms of niche development for Muufri.

Willingness

Muufri was founded in the spring of 2014 with the specific motivation to enter into a competition of a biotechnology accelerator. The price of the competition included funding and laboratory space in Ireland for the summer. The founders had to prepare a specific plan and presentation for the competition, which forced the founders to discuss their different visions, strategies and expectations for Muufri early on and extensively (Datar, 2015).

Power

Isha Datar already used her personal network and connections to bring Ryan Pandya and Perumal Gandhi into contact after she was informed about the biotechnology accelerator's competition. After winning the competition Muufri benefited from the network of the biotechnology accelerator and from the publicity that Muufri received for winning the competition. The biotechnology accelerator provided Muufri with the first funding and laboratory space. During the summer that Muufri worked on the artificial milk in Ireland, Muufri was contacted by a disruptive investment group, which after some negotiations provided Muufri with big funding. After moving the project to San Francisco and receiving the funding, Muufri also started to expand their team (Datar, 2015).

Knowledge

Quickly after the start Muufri, the competition was won and laboratory space was part of the price of the biotechnology accelerator's competition. Therefore, Muufri could move quickly into the actual learning and experimentation phase. After Muufri spend the summer in Ireland, Muufri moved to San Francisco where they continued to work on the milk product and still do. Since Muufri plans to launch their product by the end of 2017, this indicates that Muufri is still in the middle of learning, experimentation and product development (R. Pandya, personal communication, May 13 2016; Datar, 2015).

Niche status

The status of Muufri according to the theory on the stages of niche development is "full", since all three mechanisms of niche development are currently present for Muufri. However, it has to be noticed that Muufri has yet to launch their actual product. The fact that the product of Muufri is not

yet on the market could influence the assessment of the potential impact of Muufri. It might be more difficult to assess the potential impact of Muufri, because the specific characteristics of the actual product are not yet fully known.

5.3.2 Status of Remeker

This section discusses the status of Remeker by explaining the three different mechanisms of niche development for Remeker.

Willingness

Remeker is founded and developed by the Van de Voort family. Only a small group of people was involved in the development of the Remeker cheese production, since the family initiated Remeker. Only the ideas and expectations of a small group of people needed to be converged. Furthermore, this small group of people was a group who already knew each other well since they are a family. Later on, more people became involved in the farming practices and the cheese production (Remeker, 2016f).

Power

The farm De Groote Voort already existed for many years before the Remeker cheese production was introduced (Remeker, 2016a). Therefore, Remeker already had access to many resources and knowledge when it was started. Knowledge on dairy farming was present, as well as resources such as the cows for milk and a location to experiment with cheese production. The access to knowledge and resources has provided Remeker with a different starting position in the development of their product. However, De Groote Voort and Remeker still make use of external knowledge and resources. They have for example made use of the knowledge of an independent feed advisor and Remeker works together closely with their cheese makers (Boxtel, 2011).

Knowledge

Although there was already a lot of knowledge present on the farm De Groote Voort, that had already been a dairy farm for years, there was also still a lot to learn. Many developments have taken place on the farm, first the introduction to Jersey cows, then the conversion to organic farming and subsequently the developments of quitting the use of antibiotics, remaining the horns of the cows, using different feed for the cows and many more developments. Also the Remeker cheese production has known many developments, first the development of the Remeker cheese, then the development of the natural rind and subsequently the construction of the special warehouse. All these developments have been accompanied with experimentation and learning processes. The Remeker still continuous to develop, innovate, experiment and learn.

Niche status

The Remeker is a niche that is in development for already more than twenty years. All three mechanisms of niche development are present for Remeker, which means the status of Remeker is 'full' according to the theory on the stages of niche development. Furthermore, the cheese products of Remeker are also fully developed and already on the market for many years. Even though the niche already has been in development for many years, there are several very recent developments that have further differentiated the practices of Remeker from the dominant regime of the Dutch

dairy sector. For example the natural rind is an innovation that was introduced only about five years ago and with which Remeker won the 'Ekoland Innovatieprijs' in 2011 (Boxtel, 2011).

5.3.3 Reflection on niche statuses

The statuses of both Muufri and Remeker are determined based on the three mechanisms of niche development. Both niche developments earn the status of full niches, since all three mechanisms of niche development were present for both Muufri and Remeker. However, despite the niche developments both being full niches, Muufri and Remeker are still very different. Muufri shows signs of all three mechanisms, but is still developing its product and has yet to launch the Muufri milk. Remeker has been producing cheese for years already and keeps innovating and developing further. However, the theory on the stages of niche development does not differ between the statuses of Muufri and Remeker. It seems strange that aspects such as the lifetime of a developing niche or the fact whether or not the niche has an actual product launched are not taken into account for the niche status.

Once a niche development has reached the status of a full niche, the theory on the stages of niche development no longer makes a difference between niche developments. However, the cases of Muufri and Remeker, which are both full niche developments, suggest that it could be helpful to further distinguish the status of niche developments. When the status of niche developments are further distinguished, a better assessment can be made of the potential impacts of niche developments since also more is known on the niche developments and their status. An idea could be to further distinguish the status of the full niche developments by the 'maturity' of the niche developments.

The path dependency analysis in Chapter 4 has shown the importance of the interrelatedness of the organisation, technology, regulations and markets of the regime. As part of Section 5.1 and Section 5.2 the same four aspects of organisation, technology, regulations and markets are discussed for Muufri and Remeker respectively. The cases of Muufri and Remeker show that there can be a significant difference in the development and interactions of the four aspects of organisation, technology, regulations and markets between niche developments. Perhaps the four aspects can be used to determine the maturity of niche developments once the niche developments have reached a full status according to the mechanisms of niche developments. The longer the lifetime of a niche development, the more interactions will have taken place between the four aspects of organisation, technology, regulations and markets. Thus, the lifetime of the niche development will be accounted for in case the maturity of a niche development is determined by assessing the four aspects and the interactions of the four aspects.

The maturity of a niche development could also be an indication of the stability of a niche development. The case of the sustainability issues of the dominant regime has shown that the strong interrelatedness of the four aspects of organisation, technology, regulations and markets have stabilised the dominant regime. The extent to which the organisation, technology, regulations and markets of a niche developments have interacted and are interrelated, could be a indication of the stability of the niche development. Muufri is a "young" niche development with few interactions between its organisation, technology, regulations and markets. Remeker is a more mature niche development where interrelatedness between its organisation, technology, regulations and markets

can be determined. Perhaps Muufri currently is a less stable niche development than Remeker. Further research into the possibilities to differentiate among full niches would be needed to determine whether the four aspects of organisation, technology regulations and markets are good indicators of the stability of a niche development.

5.4 Conclusion

In the above sections, the results of the second research question are presented. The second research question focuses on the potentially radical niche developments that address the sustainability issues of the dominant regime. The novel ways of dairy processing on which Muufri and Remeker are based are discussed and the sustainability issues of the dominant regime to which Muufri and Remeker provide potential solutions. Furthermore, the statuses of Muufri and Remeker were determined with the use of theory on the stages of niche development. This final concluding section of the chapter presents some concluding remarks on Muufri, Remeker and their status.

Muufri and Remeker are selected for the current research because they both fit the specific criteria of being potentially radical niche developments and providing solutions to the sustainability issues of the dominant regime. The solutions that Muufri and Remeker present to the sustainability issues are discussed as part of Section 5.1 and 5.2 respectively. However, it is not yet discussed why we assess Muufri and Remeker as being potentially radical niche developments and to what extent we consider Muufri and Remeker to be radical. As explained, we consider a niche development to be radical when the novel ways of dairy processing of the niche development have the potential to significantly challenge and change the current organisation of the sociotechnical regime. Both Muufri and Remeker are considered to be potentially radical according to the previous definition, but for very different reasons.

Muufri is working on a milk product produced by genetically modified yeast, which could result in the cow being superfluous. In case Muufri would be successful, cow milk can be replaced by Muufri milk, which could result in the end of dairy farms. The end of dairy farms could significantly change the current organisation of the dominant regime. Therefore, Muufri is considered a potentially radical niche development in the current research.

Remeker is successfully producing speciality cheeses. Furthermore, Remeker presents a possibility of organising the dairy sector completely different than the current dominant regime. The dominant regime is focused on industry, efficiency and scale, while Remeker is focused on local, speciality and small scale. Remeker is an opposite movement to the dominant regime and therefore has the potential to significantly challenge the dominant regime. Overall, Remeker is also considered a potentially radical niche development in the current research.

Muufri and Remeker are both potentially radical niche developments that provide solutions to sustainability issues of the dominant regime, but they are very different and based on very different principles. Both Muufri and Remeker can also be considered representatives for similar niche developments in dairy processing. Muufri can be considered to be a representative for niche developments based on very novel and innovative science and technologies. Remeker can be considered to be a representative for niche developments based on principles of terroir.

6. The impact assessment of Muufri & Remeker

This chapter discusses the results of the third research question, which focuses on the impact assessment of the potentially radical niche developments on the dominant sociotechnical regime of the Dutch dairy sector. It is discussed how Muufri and Remeker can potentially challenge the current dominant regime and the impact that that could have on the stakeholders involved in the dairy sector. The past has shown that radical changes can begin within niche developments where networks of pioneering organisations, technologies and users evolve (Smith, 2007). Also smaller interactions that might not directly start a complete regime transition are of interest in this chapter.

The third research question and this chapter are focused specifically on the potential future impacts of Muufri and Remeker. However, there is a past interaction between the niche developments and the dominant regime that is important to keep in mind during the analysis. Namely, that the selected niche developments are specifically founded as an opposite movement to the dominant regime. The foundation of the niche developments specifically as an opposite movement to the regime presents the very first interaction between the niche and the dominant regime (Smith, 2007). Despite the niche development's intentions to be an opposite movement, still the novel ways of dairy processing of the niche developments are the result of interactions within the sociotechnical system. Even an opposing niche development is still influenced by the sociotechnical system. Simultaneously, difficulties arise when a niche development is created in opposite of the regime. The influence a niche development can have on the dominant regime is also dependent on the compatibility of the niche with the regime. So while a niche development could be created as an opposite movement to the regime, it might need some common ground with the regime to be able to grow and impact the regime (Ingram et al., 2015; Smith, 2007).

The methods used for the third research question include a desk study, a focus group and a personal conversation. Before the discussion of the impact assessments of Muufri and Remeker, Section 6.1 discusses some general findings of the focus group. Subsequently, the impact assessments of Muufri and Remeker are discussed in Section 6.2 and Section 6.3 respectively. Section 6.4 presents a reflection on the methods and results of specifically the third research question. Concluding remarks on the third research question are discussed in Section 6.5.

6.1 Findings of the focus group

The results of the focus group discussion contribute to the impact assessments of Muufri and Remeker. Since the theoretical concepts on potential future niche-regime interactions are limited, the focus group discussion contributes greatly to the results of the third research question. As already discussed in Section 3.3, some of the participants of the focus group are themselves involved with niche developments in the dairy sector. The personal experiences of the participants with niche developments have also contributed to the focus group discussion.

The focus group started with a discussion on niche developments in general. Subsequently, the potential impacts of Muufri and Remeker on the dominant regime were discussed. The results of the discussion on niche developments in general are presented in the following section. The discussion

on the potential impact of Muufri is presented as part of Section 6.2 and the focus group discussion on the potential impact of Remeker is discussed as part of Section 6.3.

6.1.1 Characteristics of impactful niche developments

The current research uses theory on mechanisms of niche developments borrowed from the area of Strategic Niche Management to analyse the current status of Muufri and Remeker. The theory on the mechanisms of niche development emphasise the importance of the mechanisms of willingness, power and knowledge (Hermans et al., 2013; Lopolito et al., 2011). The focus group was asked to discuss the characteristics they believe a niche development needs to be able to impact the dominant regime. The focus group agreed on several important characteristics for a niche development to be potentially impactful.

The first characteristic of a potential impactful niche development that was mentioned by the focus group was the characteristic of a niche having a societal stimulus. The focus group discussed that a niche development with a societal impact might show society a different view on the practices of the dominant regime. When a niche development provides society with such a different view, it is possible that a small niche development is still very impactful according to the focus group.

The second characteristic of a potential impactful niche development that was mentioned by the focus group was the characteristic of the practices or principles of the niche development being scalable. It could contribute to the potential impact of a niche development when the niche development has certain practices or principles that could be scalable to the regime level according to the focus group. An important characteristic related to the scalability of the niche development is the economic threat that the niche development could be for the dominant regime. The focus group discussed that a niche development has the potential to be impactful in case the niche development has real economic potential.

The third characteristic of a potential impactful niche development that was mentioned by the focus group was the characteristic of the products, practices or principles of the niche development being very different than the dominant regime. When the niche development is able to provide customers with a so-called unique selling point, the focus group considers the niche development to be potentially more impactful. The unique selling point of a niche development could, for example, be a completely new and different view on a current product or process of the dominant regime.

The discussion of the characteristics of impactful niche developments by the focus group gave the participants the chance to get familiar with the subject of the current research. The important characteristics discussed by the focus groups are also considered when the impact assessments of Muufri and Remeker are performed.

6.2 Impact assessment of Muufri

This section discusses the results of the impact assessment of Muufri for the coming five to fifteen years. Section 6.2.1 discusses the results of the focus group discussion and Section 6.2.2 discusses the results of the desk study. Finally, a synthesis of the results is presented in Section 6.2.3.

6.2.1 Results focus group discussion

This section first discusses the extreme successful scenario of the impact of Muufri, which would result in Muufri being the dominant regime of the Dutch dairy sector. Secondly, the realistic impact assessment of the focus group of Muufri is discussed. The advantages and disadvantages of Muufri mentioned by the focus group are incorporated in the two scenarios where this is relevant.

Muufri as the regime

When the focus group was asked to think of a scenario in which Muufri would be extremely successful, the focus group imagined that Muufri milk would become part of a new regime. They imagined that in this scenario of Muufri being the regime, milk produced by Muufri would be used as a resource to produce the gross of the dairy products. Especially some of the processed dairy products, such as cheap cheeses and fruity yoghurts, were considered very suitable to be produced by Muufri milk since the consumer might not taste the difference. Furthermore, Muufri would be able to address the health concerns of the dairy products produced from cow milk and when this is done well Muufri could succeed in promoting itself as a more healthy product than cow milk. In this scenario, where Muufri would be the regime and the milk of Muufri would be the primary resource for the gross of the products, cow milk would play a completely different role than it does in the current regime. Cow milk could become a speciality or high quality product in this scenario according to the focus group. When Muufri would become the regime, cow milk could become a niche. When cow milk would become a niche development, this could mean the end of big industrial dairy farms. The dairy farmers that are able to adjust to Muufri becoming the regime by making speciality products and good quality milk, by becoming a niche, would survive this regime change. The dairy farmers that are not able to adjust, that are not able to produce a speciality product, might not survive this regime change according to the focus group. The advantages of the scenario of Muufri being part of the regime would be the lower environmental impact of Muufri milk in comparison with cow milk. A disadvantage of this scenario according to the focus group is the possibility that Muufri would have an artificial or unnatural image.

Impact assessment of Muufri

The focus group was also asked to make a more realistic impact assessment of the potential impact of Muufri in the coming five to fifteen years. The participants of the focus group do not expect as many changes as when they imagined Muufri becoming the new regime. The focus group foresees that Muufri will most likely start a debate, a debate on the origins of our food and on the legal consequences of the development of the sorts of technologies that Muufri is based on. The focus group expects that it would take more time for Muufri to have a similar impact as the scenario when Muufri would be the regime, more likely this would take several decades instead of just one decade. However, the introduction of Muufri and the debates it might start could already have an impact on the current regime. According to the participants of the focus group the introduction of Muufri might slowly lower the societal resistance for more artificially produced food while at the same the time the dairy farmers and the dairy industry of the dominant regime might try to resist these changes in the production of dairy foods. The current niche developments in dairy farming could actually benefit from these developments with their high quality and speciality products. The focus group thinks that dairy companies of the regime would be open to replacing cow milk with Muufri milk, since the stream of Muufri milk might be more stable and more controllable. Especially when Muufri milk

would be cheaper than cow milk, the focus group imagines the dairy companies being very interested in the possibilities Muufri milk could present in the future. However, one of the disadvantages mentioned in the focus group might also hinder the growth of Muufri, the idea that Muufri milk is just not natural and therefore inferior to cow milk. Events that could contribute to the growth of Muufri could be when scandals or issues develop in the agriculture and animal-farming sector and consumers start to distrust these sorts of products because of these scandals or issues. However, in this case, Muufri would still need to compete with vegetable based dairy drinks which might also benefit from scandals or issues in animal farming.

6.2.2 Results desk study

The results of the desk study based on the theories presented in the analytical framework of Chapter 2 are presented here. Next to the results of the focus group discussion, the results of the desk study contribute to the overall assessment of the potential impact of Muufri. The results of the first and second research question are used as information sources for the desk study, as well as occasionally the focus group discussion.

Niche-regime compatibility

Niche developments based on completely different practices or principles than the dominant regime might be able to make more impact, but diffusion can be difficult for these niche developments because of the many structural changes they demand (Smith, 2007). This section discusses the niche-regime compatibility of Muufri and the dominant regime to determine how much the practices and principles of Muufri differ from the dominant regime. The compatibility of Muufri and the dominant regime could be an indication of the potential impact of Muufri. To systematically discuss the different aspects of Muufri and the compatibility of the aspect with the dominant regime, the aspects that the multi-level perspective attributed to the regime are used. In Figure 1 the different aspects of the regime are presented, which are industry, science, policy, culture, technology and markets or user preferences.

The first aspect of a regime is the industry. Muufri could fit in the industrial networks of the current dominant regime of the dairy sector except for the dairy farmers. When the scenario of the focus group is considered, Muufri could join the companies of the dominant regime and supply Muufri milk as a resource to the dairy companies of the current regime. In this scenario, Muufri would replace the dairy farmers. In a less extreme scenario, where Muufri would not replace the dairy farmers, Muufri still does not have a different industry structure than the dominant regime.

The second aspect of a regime is the science. The science needed to genetically modify yeast that Muufri uses is not new. However, the science of Muufri is not similar to the science currently used by the dominant regime. The dominant regime does not evolve around the same science that Muufri evolves around. Therefore, the science of Muufri is not compatible with the science of the dominant regime.

The third aspect of a regime is the policy. The current policies of the dominant regime are not focused on the sorts of practices and principles that Muufri is based on. It might be necessary to introduce complete new regulations once Muufri has their product on the market. Therefore, the policy of the dominant regime is not compatible with Muufri.

The fourth aspect of a regime is the culture. Currently, the dominant regime and society are used to the idea that cows produce the milk of which dairy products are produced. Muufri completely challenges this idea with their product. Therefore, there is no compatibility between the culture of the dominant regime and Muufri.

The fifth aspect of a regime is the technology. The technology of the dominant regime to produce milk clearly differs from the technology used by Muufri to produce milk. However, the technology to produce other dairy products from the milk might not have to differ between Muufri and the dominant regime. In case Muufri succeeds in producing milk that is molecular identical to cow milk, it might be possible to use the technology of the dominant regime to produce other dairy products from Muufri milk. Therefore, the technology of Muufri and the dominant regime have the potential to be compatible.

The sixth and last aspect of a regime is the markets or use preferences. Muufri is able to address the vegan consumers while the dominant regime is not. However, the vegan market might be a small market. When the scenario of the focus group is considered, it could be that Muufri eventually could reach the same markets as the dominant regime by producing similar dairy products.

Overall, it seems that the industry, technology and markets of Muufri can be compatible with the dominant regime, while the science, policy and culture are not compatible. Table 3 presents an overview of the results of the analysis of the compatibility of Muufri and the dominant regime.

Table 3: Compatibility of Muufri with the regime of the Dutch dairy industry on the different aspects of a sociotechnical regime according to the multi-level perspective (Geels & Schot, 2007).

Aspects	Compatibility	Explanation
Industry	+	No difference in industry structure, except for the dairy farmers
Science	-	Different scientific focus needed
Policy	-	Current regulations are not sufficient
Culture	-	New idea of the origins of milk
Technology	+	Potentially similar technology for producing dairy products
Markets	+	Eventually similar markets could be addressed

Sociotechnical translations

As discussed, Smith (2007) identifies three different sociotechnical translations processes by the analysis of different case studies. This section explores whether these sorts of translations processes between Muufri and the dominant regime have taken place in the past or could take place in the future.

Muufri has been established because of the sustainability issues related to dairy farming in the dominant regime. The founders want to produce animal-free milk specifically because of the problems the large amounts of cows in the dairy sector present for the environment. Therefore the first translation process of translating sustainability problems applies to Muufri, since the problems in the regime have informed the guiding principles in the creation of Muufri. Furthermore, when the extreme scenario of the focus group is considered, it seems that mostly “translations that adapt lessons” would apply to the scenario. The focus group expects that in case Muufri would be part of

the dominant regime that the regime would consist of sociotechnical practices that originate from Muufri. However, when a more realistic scenario is considered, as also discussed by the focus group, then it could also be that the dominant regime would be inspired by Muufri and would develop similar projects. In case the dominant regime would develop similar projects inspired by Muufri or maybe even together with Muufri or similar players, a translation that alters contexts would apply to the situation.

6.2.3 A synthesis of the potential impact of Muufri

During the focus group discussion of Muufri, the participants of the focus group also compared the practices and plans of Muufri with the developments evolving margarine. Similar to the milk of Muufri, margarine was initially developed as a substitute product for a dairy product, namely butter. It took several decades before the consumption of margarine was generally accepted; a lot of debate and new regulations preceded the general consumption of margarine. The focus group expects that Muufri might await a similar path when their product is introduced to the (Dutch) market. This would mean that the impact of Muufri in the coming five to fifteen years mostly entails the start of debates and potentially the introduction of new regulations. When the case of margarine is considered, it could be that it would take several decades for Muufri to become a generally accepted product.

Combining the results of the focus group, the desk study and the comparison of Muufri with margarine provides the overall impact assessment of Muufri. It seems most likely that the potential impact of Muufri will be the start of a debate. Muufri has yet to launch their actual product, but the concept of milk produced without a cow is already present. The debate on Muufri could therefore already have started or the debate might start simultaneously with the launch of their product (in the Netherlands). The debate might also inspire the dominant regime to get involved with Muufri or similar projects. Since Muufri is quite compatible to the dominant regime, there is a possibility for Muufri to develop further in collaboration with the dominant regime. When Muufri develops further with the dominant regime, there are also possibilities of more sociotechnical translations taking place. However, whether or not Muufri will develop further in collaboration with the dominant regime, the result for dairy farmers is similar. When Muufri or similar projects would be successful, this makes the dairy farmers of the dominant regime superfluous.

The realistic impact of Muufri includes the start of a debate and the extreme scenario of Muufri includes the replacement of dairy farms. Both scenarios have a strong societal impact, which explains why Muufri is considered a potentially radical niche. Muufri might also be considered a representative niche development for niche developments based on technologies novel to society. In that case, the impact assessment of Muufri can also be representative for similar niche developments. Perhaps niche developments based on technologies novel to society always have the potential to start a debate on the origins of our food.

6.3 Impact assessment of Remeker

This section discusses the results of the impact assessment of Remeker for the coming five to fifteen years. Section 6.3.1 discusses the results of the focus group discussion, Section 6.3.2 the results of the personal conversation with Jan Dirk van de Voort and Section 6.3.3 discusses the results of the desk study. Finally, a synthesis of the results is presented in Section 6.3.4.

6.3.1 Results focus group discussion

This section first discusses the extreme successful scenario of the impact of Remeker, which would result in Remeker being the dominant regime of the Dutch dairy sector. Secondly, the realistic impact assessment of the focus group of Remeker is discussed. The advantages and disadvantages of Remeker mentioned by the focus group are incorporated in the two scenarios where this is relevant.

Remeker as the regime

First the focus group was asked to discuss a scenario in which Remeker would be extremely successful. The focus group imagined a scenario in which not only Remeker, but a multitude of niche developments in dairy processing would together form the regime. In this scenario the regime of the Dutch dairy sector would be extremely diverse, with each village or region having its own niche dairy farm producing speciality or high quality products. So when Remeker would be extremely successful, the focus group does not imagine all cheese to be produced according to the Remeker practices or by Remeker; the focus group imagines Remeker being one of the many niche developments of which the new regime would consist. The different small-scale dairy farms that together would form the regime could work together to share knowledge on their specific practices and experiences. In a way, the regime would resemble a situation of the past where dairy products are produced per region instead of nationally, although the current knowledge on dairy processing and the shared experiences enable the dairy farms to produce more unique and high quality products. This scenario of many niches forming the regime could be beneficial for farmers with the drive and the craftsmanship to form their own niche development. Less innovative farmers that are less involved with the final dairy products their milk is used to produce might not be able to adjust to the new regime of extreme diversity by forming their own niche. The focus group considers the practices of Remeker to be beneficial for the environment, so they imagine that a regime with a multitude of niche developments might also be beneficial. It could be difficult to upscale the specific practices of Remeker, but in this scenario, this might also not be necessary.

Impact assessment of Remeker

When the focus group was asked to discuss a more realistic impact of Remeker in the coming five to fifteen years, the focus group still imagines that not only Remeker would have an impact but they consider the impact multiple niche developments similar to Remeker could have together on the regime. A realistic scenario according to the focus group could be that dairy processing companies of the dominant regime give dairy farmers the opportunity to develop their own niche and their own speciality products. The dairy processing industry would do this because it could be beneficial for their cooperative farmers and in case the products would be a success, the dairy processing companies could also learn and profit from these successes. But the focus group acknowledges that this scenario might still be a bit optimistic and that both regulations and the mind-set of the dairy processing companies should and need to change before this could become a reality. Events that could contribute to dairy processing companies supporting their dairy farmers to engage in niche like activities would be a continuing of the low milk prices and when farmers of the cooperatives would protest against the current practices of the regime. Something that could be a threat to this scenario is the continuity of the niche developments on the long term in case the niches evolve mostly around one person specifically or around the ideas and input of one person specifically. In case that person would not have the right succession that could mean the end of a successful niche development.

6.3.2 Results personal conversation

To be able to analyse the views of Remeker itself on the potential impact of Remeker, Jan Dirk van de Voort was interviewed. This section discusses the results of this conversation and thus the view of Jan Dirk van der Voort on the potential impact of Remeker on the regime of the Dutch dairy sector. Jan Dirk was not informed of the results of the focus group discussion, but nevertheless, his views on the potential impact of Remeker are quite similar to the potential impact as suggested by the focus group. Jan Dirk expects that the impact of Remeker could result in to more dairy farmers producing speciality products themselves of their own milk. The dairy cooperatives or factories could be part of this process by stimulating and helping farmers with producing their own dairy products. Jan Dirk foresees many opportunities for farmers to develop their own niche differing from the dominant regime on for example their farming practices, the breed of cows, the sorts of products they produce and the quality of these products. The dairy cooperatives or factories could benefit also by taking part in the process of dairy farmers producing more speciality products. By taking part the dairy cooperatives or factories can offer consumers new sorts of products with a different story. Furthermore, these sorts of products can address the market of consumers that appreciate and favour speciality products with extraordinary tastes. The consumers of this speciality products market segment are willing to pay extra for products with such a unique taste according to Jan Dirk, which would contribute to solving the economic sustainability issues of the dairy sector in the Netherlands.

Overall, Jan Dirk considers the current impact of Remeker to be limited. However, Remeker will continue to show their specific practices and insights to anyone who is interested and by doing this Remeker hopes to inspire others and other dairy farmers specifically. With the continuation of their openness, Jan Dirk expects that Remeker could have a greater impact in the future than it has had so far. Jan Dirk hopes that in the coming years Remeker will be able to further develop and specify their focus and practices, that Remeker will be able to provide answers to the current problems of the regime even more clearly (J.D. van de Voort, personal communication, June 27, 2016).

6.3.3 Results desk study

The results of the desk study based on the theories presented in the analytical framework of Chapter 2 are presented here. Next to the results of the focus group discussion and the personal conversation, the results of the desk study contribute to the overall assessment of the potential impact of Remeker. The results of the first and second research question are used as sources of information for the desk study, as well as occasionally the focus group discussion and the personal conversation.

Niche-regime compatibility

Also for Remeker the compatibility with the dominant regime is analysed, for which the different aspects of the regime as presented by the multi-level perspective in Figure 1 are used. The different aspects of which Remeker's compatibility to the dominant regime is discussed are industry, science, policy, culture, technology and markets or user preferences.

The first aspect of a regime is the industry. As discussed, Remeker presents an opposite movement to the industry of the dominant regime. In case Remeker together with similar niche developments

would replace the regime, this would mean the end of the dairy industry. Because Remeker is such an opposite movement to the industry of the dominant regime, there is no compatibility between Remeker and the dominant regime on the aspect of industry.

The second aspect of a regime is the science. Remeker is based on different practices and principles than the dominant regime is. The science of the dominant regime is focused on efficiency and remaining a constant quality, while in case of Remeker research is more focused on diversity, taste and terroir. Therefore, the science of Remeker is not compatible with the science of the dominant regime.

The third aspect of a regime is the policy. Although the policy of the dominant regime is currently no obstacle for niche developments of speciality products to form, in case the dominant regime would consist of a diversity network of dairy products policy could become an issue. To produce speciality, high quality and highly tasteful dairy products the farmer might wish to process the milk raw. Currently, there are laws in place to regulate the sales of raw milk, which might not be compatible with a scenario of the dominant regime being a highly diverse network of niche dairy farmers (Groot, 2016). The current policies of the dominant regime are not sufficient for niche developments such as Remeker and therefore there is no compatibility on the aspect of policy.

The fourth aspect of a regime is the culture. The culture of Remeker evolves around principles of terroir, diversity, local and small scale. The dominant regime evolves around very different principles, which are not compatible with the culture of Remeker.

The fifth aspect of a regime is the technology. Remeker currently uses similar technologies to produce its dairy products as the technologies of the dominant regime, albeit on a smaller scale. The aspect of technology is an aspect on which Remeker and the dominant regime are compatible.

The sixth and last aspect of a regime is the markets or user preferences. Remeker addresses the market of speciality products specifically, while the dominant regime addresses a much broader range of markets and consumers. Because Remeker and the dominant regime address very different markets and fulfil very different user preferences, the markets of Remeker and the dominant regime are not compatible.

Overall, it seems that the technology of Remeker can be compatible to the dominant regime, while the industry, science, policy, culture and markets are not compatible. An overview of the results of the compatibility of Remeker and the dominant regime of the Dutch dairy industry is presented in Table 4.

Table 4: Compatibility of Remeker with the regime of the Dutch dairy industry on the different aspects of a sociotechnical regime according to the multi-level perspective (Geels & Schot, 2007).

Aspects	Compatibility	Explanation
Industry	-	No industry would exist
Science	-	Focus would be needed on different scientific areas
Policy	-	Current regulations are not sufficient
Culture	-	Cultural change is needed focused on terroir
Technology	+	Similar technologies are used
Markets	-	Completely different markets are addressed

Sociotechnical translations

As discussed, Smith (2007) identifies three different sociotechnical translations processes by the analysis of different case studies. This section explores whether these sorts of translations processes between Remeker and the dominant regime have taken place in the past or could take place in the future.

The first translation process of "translating sustainability problems" did not take place as clearly for Remeker as it did for Muufri. Remeker was established because of the wish to produce cheese themselves at the farm and not per se as an opposite movement to the dominant regime or as an answer to the sustainability issues in the dominant regime. However, over time the focus of Remeker moved more towards addressing the problems in the dominant regime and showing the dominant regime that the problems could be handled and solved differently. Overtime more sustainability problems were translated to Remeker from the dominant regime. In case Remeker and other dairy farmers producing speciality products would form the new regime, it would be a case of translations that adapt lessons since the sociotechnical practices of Remeker and other similar niche developments would be inserted into regime settings.

6.3.4 A synthesis of the potential impact of Remeker

The developments of Remeker as a niche and the potential impact of Remeker could be compared to the developments that the beer industry in the Netherlands lived through. Similar to the dairy sector, the beer industry also reached a point in their history when only a few big players dominated the market. Slowly a phenomenon developed known as "microbreweries", which basically equals the concept of niche developments in the beer brewing industry. The first microbreweries were established in the early 1980s, but the amount of microbreweries started to rapidly expand since 2003 in the Netherlands. Currently, the beer market is very diverse, a lot of local, speciality or high-quality beers are on the market (Dijk, Kroezen, & Slob, 2016). The development of the microbreweries and the beer industry could be compared to the potential impact of Remeker on the dominant regime of the Dutch dairy sector. Possibly, Remeker together with other niche developments in the dairy sector will await a similar path as the microbreweries have gone through. However, it has to be mentioned that the beer sector is a different sector than the dairy sector. An important difference, for example, between the beer and dairy sector is the difference in resources needed; to brew beer, no farms and animals are needed for example.

For the beer industry, it took about 35 years from the first developments of the microbreweries to the current situation in which a diverse beer market has been established. Remeker has been established about 30 years ago, which means there is a possibility that the scenario discussed by the focus group might be slowly forming already. The current amount of other niches developments in the dairy sector could support the argument that the regime of a diverse network of speciality dairy products is already forming. The advocacy organisation of dairy farmers producing products themselves currently has over 200 members (Boerderijzuivel, 2016). It is possible that this organisation does not represent all dairy farmers who are producing dairy products themselves, meaning that the actual amount of niche developments in the dairy sector can be much greater. Of course, the development of a regime of a diverse network of speciality dairy products depends on more factors, also outside of the influence of both niche developments and the dominant regime.

The compatibility of Remeker with the dominant regime and the potential sociotechnical translations were very limited. For a diverse network of niche developments including Remeker to replace the dominant regime, a completely different organisation of the dairy sector would be needed. In a way, this organisation of the dairy sector would resemble a situation of the past when there were many dairy factories and dairy processing was organised locally. However, in opposite to the situation in the past, it is now possible to exchange knowledge between the niche developments and for the niche developments to potentially market their products together and nationwide. That would make this diverse network of speciality products a complete different regime than in the past. This new organisation of the dairy sector has the most potential at a national level and is less suitable for the international market. There could be a role for the current dominant regime within this new organisation of the dairy sector by serving the international market specifically, which could result in the existence of multiple regimes next to each other.

Overall, the impact of Remeker is considered together with niche developments based on similar practices and principles. Remeker is not just a representative niche development for other individual niche developments; Remeker can be considered a representative for a group or network of similar niche developments. Perhaps niche developments based on ideas of local and small-scale production are always only able to change the dominant regime as a group or in collaboration. In case Remeker and similar niche developments would be very successful together, this could result in the end of the dairy industry; a collective of niche developments would replace the dairy industry.

6.4 Reflection on the impact assessments

This section reflects on the results of the impact assessments of Muufri and Remeker by the focus group and by the desk study. Section 6.4.1 presents the reflections on the organisation and composition of the focus group and Section 6.4.2 presents the reflections analytical framework of the desk study. Finally, also some reflections are presented on the overall results of the potential impacts and the striking aspects of these results in Section 6.4.3.

6.4.1 Reflection on the focus group composition

An aspect of focus groups in general is that the composition of a focus group can influence “the dominant perspective being presented by the group” (Hyde, Howlett, Brady, & Drennan, 2005). This section reflects on the composition of the focus group used for the current research and the effect the composition might have had on the results of the impact assessments of Muufri and Remeker discussed by the focus group.

The focus group consisted of four participants in total, all with different backgrounds and occupations. As discussed already, some of the participants are involved in niche developments themselves or in other initiatives towards a more sustainable dairy sector. The involvement of participants in niche developments might have influenced the results of the focus group. Since the participants are themselves involved in niche developments or other initiatives, they are probably optimistic about the potential of these initiatives as well as that they are open for or supporting of changes in the dairy sector. Therefore, it could be that these participants also assessed the potential impacts of Muufri and Remeker on the dominant regime somewhat optimistically. It has to be taken into account that it is possible that the scenarios as discussed by the focus group might take longer to

develop or might never develop. The participants might have presented scenarios of which they hope will evolve in the future because of their personal involvement in similar initiatives.

Furthermore, the discussion of the characteristics of impactful niches by the focus group is compared to literature on Strategic Niche Management as presented as part of the analytical framework. It can be noticed that there is one aspect of niche developments that strategic niche management does not consider as important as the focus group considers it. The aspect of a niche being a societal stimulus, a niche needing to have societal impact, is a kind of aspect that has not come up as part of the mechanisms of niche developments. The fact that the focus group values this specific kind of aspect of niche developments and also considers it an important characteristic of impactful niche developments says something about the view (some of) the participants have on these sorts of subjects. Perhaps the participants value the societal impact of a niche development more than can be justified based on scientific research methods. It is possible that the participants have also overvalued the positive societal impact of Muufri and Remeker when discussing the potential impacts of Muufri and Remeker.

There is another aspect of the composition of the focus group, which might have influenced the results of the discussion. All participants are part of the dairy sector in the Netherlands. As discussed in Chapter 4, the dominant regime of the Dutch dairy sector is potentially in a state of lock-in. Therefore, it is a possibility that also the participants are influenced by or part of the lock-in of the dominant regime, which could influence the results. Perhaps the participants, similar to the dominant regime, are not as able to "think outside of the box" as they think. Perhaps there are potential impacts of Muufri and Remeker, which exceed the imagination of the participants. It should be taken into account that the views of the participants are also influenced by the current state of the dominant regime.

6.4.2 Reflection on the desk study

Next to the focus group, theoretical concepts on niche-regime compatibility and sociotechnical translations contributed to the assessment of the potential impact of Muufri and Remeker. This section reflects on the use, advantages and disadvantages of the theoretical concepts on niche-regime compatibility and sociotechnical translations.

Of both niche developments, the compatibility between the niche development and the dominant regime was assessed on the aspects of industry, science, policy, culture, technology and markets. Assessing the niche-regime compatibility on these different aspects offered useful insights into how much the niche developments and the dominant regime are currently or could potentially be compatible. When the niche-regime compatibility is low, more changes would be needed for the niche development to be integrated into or to influence the dominant regime (Ingram et al., 2015; Smith, 2007). Therefore, assessing the niche-regime compatibility was a useful contribution to assessing the potential impact of Muufri and Remeker. However, in case the niche development could or would replace the regime completely it is questionable whether the niche-regime compatibility is still as useful. The concepts on niche-regime compatibility might not be able to contribute to assessing the possibility of the niche development actually replacing the dominant regime. When a regime is replaced, this would require significant changes anyway whether the niche development is initially compatible to the regime or not. The aspect of to what extent niche-regime

compatibility still matters in case of a complete regime transition is not discussed as part of the concepts of niche-regime compatibility.

Also the concepts of sociotechnical translations were used as part of the impact assessment of Muufri and Remeker. Applying the concepts of sociotechnical translations to Muufri and Remeker provided insights into the sorts of interaction processes between the niche development and regime that have taken place so far and could potentially take place in the future. However, the concepts on sociotechnical translations did not contribute to assessing the amount of impact the niche developments could potentially have on the dominant regime. Also a very local or short-term translation between a niche development and a regime is considered to be a sociotechnical translation even though it might not have a substantial impact on the regime. Therefore, the concepts of sociotechnical translations in the current research only contribute by showing the kind of interactions that potentially can take place between the niche development and the dominant regime without significantly contributing to the final overall assessment of the potential impact of Muufri and Remeker.

6.4.3 Reflection on the potential impacts

Of both Muufri and Remeker an impact assessment was made using the focus group and the desk study, and in the case of Remeker also a personal conversation was used. The results of the impact assessments contain some surprising aspects, which are discussed in this section.

In both scenarios of Muufri and Remeker becoming part of or replacing the dominant regime this would be a disadvantage for the regime dairy farmers and an advantage for niche dairy farmers. Apparently, the participants of the focus group consider the average regime dairy farmer to lack the flexibility to be able to anticipate the changes the niche developments could introduce. The cause of this lack of flexibility could be the lock-in of previously made investments, the lack of a certain mind-set or skills, or a combination of these sorts of causes. The lack of flexibility, by which cause this may be, can also be ascribed to the path dependency and locked-in state of the dominant regime and its farmers as discussed in Chapter 4. However, it is overall striking that the focus group considers niche dairy farmers to have an advantage in both scenarios, while a niche development is more known to be less stable than the regime (Geels, 2004). This does show the benefits for dairy farmers to invest in developing their own niche, since it might be able to remain stable despite movements or developments at the regime level. Niches are eventually able to create their own path apart from the path dependent problems of the dominant regime.

Another striking aspect is the difference between the impact assessments of Muufri and Remeker compared to the reasoning with which the niche developments were founded. Muufri is specifically founded with the idea of being an opposite movement to the current regime of the (global) dairy industry. Remeker was founded for different reasons and only eventually presented itself specifically as an opposite movement to the dominant Dutch dairy sector. However, the niche development that is originally founded as an opposite movement, Muufri, has more chance of being part of the dominant regime according to the focus group and niche-regime compatibility analysis, than the niche that was not originally founded as an opposite movement, Remeker. The focus group considers it more likely for Remeker to inspire a regime transition than it does for Muufri, despite Muufri being

founded more specifically for that reason. Apparently, the reasoning for founding a niche development is not a good indicator for the sorts of potential impact of the niche development.

A striking aspect of the results of the potential impact of Remeker specifically is the resemblance between the potential impact scenario that the focus group discussed and the potential impact scenario discussed as part of the conversation with Jan Dirk van de Voort. Jan Dirk and the focus group were both not informed of the views of the other on the potential impact of Remeker. Still, both Jan Dirk and the focus group discussed a scenario in which more farmers would produce their own speciality dairy products. The specifics of the scenarios differed somewhat, but overall the same scenario was presented. An explanation for this phenomenon could be that the idea of such a new organisation of the dairy sector already lives among stakeholders of the dairy sector or other niche developments.

A striking aspect of the focus group discussion of the potential impact of Remeker is the small differences between the scenario of Remeker replacing the dominant regime and the more realistic impact assessment. During both discussions, the focus group discussed a similar scenario with only slightly different details or timelines. The discussions of Muufri's extreme and more realistic scenarios differed much more in comparison with the discussions of Remeker. It is possible that the impact of Muufri is more difficult to assess for the focus group because there is still much unknown about Muufri. Muufri has yet to launch their actual product, which left the participants guessing on the exact properties and possibilities of the product. Perhaps the focus group has a more clear idea of the potential impact of Remeker because the practices and product are more developed. Furthermore, also in this case, it could have played a role that the idea of organising the dairy sector according to the impact assessment of Remeker already lives among stakeholders of the dairy sector or other niche developments.

6.5 Conclusion

In the above sections, the results of the third research question are presented. The third research question focuses on how Muufri and Remeker can impact the dominant regime and what the impact of Muufri and Remeker could be on the sociotechnical system and stakeholders of the dairy sector. Both the results of the focus group discussion and the desk study on the third research question are discussed, analysed and reflected upon. The results for Muufri and Remeker are very different. Although Muufri is based on more radically different principles than Remeker, it is possible that Muufri might be more translated within the dominant regime because Muufri is more compatible than Remeker with the dominant regime. Muufri provides insights into how regime dairy farmers could be replaced, while Remeker provides insights into how the dairy industry could be replaced. The impacts of Muufri and Remeker could both potentially introduce radical changes to the dominant regime. However, these are extreme scenarios that might take at least several decades to develop if ever.

The potential impacts of Muufri and Remeker are very different and also impact very different stakeholders and aspects of the dominant regime. Because Muufri and Remeker impact different aspects of the dominant regime, there is also the possibility of the potential impacts to align. Different potential scenarios of Muufri and Remeker simultaneously impacting the dominant regime can be considered.

For example, it is possible that Muufri would provide the dominant regime with possibilities to focus even further on scale and efficiency by eliminating the need for regime dairy farmers. The regime dairy farmers would become superfluous for the dominant regime. The regime dairy farmers would then have the opportunity to develop their own niche development similar to Remeker. Eventually, two very different regimes could coexist; one regime with Muufri based on scale and efficiency without dairy farmers and one regime with Remeker based on terroir and speciality products without the dairy industry. The two regimes could address very different markets with their products. In this scenario, Muufri and Remeker would actually enhance each other's impacts and positively influence each other.

Another potential scenario could be thought of in which Muufri and Remeker would influence each other less positively. Muufri and Remeker are based on very different practices, but also on very different principles. Scenarios could be thought of in which either Muufri or Remeker would be very successful, while the other is not. It is possible that when either Muufri or Remeker is very successful without the other being successful, that the principles on which either Muufri or Remeker are based on are then generally accepted by society. However, Muufri and Remeker have very different, perhaps even opposite principles. It is therefore possible, that when society accepts the principles of either Muufri or Remeker that the principles of the other will not be generally accepted anymore. In this case, the success of either Muufri or Remeker could limit the success of the other. For example, it is possible that Remeker and similar niche developments replace the dominant regime before Muufri is able to establish itself. In that case, perhaps the principles of Remeker and similar niche developments are generally accepted. This could result in a big gap between the principles of the then dominant regime and Muufri, which could make it difficult for Muufri to develop.

Overall, a sociotechnical system is very broad with lots of movement. It is probably more likely that in a scenario of Muufri and Remeker both being successful that they exist alongside each other and also alongside the current dominant regime. Perhaps Muufri and Remeker eventually both grow into regime settings, but this does not have to result with certainty into the disappearance of the current dominant regime. Perhaps a situation will form in which multiple regime like movements exist.

7. Conclusions and discussion

The main research question of the current research investigates how potentially radical niche developments in dairy processing could impact the sociotechnical system of the Dutch dairy sector to become more sustainable. To be able to finally answer this main research question three research sub questions were formulated of which the results are presented in the previous chapters. First the potential lock-in of the dominant regime and its issues are analysed, subsequently two potentially radical niche developments are discussed and finally the potential impacts of the two specific niche developments on the dominant regime are analysed.

The analysis of the dominant regime shows the potential lock-in of the dairy sector based on two arguments: the difficulties of the dominant regime to overcome its sustainability issues and the entanglement of the four aspects of organisation, technology, regulations and markets of the dominant regime. Over the years the focus on efficiency and scale of the dominant regime and the financial investments made contributed to the lock-in of the dominant regime of the Dutch dairy sector.

Muufri and Remeker address some of the sustainability issues of the dominant regime and present potentially radical different ways of organising the regime. Muufri can be considered to be a representative for niche developments based on very novel and innovative science and technologies. Remeker can be considered to be a representative for niche developments based on principles of terroir.

Muufri and Remeker are very different niche developments based on very different practices and principles. The potential impacts of Muufri and Remeker, as assessed by the focus group, are also very different. Muufri is expected to mainly impact the dominant regime by causing a debate on the origins of our food. In case Muufri would be extremely successful it could replace the dairy farmers. Remeker could impact the dominant regime together with similar niche developments by replacing the dairy industry.

Overall, the three research sub questions have all been discussed in the previous chapters. The conclusion of the main research question is discussed in the following section, Section 7.1. Subsequently, the course of the research process is discussed. Section 7.2 and Section 7.3 present the discussions of respectively the analytical framework and the methods. Section 7.4 discusses the overall insights of the current research and finally Section 7.5 presents recommendations for further research.

7.1 Conclusion main research question

The main research question focuses on assessing the impacts of potentially radical niche developments in general on the sociotechnical system of the Dutch dairy sector and how this impact can contribute to the dominant regime becoming more sustainable. This section analyses the results of the potential impacts of Muufri and Remeker to assess the impact of potentially radical niche developments in the dairy sector in general.

The current research focuses specifically on potentially radical niche developments that address the sustainability issues of the dominant regime. These specific niche developments have in common that they show the dominant regime that it is possible to organise the regime differently and potentially more sustainable. The niche developments also show society that it is possible to organise the dairy sector differently and potentially more sustainable. Therefore, the existence of the niche developments challenges the dominant regime to address the sustainability issues that the niche developments make apparent. The existence of niche developments contributes to the pressure on the dominant regime next to the pressure of the landscape level. When the pressure on the dominant regime increases, this contributes to the potential impact of the niche developments on the regime. The specific impact of each niche development might differ, but potentially radical niche developments that address sustainability issues of the dominant regime have in common that they put pressure on the dominant regime to solve its sustainability issues. The niches provide working examples of possibilities to organise the regime differently, maybe even more sustainably on multiple aspects.

Next to the pressure that the niche developments can add on the dominant regime, niche developments add more to the sociotechnical system. Niche developments, in general, can also add diversity to the complete sociotechnical system of the dairy sector in the Netherlands. The existence of niche developments and all the learning and experimenting processes that take place within the niche can be beneficial to the sociotechnical system. In case, for example, the regime encounters difficulties or could potentially fail, than there is already knowledge within the sociotechnical system on potentially different and innovative ways of organising the sociotechnical system. The diversity that potentially radical niche developments add to the sociotechnical system is another advantage or potential impact of these niche developments.

7.2 Discussion of analytical framework

The theoretical concepts that are used during the current research are presented in the analytical framework and used throughout the research. Throughout the research, the concepts of sociotechnical systems and the levels presented by the multi-level perspective are used. Furthermore, the first research question focused mainly on the theories of path dependency, the second research question focused mainly on the mechanisms of niche development and the third research question focused mainly on theories on niche-regime compatibility and sociotechnical translations. This section discusses the use and some advantages and disadvantages of the theories.

Throughout the complete research, the concepts of a sociotechnical system and of the levels of the multi-level perspective are used. These concepts add structure throughout the research and have allowed for a clear distinction between movements based on scale. However, the concepts of sociotechnical systems and the multi-level perspective also have some shortcomings and disadvantages. The difficulty with the use of the concept of sociotechnical systems is the fact that it is such a broad concept with no clear boundaries. It is unclear where a specific sociotechnical system ends and where another sociotechnical system begins, which makes it difficult to analyse a sociotechnical system. The three levels of the multi-level perspective, the landscape, the regime and niches, add some clarity on which different movements occur within a sociotechnical system. However, the use of the concepts of the multi-level perspective and the corresponding figures, such as Figure 1, also have some difficulties. The multi-level perspective as depicted in Figure 1 does not

seem to acknowledge the possibility of the existence of multiple regime like movements next to each other. Furthermore, the multi-level perspective as depicted in Figure 1 seems to assume that each niche will eventually enter the regime level, as can be interpreted from all the arrows moving upward towards the regime level. The multi-level perspective as depicted in Figure 1 seems not to take into account the possibility of a niche developments remaining at a niche level.

The theories on path dependency were applied to the sustainability issues and to the complete dominant regime to show the potential lock-in of the dairy sector. The theories on path dependency present three different phases of which the final phase is a state of lock-in. However, theories on path dependency do not explain any processes or mechanisms that contribute to the path development and the final lock-in. The current research uses the aspects of organisation, technology, regulations and markets of the dominant regime to explain the interactions and processes that might have contributed to the potential lock-in. The entanglement of the aspects is an element that was added to the theories of path dependency for a better analysis of the potential lock-in. Furthermore, the theories on path dependency do also not take into account any developments outside of the regime that contribute to the path dependency, as discussed in Section 4.3.4.

The theories on the mechanism of niche development were applied to assess the statuses of Muufri and Remeker. However, the mechanisms of niche development do not differentiate between full niches despite there being large differences possible, as discussed in Section 5.3.3. The current research used the interactions between the organisation, technology, regulations and markets to show further differences between Muufri and Remeker. Similar to the theory on path dependency, the theory on the mechanisms of niche development missed some elements to be of optimal use to the current research.

The theories on niche-regime compatibility and sociotechnical translations were applied to Muufri and Remeker to assess their potential impacts. To analyse the niche-regime compatibility the current research used the aspects of a regime as presented by the multi-level perspective. The aspects of a regime from the multi-level perspective made the niche-regime compatibility analysis more structured and consistent. Still, the use of the theories of niche-regime compatibility in case of a complete regime transitions is questionable, as discussed in Section 6.4.2. Also discussed is the shortcoming of the theories on sociotechnical translation, which only take the sorts of impacts and not the amount of impact into account.

Next to the theories on niche-regime compatibility and sociotechnical translations other concepts are used to develop the impact assessment, as presented as part of the analytical framework in Section 2.4. The first concept discussed was that of technology assessment, which aims to assess potential future impacts of an innovation beforehand to be able to advise policymakers and society (Bechmann et al., 2007; Grunwald, 2009). Although at first the concept seems to fit the aim of the current research very well, only the idea of using a focus group of experts to gain insights turned out to be a useful element of technology assessment. Because of the strong focus on advising policymakers and society, no other elements could contribute to the current research. A similar problem arose with applying the concepts of radical innovation from a business perspective. Also for these theoretical concepts, the focus differed too much of the specific focus of the current research. Both technology assessment and radical innovations from a business perspective do show the broad interest in different research fields for assessing potential impacts of innovations. Also the multi-level

perspective shows a similar interest, although it focuses more on the historical analysis of the impacts of innovations and niche developments. However, the three different levels as presented by the multi-level perspective, niches, the regime and the landscape, was a very useful aspect throughout the current research.

Overall, the used theoretical concepts have several shortcomings, which might have limited the results of the current research. The third research question includes the impact assessments of Muufri and Remeker. However, the theories presented in the analytical framework lacked the needed methods to properly assess the potential impacts of Muufri and Remeker. The lack of methods for an impact assessment is the biggest shortcoming of the analytical framework, which has influenced the results of the current research the most. In case theoretical concepts would have been present focusing on the potential future impacts of niche developments with a broader interest than advising policy makers or businesses, a more detailed analysis could have been performed with more conclusive results.

7.3 Discussion of methods

To be able to answer each of the sub research questions and finally the main research question, the current research used specific methods for each research question. This section discusses some reflections on the choice of methods.

Based on findings from the research, the focus and formulation of the first research question were adjusted. The initial first research question focused on the complete history of the sociotechnical system of the Dutch dairy sector and tried to proof the lock-in of the complete sociotechnical system. However, this approach turned out not to be contributing the current research appropriately. The focus was lost on what the discussion could actually contribute to the research by attempting to discuss the complete history of the dairy sector to show the path dependency of the sociotechnical system. The main research question evolves around the impact of potentially radical niche developments. The lock-in of the dairy sector is specifically analysed to show the need for niche developments to bring new insights into how the sustainability issues of the dominant regime can be solved. The potential lock-in of the dominant regime prevents the regime of solving the sustainability issues itself, because of its path dependency and lost flexibility. By explaining how the dominant regime is potentially in a state of lock-in, the current research shows the need for niche developments to challenge the dominant regime. The potential lock-in of the dominant regime can already be demonstrated by discussing the path dependency of the sustainability issues only. Therefore, by only discussing the path decencies of the sustainability issues the chapter can be focused more clearly.

The methods of the first and second research question are mainly the desk studies. Reflection on the desk studies is discussed as part of the discussion of the analytical framework in the previous section. For the third research question however a focus group was used next to the desk study. The choice of using a focus group was based on methods commonly used in technology assessments. As discussed in Section 6.4.1, the results of the focus group are affected by the composition of the focus group. Similar difficulties would have arisen in case interviews were used as the main research method. Furthermore, interviews would not have allowed participants to directly react to each other and build on each other's ideas, as was now the case during the focus group. An effort was made to

ensure that different parties or stakeholders of the dairy sector were represented to compensate somewhat for the problem of the composition of the focus group affecting the results. Therefore, participants with diversity in backgrounds and occupations were selected. The specific knowledge and experience of each of the participants resulted in very useful insights into what stakeholders of the Dutch dairy sector consider the potential impact Muufri and Remeker to be. Without these insights, the impact assessments of Muufri and Remeker would lack the perspectives of people within or closely working with the dominant regime of the Dutch dairy sector.

A very substantial part of the current research is based on the results of the focus group discussion, because theories on the impact assessment of niche developments are lacking within the analytical framework of the current research. Therefore, weaknesses in the methods of the focus group discussion could present weaknesses in a big part of the research. As discussed, it is possible that the results of the impact assessment are optimistic because of the involvement of some participants of the focus group in similar niche developments. However, in case different methods were selected there could be similar problems, also because the resources and time of the current research are still limited.

7.4 Insights from the research

The current research into the potential impacts of niche developments on the dominant regime presents some useful insights. These insights are discussed in this section, which includes the discussion of specific insights of the current research as well as more general insights.

The current research includes impact assessments of Muufri and Remeker. These impact assessments give insight into potential points of attention for Muufri and Remeker, for other niche developments in the dairy sector and for the dominant regime of the dairy sector. For example, based on the impact assessment, Muufri could decide to address the potential debate that might arise. And Remeker could, for example, decide to contribute to helping other dairy farmers develop their own niche developments. As part of the current research, specific potential scenarios of the impacts of Muufri and Remeker are developed. These scenarios are developed with the help of stakeholders of the dairy sector, but outside of Muufri and Remeker. The scenarios could help Muufri and Remeker develop a more clear idea of what their potential impact could be and what to do next to enhance their impact. Also niche developments similar to Muufri and Remeker could gain inspiration from the current research. Furthermore, the current research has presented a possible method for developing such scenarios for niche developments based on both expert opinions and theory.

Similar to the niche developments, the dominant regime can also use the impact assessments to gain insights and define points of attention. However, the current research also showed an interesting aspect for regimes in a state of lock-in in general. A regime in a state of lock-in is less likely to be flexible enough to be open for creative solutions and suggestions from the outside. Simultaneously, a locked-in regime especially has a greater need for some creative and outside perspective, because it is locked-in in its own path. This dilemma of the locked-in regime especially needing some pressure from outside, while at the same time not being open for outside perspectives presents a paradoxical situation. The current research has shown this dilemma and the developments leading up to it for the case of the dairy sector in the Netherlands. Hopefully, by making the niche developments and

the dominant regime more aware of their current positions both can work on becoming more sustainable, either together or apart.

The current research makes a suggestion on how it is possible to assess the potential impacts of niche developments on the dominant regime beforehand. For the current research, a specific research method needed to be developed, because there was no method formulated yet by the existing researches as presented in the analytical framework. The lack of existing methods to analyse the potential impacts of niche developments on the dominant regime presents a very important insight of the current research. The current research has shown that the theories presented in the analytical framework, do not suffice to analyse potential niche-regime interactions. As discussed in the analytical framework, most researches focus either on advising policymakers or businesses on how to handle niche innovations or it focuses on the impact of niche developments from a historical perspective. All the methods and theoretical analyses of the current research together present a potential method to assess the potential impacts of niche developments on a regime within a sociotechnical system. The current research shows that the subject of impacts of potentially radical niche developments could be interesting to focus more research on. Simultaneously the current research shows the shortcomings of the current body of literature.

To investigate the potential impacts of niche developments on a dominant regime, several additions to the current body of literature would be appreciated. There are three specific subjects where we would have appreciated more or better theories or methods during the current research. Firstly, the path dependency of the dominant regime and the processes that have contributed to the lock-in state were difficult to determine. Perhaps a wide research into specific processes that contributed to the path dependency of locked-in organisations and regimes in the past can provide the needed insights. This research might be able to determine a specific set of processes that generally indicate the path dependency and lock-in of an organisation or regime. The results of this research and the determined processes can then be used as indicators to assess the path dependency of current organisations and regimes. Secondly, the current research missed some specific methods to assess the niche developments thoroughly. It was both difficult to determine the extent in which niche developments are potentially radical and it was difficult to determine the exact current state of the niche developments. To be able to assess the extent to which a niche development is radical, more research could be performed into the characteristic aspects of radical niche developments of the past. When more is known about the characteristics of past radical niche developments, perhaps the radicality of future niche developments can be better assessed. To be able to assess the current status of niche developments better, more theory is needed beyond the mechanisms of niche development. During the current research, the possibility of using the maturity of a niche based on the interactions between the organisation, technology, regulations and markets of the niche developments is proposed. Perhaps the possibilities of using these interactions as an indicator for the maturity of a niche development can be investigated by assessing these interactions for a wide range of niche developments from different sectors. Thirdly, it was difficult to determine the best suitable methods to perform the impact assessments of the potentially radical niche developments. As discussed, the theories presented in the analytical framework are not sufficient to specifically assess the future impacts of potentially radical niche developments from a sociological perspective. To develop appropriate methods in the future, more extensive follow-up research needs to be performed. Potential ways of organising this follow-up research are presented in the next section.

7.5 Recommendations for further research

Overall, the current research has revealed possibilities for very interesting further research. The results of the current research are quite exploratory, but show what subjects can be interesting to follow up on. Recommendations for further research are presented in this section.

The first research question focuses on showing the potential lock-in of the dominant regime and discusses some processes that might have contributed to the lock-in. The lock-in of the dominant regime and its sustainability issues could not be determined with certainty. It can be interesting to further and in more depth investigate the potential lock-in of the dairy sector. The current research has already shown some interesting processes, which could have contributed to the locked-in state of the dominant regime. In case the lock-in of the dairy sector can be determined with certainty by a historical research, this would also further emphasise the need and use of niche developments.

The main research question focuses on how potentially radical niche developments can impact the dairy sector in the Netherlands to become more sustainable. As discussed, the analytical framework used did not present a strategy to analyse the potential impacts of niche developments on the dominant regime. The strategy developed in the current research is still in an exploratory state. Therefore, further research can be interesting into the area of impact assessments of potentially radical niche developments. The follow-up research has lots of options on the organisation of the research, for example:

- Different methods, such as interviews or surveys, can be used to analyse the thoughts of stakeholders;
- More focus groups can be organised to gain more conclusive results on the insights of stakeholders;
- Other potentially radical niche developments in the dairy sector could be analysed. This could also confirm whether or not the impact assessments of Muufri and Remeker are indeed representative for similar niche developments;
- Similar methods could be used to analyse potential niche-regime interactions within a different sector. This could give insights into whether the impact assessment of potentially radical niche developments in the dairy sector could be generalised.

In case any follow-up research will be performed, there are some lessons to be learned from the current research. Firstly, the current research shows that although certain theories seem to cover the subject sufficiently, in case no suitable methods are described as part of the theory, it remains difficult to apply the theory to a specific case. In case follow-up research is undertaken, more time should be used to make a broader assessment of the theories and methods available to assess the impact of niche developments. The current research has focused on several specific areas of research, which beforehand seemed most suitable. However, possibly there are more researches, theories or methods on subjects of niche developments and adjacent topics, which could also be relevant and which also formulate methods. Secondly, it can also be recommended to spend more time and resources into the selection of the niche developments that are to be researched. With more time and resources, more potentially interesting niche developments and less well-known niche developments could be discovered. Also the extent to which a niche development is potentially radical and more sustainable than the dominant regime can be better assessed beforehand. In case

the niche developments are better assessed beforehand, a better selection of suitable niche developments to research can be made and the results of the research can be more precise for specific sorts of niche developments. The current research was explorative and therefore it was not an issue that the specific aspects of Muufri and Remeker were not completely assessed beforehand. Thirdly, any follow-up research would benefit from the setting of clear boundaries of the research beforehand. As discussed for example, the focus and formulation of the first research question was adjusting during the research, because it lacked focus. Therefore, by clearly defining as much of the boundaries of the research as possible, the complete research can be more efficient, focused and conclusive.

When follow-up research is performed based on the recommendations as described, this could take several forms. In case a similar subject is researched using different methods, such as for example surveys or interviews, it can be nice to also inquire the participants about their thoughts on the radical and sustainable aspects of the selected niche developments. Furthermore, the research could use different methods and compare the use of the different methods to assess the potential impact of niche developments. In case more focus groups are organised as part of the follow-up research, it can be a valuable addition to vary more in the compositions of the focus groups. As discussed, several aspects of the composition of the focus group might have influenced the results of the focus group discussion. Varying the composition of several focus groups in a follow-up research can help understand the effect of the focus group composition on the results. For example, the results of focus groups with participants from outside the dairy sector could be compared to the results of focus groups with participants who are part of the dominant regime. In case other niche developments in the dairy sector are investigated, it can be useful to spend more time on the selection and assessment of the niche developments, as discussed already. In case similar methods are used to investigate the impact of potentially radical niche developments in a different sector, it first needs to be assessed whether the methods of the current research can be applied to the specific other sector of interest. It could also be beneficial to elaborate on the differences between the dairy sector and the sector of the follow-up research, and whether these differences between the sectors can affect the results of the research.

Overall, more conclusive results can be obtained in case the follow-up research would have access to more time and resources. Gaining more knowledge on the subject of potential niche-regime interactions could contribute to insights for both niches and the regime, which can hopefully lead to positive developments towards more sustainable practices in general.

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Appendix

Script focus group (in Dutch)

13.45 – 14.00 Inloop deelnemers, uiterlijk 14.00 beginnen

14.00 Introductie

Mijn naam is Anne Verschoor, ik studeer Levensmiddelentechnologie aan de Wageningen Universiteit. Op dit moment ben ik bezig met mijn master thesis. De hoofdvraag van mijn onderzoek is: ***Wat zou de impact van radicale en duurzame niche ontwikkelingen in de zuivelverwerking op het socio-technische systeem van de Nederlandse zuivelindustrie kunnen zijn?*** Ik bekijk de mogelijke impact van twee specifieke niches voor de aankomende 5 tot 15 jaar ongeveer. Deze focusgroep zal ik gebruiken om inzicht te krijgen in wat jullie, met jullie ervaring in de zuivelsector, denken dat de impact van de twee verschillende niches op de zuivelindustrie zou kunnen zijn. De dingen die besproken worden tijdens deze focusgroep zullen een grote bijdrage leveren aan mijn onderzoek.

Voordat we echt beginnen wil ik jullie graag nog vertellen dat deze focusgroep zal worden opgenomen. Op deze manier kan ik later alles nog rustig naluisteren en goed analyseren. Ik zal deze opnames vertrouwelijk behandelen en niet met anderen delen.

Mochten er tijdens de focusgroep dingen worden gezegd die ik direct zou willen citeren, mag ik jullie dan eventueel met naam en toenaam noemen in mijn thesis of blijven jullie liever anoniem?

REACTIE GROEP

Verder zou ik jullie willen vragen om met respect met elkaar om te gaan en elkaar uit te laten praten. Ik zal er ook voor zorgen dat iedereen aan het woord komt. Al jullie ideeën en inbreng zijn welkom, er zijn geen stomme of foute opmerkingen.

Eerst zullen we het kort hebben over niches in het algemeen en daarna zullen we elk van beide niches bespreken. Alles bij elkaar zal het maximaal anderhalf uur duren en halverwege zullen we een korte pauze nemen.

Hebben jullie nog vragen over wat ik net heb verteld of over het verloop van de focusgroep?

REACTIE GROEP

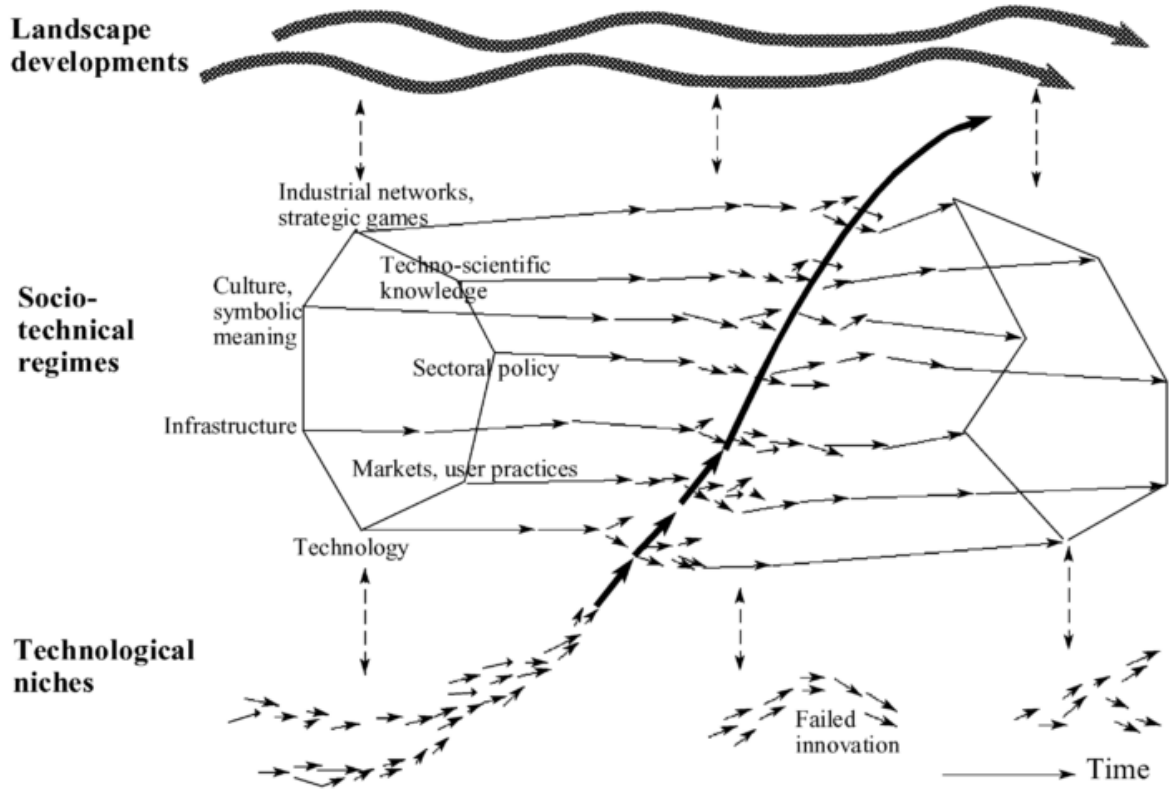
Dan stel ik voor dat we beginnen met een voorstelronde. Ik zou jullie willen vragen om je voor te stellen door je naam te zeggen en kort te vertellen wat je ervaring is in de zuivelsector.

REACTIE GROEP

14.10 Algemeen: niche en regime

Met mijn onderzoek maak ik onder andere gebruik van de theorie van de “multi-level perspectief” om verschillende ontwikkelingen te onderscheiden gebaseerd op hun grootte. Het “multi-level

perspectief" onderscheidt drie verschillende levels: niches, het regime en het landschap. Op het scherm kunnen jullie een figuur zien die deze theorie samenvat (zie Afbeelding 1). Het gaat er vooral om dat jullie het concept globaal begrijpen. In het kort houdt het in dat innovaties zich kunnen ontwikkelen binnen de niches, het regime omvat de dominante organisaties en technologieën en het landschap geeft de externe omgeving weer buiten de invloed van de niches of het regime. Mijn onderzoek richt zich op de interactie tussen niches en het regime in de Nederlandse zuivelindustrie.



Afbeelding 1: Een dynamisch multi-level perspectief op technologische transities (Geels, 2002).

In het kort definieer ik een niche binnen mijn onderzoek als een ruimte waarin een nieuwe technologie of concept zich kan ontwikkelen buiten de harde selectie omgeving om. Het regime stel ik gelijk aan het concept van de dominante sector inclusief bijvoorbeeld de belangrijkste leveranciers, consumenten, regelgevingen en andere producenten van zuivel producten.

Is dit voor iedereen duidelijk? Zijn er nog vragen over dit figuur?

REACTIE GROEP

Ik onderzoek dus de impact van niches in zuivelverwerking op het regime van de Nederlandse zuivelindustrie. Nu wil ik jullie eerst graag een algemene vraag stellen: Welke eigenschappen heeft een niche in het algemeen nodig om een impact te kunnen hebben op het regime? Denk bij het beantwoorden van deze vraag ook aan je eigen ervaring met niches. Ik wil jullie vragen om snel wat dingen op te schrijven die te binnen schieten en dan zullen we die kort bespreken. *(Deelnemers eerst antwoord laten noteren voor het bespreken)*

REACTIE GROEP

14.20 Muufri

Ik zal eerst kort wat vertellen over Muufri. Muufri is een start-up bedrijf in Amerika. Muufri wil een kunstmatige melk maken door gemodificeerde gisten de belangrijkste eiwitten in melk te laten produceren. Een melk geproduceerd zonder koe dus, die wel moleculair identiek is aan koemelk. Plantaardige bronnen worden gebruikt voor de vetten, en de mineralen en suikers worden los gekocht, daarna worden alle ingrediënten gecombineerd met water. Dit resulteert in een veganistische melk die ook gebruikt kan worden om andere zuivelproducten van te maken zoals kaas, yoghurt of room. Ook zou de samenstelling van de melk gemakkelijk veranderd kunnen worden, waardoor bijvoorbeeld een lactose vrije melk geproduceerd kan worden. Ze willen hun product eind 2017 op de markt brengen.

Ik wil jullie nu vragen om één voordeel en één nadeel van deze niche op te schrijven. Dit mag een voordeel of nadeel zijn voor jou persoonlijk, voor de zuivelsector of voor de wereld.

Ik stel voor dat we even bespreken wat jullie hebben opgeschreven. Wil jij beginnen?

REACTIE GROEP

14.30 Nu wil ik graag aan jullie vragen om je een situatie voor te stellen waarin Muufri de grootst mogelijke impact zal hebben in de aankomende 5 tot 15 jaar. Dit mag een overdreven grote impact zijn die misschien niet volledig realistisch is, maar op deze manier kunnen we wel op ideeën komen. **Hoe ziet de zuivelsector er dan uit?** *Vragen die ik verder zou kunnen stellen om de discussie te helpen:*

- *Wat is er veranderd aan de zuivelsector ten op zichte van de huidige situatie?*
- *Welke partijen zijn het meest beïnvloed door deze veranderingen in positieve zin?*
- *En welke partijen zijn het meest beïnvloed door deze veranderingen in negatieve zin?*
- *Wat als er meer niches ontstaan gebaseerd op gelijksoortige ideeën of innovaties?*

REACTIE GROEP

14.40 Wat zou een meer realistische impact zijn die Muufri de aankomende 5 tot 15 jaar op de zuivelsector zou kunnen hebben? *Vragen die ik verder zou kunnen stellen om de discussie te helpen:*

- *Wat zou er, in deze meer realistischere situatie, veranderd zijn ten opzichte van de huidige situatie in de zuivelsector?*
- *Denk je dat deze niche de huidige zuivelindustrie aanzet tot nadenken of veranderen?*
- *Is het mogelijk dat de zuivelindustrie ideeën op doet van deze niche?*
- *De eigenschappen die eerder genoemd zijn die een niche nodig heeft om impact te hebben op het regime, heeft deze niche deze eigenschappen?*
- *Zijn er voor- of nadelen aan de impact die deze niche zou kunnen hebben op de zuivelindustrie?*
- *Wat zou kunnen bijdragen aan de groei van de niche? Wat zou juist een bedreiging voor de niche kunnen zijn?*

REACTIE GROEP

14.50 PAUZE!

14.55 Remeker

Ik zal weer eerst kort wat vertellen over Remeker. Remeker kaas wordt geproduceerd op een biologische boerderij van rauwe Jersey melk. De kazen worden gemaakt met een natuurkorst van ghee en gerijpt in een pakhuis op natuurlijke wijze. Het is een echt specialiteitsproduct, waar klanten dan ook een duurdere prijs voor betalen. De Remeker kaas wordt gemaakt op boerderij De Groote Voort, een biologische boerderij met Jersey koeien. Op de boerderij wordt er geen antibiotica gebruikt, de koeien behouden de horens, de koeien krijgen speciale verse voeding van geplette granen en de pasgeboren kalfjes blijven drie weken bij de moeder. De boerderij en kaasmakerij bieden werk en inkomsten voor vijf families.

Ik wil jullie nu vragen om één voordeel en één nadeel van deze niche op te schrijven. Dit mag opnieuw een voordeel of nadeel zijn voor jou persoonlijk, voor de zuivelsector of voor de wereld.

Ik stel voor dat we weer even bespreken wat jullie hebben opgeschreven. Wil jij nu beginnen?

REACTIE GROEP

15.05 Nu wil ik weer aan jullie vragen om je een situatie voor te stellen waarin Remeker de grootst mogelijke impact zal hebben in de aankomende 5 tot 15 jaar. Dit mag een overdreven grote impact zijn die misschien niet volledig realistisch is, maar op deze manier kunnen we wel op ideeën komen. **Hoe ziet de zuivelsector er dan uit?** *Vragen die ik verder zou kunnen stellen om de discussie te helpen:*

- *Wat is er veranderd aan de zuivelsector ten op zichte van de huidige situatie?*
- *Welke partijen zijn het meest beïnvloed door deze veranderingen in positieve zin?*
- *En welke partijen zijn het meest beïnvloed door deze veranderingen in negatieve zin?*
- *Wat als er meer niches ontstaan gebaseerd op gelijksoortige ideeën of innovaties?*

REACTIE GROEP

15.15 Wat zou dan een meer realistische impact zijn die Remeker de aankomende 5 tot 15 jaar op de zuivelsector zou kunnen hebben? *Vragen die ik verder zou kunnen stellen om de discussie te helpen:*

- *Wat zou er, in deze meer realistischere situatie, veranderd zijn ten opzichte van de huidige situatie in de zuivelsector?*
- *Denk je dat deze niche de huidige zuivelindustrie aanzet tot nadenken of veranderen?*
- *Is het mogelijk dat de zuivelindustrie ideeën op doet aan deze niche?*
- *De eigenschappen die eerder genoemd zijn die een niche nodig heeft om impact te hebben op het regime, heeft deze niche deze eigenschappen?*
- *Zijn er voor- of nadelen aan de impact die deze niche zou kunnen hebben op de zuivelindustrie?*

- *Wat zou kunnen bijdragen aan de groei van de niche? Wat zou juist een bedreiging voor de niche kunnen zijn?*

REACTIE GROEP

15.25 Afsluiting

We zijn nu bij het einde van deze focusgroep. Zijn er nog dingen die jullie graag zouden willen toevoegen aan wat we net hebben besproken?

REACTIE GROEP

Als er verder niets meer is dat jullie zouden willen toevoegen, zou ik het graag willen afsluiten. Ik wil jullie heel erg bedanken voor jullie inzet vandaag! Ik vond het erg leuk om jullie ideeën te horen. Mochten jullie het leuk vinden dan zal ik mijn eindverslag sturen zodat jullie ook het eindresultaat kunnen inzien.

15.30 Einde