

Framing in innovation

Towards sustainable agro-food systems

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Framing in innovation
Towards sustainable agro-food systems

Framing in innovatie
Op weg naar duurzame agro-food systemen
(met een samenvatting in het Nederlands)

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1.

The Dutch agro-food sector in transition

“There are not many areas in which words and labels – in a metaphorical sense, following Herzberg, but also literally on labels on packages – cause so much confusion and polarization as in the area of agriculture and food”¹

¹ Translated from Herzberg lecture given by Louise Fresco (2012)

1.1 The Dutch agro-food sector after WWII

The agro-food sector in the Netherlands has grown tremendously since the Second World War. The idea that there should never be a famine in the Netherlands again induced a policy-driven growth of the agricultural sector between the 1950s and 1980s. Since the end of the 1980s that growth has been declining, and issues regarding the profitability of farms and societal issues regarding animal welfare and environmental pressure have become increasingly important (Bekke and De Vries, 2001). In order to deal with these sustainability issues and to further sustain the agricultural sector, innovations are deemed necessary. However, because the Dutch agro-food system is very complex and involves a great diversity of actors, varying from farmers to processing businesses, and from societal organizations to farmers' associations, innovation is not very simple. These actors have different backgrounds, goals, ideas and stakes, which make the interaction between them sometimes difficult. In order to study this collaboration between actors, it is useful to take the micro-level, the level at which actors interact, into account (e.g. Klerkx et al., 2010; Elzen et al., 2011). The phenomenon highlighted in this thesis is that different actors have their own way of *framing* issues related to the challenges of sustainability, which often leads to problems in collaborations. Framing is one of the aspects that play a role in processes involving different actors. After all, looking at framing appears to be useful for studying conflicts, negotiations and inter-group interactions (Dewulf et al., 2009).

In the next section we first draw attention to past and current developments in the agricultural sector, the importance of sustainable development and the role of innovation processes in the development of the sector. Then we introduce the problems and research questions and take a glance at the research design and expected results.

The Dutch agro-food sector under pressure

The agro-food sector comprises all companies producing, processing or distributing food and agricultural products. Not only farmers, but also, for example, food industries, auctions, flower shops, animal transport companies, butcheries and supermarkets belong to this sector (Ministry of Agriculture, Nature and Food Quality, 2001). Although the share of agricultural production declined from 3.2% of GDP in 1995 to 1.5% in 2011, the Dutch agro-food sector is an important driver of the Dutch economy, with an added value of 48 billion euro, which comprises almost 10% of the Dutch economy and employment (Topteam Agro & Food, 2011). Furthermore, over 50% of the Dutch land area is used for agricultural activities (CBS et al., 2012).

Besides companies also for example societal organisations, intermediary organisations and governmental organisations are involved in the agro-food system. Innovation in the agro-food system is different from innovation in most other production sectors, because agricultural production depends on the natural environment (space and resources) and is geographically dispersed. Therefore, innovations often have to be adapted to the characteristics of a region and are under continuous development in order to deal with new challenges such as pests and diseases (Wright, 2012). Furthermore, the agricultural production sector involves a high percentage of small and medium-sized enterprises, with only a few employees (SER, 2004).

Dutch agro-food pathways

The availability and success of chemical fertilizers and pesticides and the improvement of agricultural management in general made it possible to raise agricultural production after the Second World War (Smit, 2011). Despite the environmental downside of pollution, desiccation, depletion of resources and negative effects on the landscape, the Netherlands became one of the largest exporters of food worldwide (Kelholt, 2009). In 2011, the Netherlands was the second largest exporter, after the United States, of exporting agro-food products in the world. The Netherlands exported 75% of its agro-food products (consisting of production, import that is distributed in the Netherlands and processed products) (Topteam Agro & Food, 2011).

In 1957 the European Union (EU) laid down in its Common Agricultural Policy (CAP) the goal to increase agricultural productivity by promoting technical progress (EEC, 1957). That goal was reached: after the Second World War the average (world market) price of agricultural products declined, and productivity increased while the world population was growing, as a result of subsidizing agricultural output, supporting the market for commodities, implementing import barriers for producers from outside the EU and subsidizing export (Hazell and Wood, 2008; Smit, 2011). On the other hand, production support led to unbridled production, resulting in 'butter mountains' and 'milk lakes' (Smit, 2011). The interests of policymakers and pressure groups were relatively congruent at that time. But agriculture became a focal point for environmental policy in the 1980s (Frouws and van Tatenhove, 1993) and soon afterwards the idea of sustainable agriculture was introduced. Because the agricultural sector has had to handle several crises such as mad cow disease, avian influenza, dioxins in chicken meat and swine fever, food safety and quality rules and regulations for food producers and processors have become more stringent (Ruben et al., 2006).

Another important factor influencing the agro-food sector was globalization. As a result of globalization, consumers can permanently choose between many products from all over the world (Ruben et al., 2006). Consequently retailers can also choose from which countries they buy their products, which has increased competition and made prices go down. Consumers have increasing demands regarding quality, traceability and the environmental friendliness of products and processes (Ruben et al., 2006).

New societal values have risen up, like environmental awareness, conservation of nature and the quality and safety of food (Bekke and De Vries, 2001). These changes are putting a lot of pressure on the firms, farms, research institutes and other actors in the sector. In the Netherlands, the period of agricultural production growth ended in the 1990s (Bekke and De Vries, 2001). Three developments led to this decline in production: changes in the Common Agricultural Policy such as lower minimum prices and the introduction of the milk quota; saturation of the most important export markets; and policy measures to decrease the environmental pressure of agricultural production (CPB and PBL, 2006).

Figure 1.1 shows that the number of farms in the Netherlands has decreased drastically: from 124,903 farms in 1990 to 70,392 farms in 2011 (LEI and CBS, 2012). Between 2011 and 2012 almost five Dutch farms a day quit their business (CBS, 2012). The number of big farms (with a revenue higher than 500,000 euro per year) is increasing. Around 50% of the Dutch

farms produced 95% of the total economic production value ² in 2012.

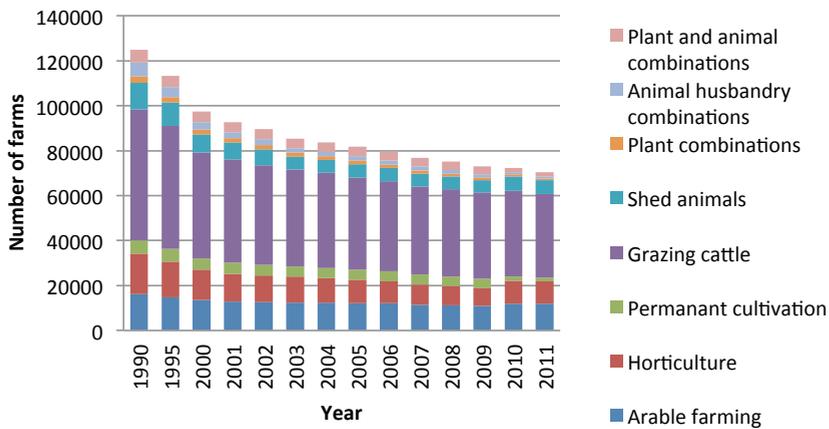


Figure 1.1 Number of farms in the Netherlands per production category between 1990 and 2011 (LEI and CBS, 2012)

The number of people working on farms is decreasing as well, because of intensification and mechanization (Bieleman, 1998). Rural areas and the role of agriculture in rural society are changing and agriculture is no longer viewed as a food production activity only. The emphasis has shifted to environmental sustainability and the countryside as a place of ‘consumption’ (Hassink et al., 2012). Two types of solutions to maintain a strong agricultural sector in the Netherlands can be recognized. On the one hand, solutions are directed at further intensification, scale increase and stronger focus on the market. On the other hand, solutions point in the direction of a broadening of agricultural activities by combining agricultural activities with non-agricultural activities, such as care, education and nature conservation (Dammers et al., 1999; Hassink et al., 2012).

1.2 The urgency of sustainability

Sustainability in agriculture, as in other fields, is not a straightforward term and different definitions of sustainable agriculture exist. For example, Ikerd (1993, p. 151) defines sustainable agriculture as agriculture that “use[s] farming systems that conserve resources, protect the environment, produce efficiently, compete commercially, and enhance the quality of life for farmers and society overall”. Pretty (2008, p. 451) defines sustainable agriculture as systems that “aim to make the best use of environmental goods and services while not damaging these assets”. But what is regarded as sustainable agriculture depends on the time and place in which you are living, so it varies ‘temporally and spatially’ (Rigby and Cáceres, 2001, p. 23). This makes sustainable agriculture a contested idea. Although there are a lot of efforts to make agriculture more sustainable, such as stringent rules and regulations regarding environmental impact, agriculture cannot be regarded as being sustainable at this moment, as natural resources are depleted and there is severe pressure on biodiversity, the (chemical) environment and the landscape (Smit, 2011). Still many

²The economic value is the economic size of agricultural activities, based on the standardized annual yield of a crop or animal.

ecological, societal and economical challenges exist.

Because the agricultural sector is subject to a lot of economical, technical, ecological, societal and political changes, innovations are needed in order for the sector to survive (De Groot, 2003; Werrij, 2007). Boundaries of production growth seem to have been reached and concerns related to animal welfare, biodiversity and environmental problems have come to the fore (Beers et al., 2010) resulting in an increasing interest in sustainable practices. “The Dutch agro sector is currently at risk of losing its ‘license to produce’ (social problem), ‘license to operate’ (policy problem) and ‘license to deliver’ (market problem)” (Veldkamp et al., 2008, p. 2). Innovations are needed to keep these licences and to solve the social, political and market problems by developing innovative ways to produce, market and sell agricultural products.

Sustainability is present in discourses about the future of the planet and especially in relation to food production (Nousiainen et al., 2009; Kloppenburg et al., 2000). In the field of agriculture, Francis and Hildebrand (1989, p 8.) state: “Everyone assumes that agriculture must be sustainable. But we differ in the interpretations of conditions and assumptions under which this can be made to occur.” The term is ambiguous in the sense that a lot of definitions exist, and there is no agreement about the operationalization and how it can be measured (Nousiainen et al., 2009).

Veldkamp et al. (2008) support the idea that ‘sustainability’ as such does not exist, as there is no ‘sustainable’ end situation, but that ‘sustainable development’ is the term we should focus on. According to Veldkamp et al. (2008, p. 2), “sustainable development in agriculture can be looked upon as adaptability and flexibility over time when it comes to responding to changing demands and perceptions”. Furthermore, they emphasize that agriculture and regional development are all part of the same complex adaptive system. Therefore, Fiksel (2006) states that it is essential to address sustainable development as a system dynamic property, which makes the concept of sustainable agriculture even more confusing. Everyone agrees that sustainable agriculture is important, but because of the difficult trade-offs between the people, planet and profit aspects of sustainable development (Alkon, 2008; Bos, 2008; Bos and Groot Koerkamp, 2009), and the complexity of the agro-food system, sustainable innovations are not easy to define, let alone to realize.

1.3 Changing conditions for agro-food innovation

Since WW II innovations in the agricultural sector were mainly characterized by the idea of adoption and diffusion, where extension agents brought the innovations to the farmers (Röling and Engel, 1990; Leeuwis and Pyburn, 2002). The question ‘how do we get the message across?’ focusing on transferring information, was prominent at that time. But soon the emphasis shifted to ‘why don’t they do what we want them to do?’ (Röling and Engel, 1990, p. 7). This rather linear model of innovation was criticized later on because it could not take into account the complexity of issues like sustainability (Röling and Engel, 1990; Leeuwis and Pyburn, 2002). So far, innovation in the agro-food sector had mainly focused on increasing production or efficiency (Leeuwis and Pyburn, 2002).

But farming these days is not only a rural activity. As there are less farmers, the “non-farming citizens have become increasingly important in influencing the general view on agriculture and in decision-making over rural and agricultural affairs” (Boogaard et al., 2011, p. 2). This relation between agriculture and society is becoming more important. Furthermore, societal issues like animal welfare, the landscape and human health are under discussion, which necessitates interaction with society; the role of different actors in agricultural innovation processes is becoming more prominent.

The context in which innovations are taking place is also changing. For instance, Bekke and De Vries (2001) explain that the relation between the sector and the government has changed. Agricultural policy development was no longer taking place in isolation, but stakeholders became more involved. The interests of all the different actors in the agriculture sector have become incongruent, and societal organizations have become more important in discussions on policy, or when addressing changes in the agro-food sector. Furthermore the agricultural sector became more fragmented in sectors and regions instead of a central ‘*Landbouwschap*’ and internationalisation and market developments became more important (Bekke and De Vries, 2001).

Participatory approaches

The complexity of sustainable innovations and the diversity of actors involved in the agro-food system make it difficult but important to take different actors into account in the process of developing a system innovation. Involving different actors will encourage different perspectives being taken into account, and in the end make the innovation more widely accepted (Smits and Den Hertog, 2007). The idea of involving actors in innovation processes has played an important role in the agro-food sector. Participative methods, which relate mainly to the participation of farmers in research, have a long history. According to Pretty (1995) two overlapping schools of thought and practice have evolved. The first school of thought sees participation as something that can help to increase efficiency: when you involve actors, the chances are higher that they agree with and support the new development. The second school sees participation as ‘a fundamental right, in which the aim is to initiate mobilization for collective action, empowerment and institution building’ (Pretty, 1995, p. 1251).

In the Netherlands in particular there is a long tradition of involving actors in the agro-food sector in an early phase of innovation processes and many studies are based on experiments in practice (van de Fliert and Braun, 2002; Hoffmann et al., 2007; Pretty, 2008). Sustainable agriculture needs new technologies and practices, but also “professionals willing and able to learn more from farmers and other stakeholders, supportive external institutions, local groups and institutions capable of managing resources effectively and agricultural policies that support these features” (Pretty, 1995, p. 1249). According to Pretty (1995), it is essential to seek multiple perspectives on a problem because different actors can have different understandings of a problem. This is an argument to involve a variety of actors in what Pretty (1995) calls ‘participatory approaches’. Participation was seen as successful because of: “increased mobilization of stakeholder ownership of policies and projects; greater efficiency, understanding and social cohesion; more cost-effective services; greater transparency and accountability; increased empowering of the poor and disadvantaged;

and strengthening the capacity of people to learn and act” (Pretty, 1995, p. 1251). The study of Pretty (1995) is mainly focused on the involvement of actors in research. However, both the public and private stakeholders are also increasingly involved in innovation trajectories in the agro-food sector (Werrij, 2007). Social acceptance plays an important role in the agro-food context. As a result, the agricultural sector is looking for contact with society (Dammers et al., 1999) and increasingly involves actors representing society in innovation trajectories such as citizens or societal organisations.

Several of these innovation trajectories in the agricultural system in the Netherlands have recently been executed under the guidance of the TransForum programme. TransForum was a Dutch innovation programme, established in 2004, that hosted many innovation projects in the agro-food sector. The aim was “to provide a sustainable development perspective for the Dutch agro sector and rural areas by searching for and experimenting with new value propositions” (Veldkamp et al., 2008, p. 1). The projects consisted of practical projects, learning projects and scientific projects. The practical projects aimed to improve ecological, economic and social sustainability, and involved heterogeneous actors, such as the government, societal organizations, and businesses and knowledge institutes (Veldkamp et al., 2008). The research presented in this thesis is part of the scientific part of the TransForum programme.

TransForum focused on system innovations towards a more sustainable agricultural sector. System innovations are defined by Geels (2004b, p. 19) as “large-scale transformations in the way societal functions such as transportation, communication, housing and feeding are fulfilled”. System innovation is more than just introducing new technologies; system innovation relates to changes in the whole socio-technical system, which includes technology, infrastructures, regulations, user practices and cultural meanings, etc. Therefore, many actors are involved in one way or another, like farmers, knowledge institutes and businesses. Societal actors should also be taken into account in order to improve societal acceptance. An example of such a societal organization is the Society for Protection of the Animals. They have an influence via lobbying for rules and regulations and the trademarks they provide for products. Furthermore, societal organizations can influence the image the public has regarding a certain topic, such as animal welfare conditions.

Studying agro-food transitions by focusing on framing

Multiple actors are increasingly involved in agricultural innovation. This research focuses on the involvement of heterogeneous actors in innovation projects aimed at sustainable innovations; we study the collaboration between these actors in innovation projects. So far, innovation and transition studies have mainly focused on the systemic nature of transitions at the macro or system level, while forgetting the interplay of actors at the micro-level of innovation projects which is crucial for sustainability transition processes (Farla et al., 2012). The interplay of actors is never straightforward, in particular when they need to collaborate.

The quote by Louise Fresco (2012) at the beginning of this chapter points exactly at the phenomenon under study in this thesis, namely the phenomenon that: “words and labels [...] cause so much confusion and polarization” when actors are interacting and collaborating. This thesis is about ‘framing’ in innovation projects towards sustainability in the agro-food

sector. Framing is a concept used in different strands of literature, so varying definitions exist. In this research we define framing as the phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics. Studying framing shows how the perception of actors is limited by frames and can therefore help us to understand the interaction between actors and thus provide an insight into how actors deal with sustainability issues in complex multi-actor constellations. By getting more insight into how actors frame ideas, underlying mechanisms may be discovered, which can help to explain how innovations in complex settings, with multiple actors, develop.

1.4 Objective, relevance and research questions

We are interested in the difficulties in multi-actor settings in innovation processes towards a sustainable agro-food sector. Therefore the objective of this thesis is to understand framing of sustainability problems in innovation projects in the agro-food sector, and more specifically in the animal husbandry sector. In the animal husbandry sector, specific issues are discussed, such as animal welfare and animal diseases that in some cases also form a risk for humans. Inspired by science and technology studies and building on existing theories on framing we will eventually define three different types of framing, namely cognitive, interactional and material framing. Cognitive frames are defined as structures in one's mind that enable and constrain understanding, action and interaction. Interactional frames originate from action and interaction and are reproduced in these interactions. A material frame is defined as the characteristics of artefacts that enable and constrain understanding, action and interaction. In the literature on framing we found studies that mainly focus on either the level of face-to-face interactions or the 'global discourse' level. We add a third level, namely the level of the 'localized collective', because in our view, framing on the level of localized collective, such as a project is different from the other two levels.

The scientific relevance of this thesis is that studying framing in innovation processes sheds a different light on the micro-level of innovations and provides an insight into how new (technological) concepts are elaborated in these processes. Studying framing on this level helps thereby to understand the developments in innovation projects. Framing provides an insight into the interaction between heterogeneous actors, how these actors frame sustainability and how they search for innovative solutions. The unit of analysis is the framing of topics in innovation projects. We study this by analysing 'topic biographies', based on topics addressed by the participants, as will be explained in chapter 3. By focusing on how framing occurs in topic biographies, our study yields a different view on interaction in innovation projects and thereby contributes to innovation studies. Where framing studies mostly focus on one level and one type of framing, we study different types of framing and the different, interrelated levels of framing in innovation processes.

The societal relevance of this study relates to how interaction between heterogeneous actors in innovation projects can be understood and improved. If the conditions of fruitful interaction are better understood, innovation projects can better live up their promise to deliver more widely societal accepted ideas. Especially in these days, in which changes are occurring in the actors in the agro-food chain that have influence on food practices from farm to fork interaction between actors in the agro-food sector seems to get more important

(Spaargaren et al., 2012). Improved interaction in complex innovation processes can help to take different aspects into account in realizing a transition towards a more sustainable agro-food sector.

We formulated the following research questions:

1. How does framing occur in complex multi-actor settings in innovation processes?
2. How does framing facilitate and hinder innovation in complex multi-actor settings?
3. What are the implications of framing for the ambition of transitions in agriculture and system innovation in general?

This qualitative research is based on a case study design in which three cases are investigated that are examples of sustainability challenges in the Dutch agro-food sector. To be specific, the cases concern the animal husbandry sector in which various actors frame sustainability issues in different ways. In order to study these cases we take an interpretative approach wherein the process of how meaning is created and negotiated is central. Such an interpretative or constructionist approach presupposes the coexistence of multiple, socially constructed realities which are historically and culturally specific (Berger and Luckmann, 1966). A case study provides the rich context in which this meaning is created and sustainability issues are framed.

The three cases are chosen because they are examples of collaboration between multiple, heterogeneous actors working on sustainable innovations in the agro-food sector. Furthermore, these cases could be studied in real time (*ex durante*) and were examples of different phases of innovation. The first case is the Roundel project, which is about the development of a new type of laying hen system and the marketing of the eggs produced in that system. The system is developed as an alternative system for keeping laying hens, in which the needs of the chicken, the farmer and the citizen and the environmental impact were central. Plans and designs already existed; the project was in the phase of implementation. The second case, the Kwatrijn project, is about the development of a dairy system close to a nature conservation area. Animal welfare and environmental concerns played an important role as well, when designing a system. In this case there was some agreement about the problem, but not about the solution. The third case is about the developments around the use of antibiotics in animal husbandry, wherein measures are taken to lower the amount of antibiotics used in farming. In this case, the definition of the problem was unstable. In the three case studies topics are studied in depth and followed over time. With interviews and document analyses, topic biographies were built that show instances of framing over time.

The first research question requires a further elaboration of the different types of framing, the different levels at which framing occurs and the changes in framing that we find in the cases. The second research question is about the effect framing has, and more particularly the effect that changes in framing have on the innovation process. The third question is about the implications that studying framing can have for understanding agricultural transitions and system innovations in general.

1.5 Outline of this thesis

In chapter 2 we give an overview of the literature in the fields of innovation, interaction between actors and framing. Based on this literature, the definitions of three types of framing are developed and a theoretical framework is proposed. In chapter 3 the methodology that we developed and used is explained. Chapters 4 to 6 discuss the three case studies: the Roundel, the Kwatrijn and antibiotics use in animal husbandry. The final chapter, chapter 7, analyses the topic biographies as discussed in the three cases, and draws the theoretical, empirical, conceptual and practical lessons from these three case studies.

2.

Theory: Framing in system innovation

2.1 Introduction

In the previous chapter we highlighted that the agro-food sector needs innovations in order to continue its position in society and deal with sustainability issues. As Spaargaren et al. (2012 p. 3) state, “The present foodscape is a contested landscape-in-the-making, with many actors, dynamics and uncertainties resulting in a complex configuration of food practices”. The major actors and stakeholders in the food sector recognize and accept that it is important to make food production and consumption more ‘sustainable’: “the need for a sustainability transition in the food sector has been one of the major factors putting an end to the post-WWII consensus on rationalization and intensification” (Spaargaren et al., 2012, p. 3).

Due to the complexity of agro-food value chains and the interdependencies between the different actors in the chains, the entire agricultural system is involved in innovations. In the past, innovation in the agricultural sector was seen as a linear transfer of technology from universities to farmers, and questions were mainly about how to increase the adoption rate (Leeuwis and van den Ban, 2004). The linear approach was criticized by many scholars because of its limited attention to issues such as sustainability and the lack of incorporation of a broader range of issues related to farming (IAASTD, 2009). Not only were feedback mechanisms important in innovations, but also the interaction with various actor groups reflecting different demands from society, such as sustainability, costs, safety and animal welfare, became apparent. The linear model had to be replaced by a model that was better equipped to cope with iterative, interactive and complex processes of agro-food innovations. This has led to an increasing popularity of the so-called ‘system perspective’ in the agricultural sector. In a system approach the focus is on the structure of the innovation system and the way in which the various sets of actors interact (Freeman and Lundvall, 1988; Klein Woolthuis et al., 2005; Hermans et al., 2013).

According to Hall et al. (2006, p. iv), an ‘innovation systems’ concept is useful for capturing complexity by drawing attention to the totality of actors needed for innovation and growth; consolidating the role of the private sector and the importance of interactions within a sector; and emphasizing the outcomes of technology and knowledge generation. So, in the context of complex innovations in the agro-food sector in which various actors are involved, we build upon a systems perspective on innovation. We zoom in on the interaction between heterogeneous actors and focus in particular on framing of actors. Furthermore, innovation literature focusing on actor involvement and user-producer interaction shows us that in order to change an entire system, interaction between different actors is important (Oudshoorn and Pinch, 2003; Smits and Den Hertog, 2007; Geels, 2011; Nahuis et al., 2012). The idea is that when involving various actors in an early stage of the innovation process, different ideas and perspectives are taken into account in the innovation process. This enables the innovation to become more widely accepted, and a diversity of problems to be considered (Smits and Den Hertog, 2007). One problem, however, is that interaction between multiple heterogeneous actors is not easy to organize because of the diversity of information, resources, ideas and perspectives between actors.

So far, most studies focusing on transitions and innovation systems have focused on macro-

and meso-levels, but more recently innovation scholars have called for more attention to the level of actors, considering actors' strategies, resource endowments and agency (Markard and Truffer, 2008), cultural legitimacy (Geels and Verhees, 2011) and normative contestation (Elzen et al., 2011), in order to better understand innovation processes. As Elzen et al. (2011) state, actors actively work on bringing about alignments and linkages in innovation projects and play an important role in normative transitions and transitions towards sustainability in general. Klerkx et al. (2010) suggest that by focusing on the meso- or macro-level, the activities of innovating actors are probably not fully grasped. At the micro-level of the individual actors, the differences in their perspectives and cognitive aspects of individual actors will come to the fore (e.g. Weick, 1990; Kaplan and Tripsas, 2008; Vandeberg, 2009). Weick (1990, p. 17) states that "cognition and micro-level processes are keys to understanding the organizational impact of new technologies". According to Kaplan and Tripsas (2008), cognitive factors are often not taken into account in literature on the dynamics of technology, while these cognitive aspects are important for understanding the dynamics of technological change. When applying such a 'cognitive lens' to innovation processes, the emphasis is "on interactions between the frames of multiple sets of actors" (Kaplan and Tripsas, 2008, p. 791). This leads to an approach in which the micro-level is central, and shows that it is important to study these interactions. A crucial aspect is how problems and solutions get defined.

The question, then, is how to study interaction at the micro-level of innovation processes. One can focus on different aspects, such as agency or power (Stirling, 2008). In this research we focus on the idea that actors frame things differently because of their diversity. Framing is the phenomenon that actors are limited in the way they think and act due to underlying cognitive structures, interactional patterns and/or material characteristics. In particular, umbrella terms such as 'sustainability' (van Lente and van Til, 2008), involving different meanings, can be expected to be framed in different ways by various actors. A focus on framing foregrounds the actors, and especially the interaction between actors in processes of change, and thereby helps to understand interaction in innovation processes. By studying framing we get an insight into the different approaches actors can have towards a certain topic, action or person and thereby it provides an understanding of how innovations in a complex field like the agro-food sector can unfold.

This chapter discusses the innovation literature and specifically the literature on interaction in innovation processes and on framing. Section 2.2 reviews the system innovation and transition literature. Section 2.3 focuses on what we can learn from literature on the involvement of actors in innovation processes. Section 2.4 presents the literature on participation in the agricultural sciences. In this field a lot of work has already been done on participatory methods with a central focus on the involvement of farmers in research. Section 2.5 is on the difficulties related to interaction between actors in innovation projects. Section 2.6 explores the framing literature to provide a basis for studying framing in innovation projects. Section 2.7 introduces the theoretical framework used in this thesis. The chapter ends by summarizing conclusions regarding the theoretical approach (section 2.8).

2.2 System innovations

“Innovations are novel products, processes, services or ‘ways to organise’ that are successfully introduced” (van Merkerk, 2007, p. 18). Smits (2002) emphasized that besides the ‘product’ also the functioning of the product in the context is important. As Smits (2002) states, “Innovation processes are neither linear nor causal and are better regarded as interactive processes in which there is a large extent of co-evolution of scientific, technological and societal systems” (p. 866). From a systems perspective, innovations are no longer seen as an isolated process, but as taking place in the context of a system and as part of a process with heterogeneous actors involved (Smits and Kuhlmann, 2004).

As becomes clear from the literature on systems of innovation, it is often not only the technology that changes, but the entire system. Therefore an innovation process is defined as the joint and interactive process of the development of technology in interaction with the system in which the technology is embedded (Hekkert et al., 2007). Geels (2002) emphasizes that in order to create sustainable technological change, the focus must not only be on technology, but also on changes in the social dimension, such as user practices, regulation and industrial networks. Change towards a more sustainable situation is difficult, because the entire system, including various actors, networks and regulations, needs to change. According to Geels (2011) these systemic changes in society can be called socio-technical transitions, because they involve new technologies, but also policy, markets, consumer practices, infrastructure, cultural meanings and scientific knowledge (Geels, 2004b; Elzen et al., 2011). According to Geels (2010), these so-called ‘socio-technical transitions’ are difficult to manage and can be hindered by lock-in, path dependency and orientation towards incremental innovation along predictable trajectories. Regimes are “semi-coherent sets of rules, which are linked together” (Geels, 2004a, p. 904; Geels, 2010). Actors negotiate on various solutions and try to enrol other actors in this process and thereby determine the problem perception within innovation systems or regimes. Solutions are then conceptualized at the micro-level of the actors and their interaction with different stakeholders in the innovation process. Various innovation scholars have emphasized the role of actors, and especially users in innovation processes (e.g. Geels, 2004a; Hekkert et al., 2007; Boon, 2008; Moors et al., 2008; Smits and Boon, 2008; Nahuis et al., 2012). In the following section we explore the role of actors in innovation processes in more detail.

2.2.1 Involvement of a diversity of actors in the innovation process

Many innovation and transition studies focus on the involvement of different actors or users in particular in the innovation process (see e.g. Nahuis et al., 2012). Grin (2012, and Grin et al., 2010) argue that user practices are more often taken into account in transition studies, but the units of analysis are often defined by supply systems and thereby taking into account the specific aspects of users in that transition and not the daily practices or wider patterns of societal change. A central idea is that the involvement of heterogeneous actors in an early phase of the process can help to realize system innovations (Dammers et al., 1999; Smits and Den Hertog, 2007).

According to Smits and Den Hertog (2007), five reasons can be presented for involving different users in the innovation process. First, it can help to get a more effective articulation of societal needs. The market is not always able to meet societal needs (Smits and Boon,

2008). Second, it can increase the competitive strength. By involving users in the innovation process, companies know the needs of the users and therefore have a better chance of launching products which are really needed by users. Third, user involvement can improve acceptance and societal embedding of knowledge and technologies. By involving different users, the innovations are more embedded in society, because users involved in the innovation process can influence the innovation by giving their opinions and ideas. Fourth, improvement of the learning capacity of society as a whole can be achieved by involving users in the innovation process. Finally, by involving different users the innovation process becomes more democratic, because different users are in a position to react to the innovation. And as most research is publicly financed and most innovations influence people's lives in one way or another, it is a moral right of the public to be involved in decision-making (e.g. Boon, 2008).

In the innovation system approach of Hekkert et al. (2007) the role of heterogeneous actors is also taken into account as they contribute to the emergence or production of an innovation (Hekkert et al., 2007). Furthermore, as Smits and Kuhlmann (2004) show, ensuring that all actors are involved can also prevent lock-in in a particular innovation trajectory, as different actors bring different aspects to the fore. Markard and Truffer (2008) emphasize the variety of different actors, pursuing different innovation strategies and controlling different sets of resources in a technological innovation system, and simultaneously actors are united by shared expectations or a shared vision.

The involvement of users has been recognized since the study of Von Hippel (1976) on the role of users in the scientific instrument industry. Oudshoorn and Pinch (2003) gave an overview of different approaches to so-called user-producer interaction (UPI). In their book *Users Matter* (2003), they made a distinction in four science and technology studies (STS) approaches focusing on the co-construction of users and technology, namely the social construction of technology approach (Bijker, Hughes et al. 1989), feminist studies of technology (Cockburn and Ormrod, 1993), semiotic approaches (Woolgar, 1991), and media and cultural studies (Silverstone and Hirsch, 1992; Oudshoorn and Pinch, 2003; Boon, 2008; Oudshoorn and Pinch, 2008). Boon (2008) added a fifth strand to that, i.e. innovation management and governance studies, which are influenced by economics, sociology, organizational and management studies (Hackett et al., 2008). Boon (2008) distinguished within this fifth strand three subcategories which have similar empirical and theoretical starting points and influence each other, namely 'evolutionary economics', 'the search for the origins of innovations' and 'innovation systems literature'. While evolutionary economics (first subcategory) focuses on the macro-level of innovations, the second subcategory, the search for the origins of innovations, focuses more on the demand side. Users are seen as really contributing to innovations to varying degrees. The idea is that zooming in, in this interaction and engagement might be interesting as users can be the sources of innovations or express the needs they have that according to them should be taken into account in an innovative solution (Boon, 2008). The third subcategory is the literature on innovation systems, based on the idea that innovations do not take place in organizations in isolation, but are influenced by the context of other actors and institutions (Freeman and Lundvall, 1988; Lundvall, 1992; Nelson, 1993; Freeman, 1997). These studies show that including a diverse set of actors while studying technological innovations, such as the government, universities,

intermediary organizations, companies and users, is important and interactive learning between these heterogeneous actors can support successful technology development and stimulate innovations (Boon, 2008).

It seems that especially in innovation trajectories towards more sustainable development, not only (end-) users but a diverse set of actors are involved in generating, exchanging and using knowledge, such as societal organizations, knowledge institutes and governmental organizations. Therefore, we think that it is not only important to discuss the role of users, but also to focus more in general on the role of diverse sets of actors. As stated earlier, actors are important in innovation trajectories, because socio-technical systems do not function autonomously but are “the outcome of the activities of human actors”, embedded in social groups and sharing certain characteristics (Geels, 2004a, p. 900). Additionally, Foxon et al. (2010) state that we can learn from transition management that “purposeful actions by actors within systems can give rise to changes in technologies, institutions and infrastructures” (p. 1203). They state that the behaviour and decisions of actors are likely to be key influences on how to realize a system transition.

2.2.2 Interaction between actors in agricultural innovations

From innovation studies we have learned that involving actors is needed in order to develop innovations in which many perspectives are taken into account. In the agricultural sector the involvement of actors in innovation, and especially in research, was object of study as well (Broerse, 1998) and introduced in the late 1980s. Farmer participatory research has received increasing attention since ‘Farmer First’, in which the farmer was the starting point of research (Chambers et al., 1989; Chambers, 1994), and ‘Participatory Technology Development’ (Jiggins and De Zeeuw, 1992), in which the farmer had an important role in developing technology. The role of the farmer has increased since the farmer has been seen as a resource manager, and the farmer is needed in order to let new technologies have an impact on farmers’ fields, in, for example, testing machines or new varieties of crops (van de Fliert and Braun, 2002).

As creating a more sustainable way to farm is not only about new technologies and practices, it is increasingly realized that the involvement of actors, including farmers, is an important measure to create sustainable agriculture (Pretty, 1995; van de Fliert and Braun, 2002). Farmers can be involved in order to increase efficiency and help to implement an innovation. Another reason they are involved is that involvement in an early stage can mobilize for collective action, empowerment and institution building (Pretty, 1995). Involving farmers means that innovations are not only adopted, but also adapted to farm-specific conditions (van de Fliert and Braun, 2002). Therefore the farmer is becoming more important in the innovation process.

According to Pretty (1995), problems related to sustainable agriculture are always open to interpretation and actors have their own understanding of the problem. Therefore, it is essential to seek multiple perspectives on a problem situation by ensuring the wide involvement of different actors (as explained in chapter 1), which calls for participatory approaches. Pretty (1995), therefore, discerns different ways of how people can participate in projects related to development and sustainability, namely manipulative, passive, by

consultation, for material incentives, functional, interactive, and by self-mobilization.

While these different ways of participating in agricultural projects are mainly related to researchers, participatory approaches are also becoming more important for other 'producers' of innovations. In the agro-food sector both public and private stakeholders are increasingly involved in innovation trajectories, such as NGOs and food processing firms (Werrij, 2007). Besides the profitability of farms and the space for agricultural production on the landscape, societal acceptance also plays a more important role in the agro-food context (e.g. debates on animal welfare in animal husbandry, globalization of food chains, and the use of genetically modified organisms in farming). As a result, the agricultural sector is looking for contact with society (Dammers et al., 1999), and this makes the involvement of societal representatives (NGOs, citizens etc.) in innovation trajectories important.

However, as Grin et al. (2004) state, there are also difficulties in projects on future livestock systems in which interaction between different actors has been central. Differences between actors can cause difficulties because of a discomfort with the roles the stakeholders are supposed to play; many knowledge workers tend to incline towards their home discipline instead of the trans-disciplinary attitude needed; the disciplinary differences between institutes still play a role; the existing system and the modernized agriculture cause constraints for developing new systems; and stakeholders can be afraid of the results of the project for future policy norms, political or societal debates or their credibility (Grin et al., 2004).

2.2.3 Complexity of multi-actor constellations

Based on the literature on the involvement of actors in innovation processes, in particular in agricultural studies, we assume that interaction between actors can fasten innovation processes and may also increase the quality, acceptance and innovativeness of these innovations (Dammers et al., 1999; Smits, 2002; Smits and Den Hertog, 2007; Boon, 2008). In innovation processes with different actors involved, the various actors try to construct the meaning of technology in stakeholder meetings, markets, public debates, fora and experiments as well as in actual use (Pinch and Bijker, 1987; Kline and Pinch, 1996). Nevertheless, only bringing together different stakeholders is not a guarantee for success, especially when the actors involved are from different backgrounds, and have different roles and responsibilities. The heterogeneity of actors and the flexibility of a technology can influence the way interaction between actors should be organized (Nahuis et al., 2012). People can also be afraid to involve actors because they fear that the project becomes less controllable, less precise and will slow down the planning process (Pretty, 1995). Some argue that a shared vision among actors is a key factor for innovation success (Vergragt, 1988; Akrich et al., 2002; Berkhout, 2006), while others state that differences between people can stimulate the innovativeness of the process (Nooteboom, 2000). According to Donnellon et al. (1986), a shared vision among actors is not essential for taking action. According to Geels (2010), a shared vision, or a common idea regarding what has to be changed, is important in order to get innovation working. Nevertheless, conflicts may raise very creative and out-of-the-box ideas. As Nooteboom (2000) states, some cognitive distance can stimulate novelty. Different routes can lead to a single end and different perspectives can result in new ideas. So, flexibility in the interpretation of a vision can increase the relevance for a

greater number of actors, while too much flexibility can destabilize the vision and reduce the capacity to structure the actions of social actors (Berkhout, 2006). In some cases design outputs such as scale models can serve as a ‘boundary object’ and can create mutual understanding among diverse actors involved in innovation processes (Klerkx et al., 2012). Furthermore, differences in expertise, power, resources, information and problems with trust may frustrate interaction between actors (Pretty, 1995; Klerkx and Leeuwis, 2009).

Klerkx and Leeuwis (2009) came up with four types of gaps prevent formation and functioning of an innovation network. First, differences can occur in cognition: actors from different backgrounds have too much cognitive distance to learn together, or have different norms, values and incentive systems. Second, there can be information asymmetry, for example as a result of limited resources (Bougrain and Haudeville, 2002), causing information gaps between actors. Third, managerial gaps can occur when actors are not able to acquire and implement new knowledge and technology because they have no access to the channels used for communication on innovations (Bessant and Rush, 1995). And fourth, system gaps could exist, which makes it difficult to fit the innovation within the broader innovation system (Klein Woolthuis et al., 2005).

In interaction between heterogeneous actors, differences and gaps between actors come to the fore. Berger and Luckmann (1966) state that people act on their interpretations of the world. Davidson (2006) adds that in order to change people’s actions substantively, their understandings must change. In the social construction of technology approach, the idea is that different social groups can construct completely different meanings of technology (Pinch and Bijker, 1984). As we are interested in the transition from the existing situation in the agro-food system towards the desired, more sustainable situation, we are particularly interested in such changes in interpretation. In a broad range of studies, framing and frames are used to study “inter-group interactions, conflicts and negotiations in which different actors are central” (Dewulf et al., 2009, p. 155). That idea inspired us to study the interactions in innovation processes, with a framing perspective. In the following section we delve deeper into the different approaches of framing. We are particularly interested in studying the processes of framing, in order to increase insight into interactions in transition processes in the agricultural sector.

2.3 Framing

Innovation processes in which a diverse set of actors are involved are typical examples of processes in which actors are confronted with differences in frames because of the different perspectives of actors, leading to negotiations or conflicts. Framing is a theoretical concept that can help to understand these difficulties in interaction.

In studies on transitions and innovations (Sengers et al., 2010; Elzen et al., 2011; Geels and Verhees, 2011) there is a growing awareness of the importance of cognitive approaches towards change as well, and framing is one of these approaches. Geels and Verhees (2011), for example, emphasize agency, collective sensemaking and framing struggles as components of their cultural-performative perspective. They address the role of cultural legitimacy in technical innovation journeys, by paying attention to the role of culture and

wider society in order to understand the production of cultural legitimacy via discourse and framing struggles. Sengers et al. (2010) use frame analysis in studying media discourses to identify cognitive frames. They state that frame analysis can help to study media and can show how actors' cognitive frameworks socially construct reality. Moreover, frame analysis can help to "improve socio-technical debates surrounding contested technologies by articulating their underlying structures and make these more transparent" (Sengers et al., 2010, p. 5026). It provides an insight into the way thinking is structured by socio-cognitive frames and how this thinking can be different from other participants' thinking (Sengers et al., 2010). According to Elzen et al. (2011), framing is a "process through which actors define problems, attribute causality and responsibility and generally influence the meaning of issues or problems" (p. 265). They studied how effective normative contestation of an existing regime influences the orientations of transitions in the making by analysing examples of system innovations in pig husbandry systems. They concluded that normative pressure may be weakened by a diversity of problem definitions. Furthermore, they concluded that when a 'coherent package' is created by aligning the problem, regulatory, market and technology streams, normative contestation has its largest impact.

The framing concept is used in different ways. In the following section we discuss the different traditions of framing. The common denominator is that framing is a 'sensemaking device' (Weick, 1995).

2.3.1 Literature on frames and framing

The concept of framing already has a long tradition, or put more precisely, several traditions. Framing originates from cognitive psychology (Bartlett, 1932) and anthropology (Bateson, 1972). Starting with Bartlett's schema on theory of memory (Bartlett, 1932), cognitive psychologists define frames as cognitive structures in our memory that can help us to organize and interpret new experiences. In the work of Bateson (1972) on (meta-) communication, framing is about the understanding of ongoing interaction by focusing on the exchange of cues. His example is the play between two boys. They are playing and at a certain moment it becomes rougher. One of the boys hits the other one and a fight starts. The reason is that one of the boys no longer perceives a hit as a game, but as a fight, and starts to hit the other one. According to Bateson, the ambiguity of how to interpret ongoing interactions creates the need for framing. In later studies, framing has also been used in, for example, artificial intelligence (Minsky, 1975), sociology (Goffman, 1974; Benford and Snow, 2000), policy studies (Schön and Rein, 1994; Hajer, 1995), psychology (Levin et al., 1998), communication studies (Entman, 1993; Tannen, 1993; Bryant and Miron, 2004), management studies (Creed et al., 2002) and conflict and negotiation studies (Lewicki et al., 2003).

Various studies try to make a distinction between different meanings of frames and framing. In policy sciences, Rein and Schön (1996) describe four distinct (but mutually compatible) meanings of a 'frame', which cover a broad spectrum of framing research: 1) as an underlying structure giving regularity to events as they unfold over time, 2) as setting a boundary, like in framing a picture, focusing on what is inside the frame, 3) as a schema of interpretation, and 4) as strong and generic narratives that guide both analysis and action in practical situations. The first meaning hints at a lack of adaptability to events as they unfold over time. This emphasizes the constraining force of frames. For instance, a specific frame of

a problem points to specific 'reasonable' solutions and obscures other possible solutions (Benford and Snow, 2000). The same holds for the second description, setting a boundary: by leaving some parts outside the frame, extra attention is given to the elements that are in the (picture) frame. Related to this, Beers et al. (2010) point to the fact that framed images can have a large, partly unwanted influence, because they necessarily simplify complex real-world phenomena. The third meaning, a schema of interpretation, points to the enabling properties of frames. Schemes of interpretation make events meaningful, and can organize experience and guide action, whether individual or collective (Davidson, 1985). Finally, the fourth meaning treats frames as strong and generic narratives that guide both analysis and action in practical situations. Such narratives tell what the problems are, what needs fixing and how it can be done. An example is the narrative of a disease that requires cure or quarantine (Rein and Schön, 1996).

In conflict studies, Gray (2003) defines framing as involving "shaping, focusing and organizing the world around us" and "framing is the activity and process of creating and representing frames" (p. 11). In environmental conflict studies, frames play a role in the creation, evolution and perpetuation of environmental disputes (Gray, 2003). Frames are then used for five reasons, namely: to define issues, to shape what action should be taken and by whom, to protect oneself, to justify taking a stance on an issue, and to mobilize people to take or refrain from action on issues.

A useful overview of different framing studies is made by Dewulf et al. (2009). According to Dewulf et al., "the smorgasbord of approaches differs conceptually, ontologically and methodologically" (2009, p. 156). The definitions of framing of Bartlett (1932) and Bateson (1972) form the roots of the two main traditions in the concept of framing, as defined by Tannen and Wallat (1987). Tannen and Wallat make a distinction between 'interactive frames' and 'knowledge schemas'. Interactive frames refer to what is going on in interaction, and knowledge schemas refer to participants' expectations about people, objects, events and settings in the world. Whereas frames are, according to Tannen and Wallat, interactive, schemas are more static, although structures of expectations are dynamic as well. Later on, Dewulf et al. (2009) extended this distinction in a broad review of the framing literature, in which they made an ontological distinction between 'cognitive frames' and 'interactional framing'. According to them, cognitive frames are mental representations, and interactional framing is considered to be "the dynamic enactment and shaping of meaning in ongoing interaction", but these categories are not mutually exclusive. Or, as Aarts and van Woerkum (2006) state, "interactional framing and cognitive frames both emphasize different aspects of the framing process". According to Tannen and Wallat, there is a relationship between interactive frames and knowledge schemas. In the case of a mismatch in knowledge schemas, a shift of frames is triggered (Tannen and Wallat, 1987). Based on this ontological distinction in cognitive and interactional approaches, the different approaches could be divided, as presented in Table 2.1 and Table 2.2.

Table 2.1 Cognitive approaches towards framing³

Cognitive approaches		
<i>Author</i>	<i>Field</i>	<i>Definition</i>
Minsky (1975)	Artificial intelligence	Frames are cognitive representations of knowledge, stored in memory.
Bartlett (1932)	Cognitive psychology	Frames are memory-based structures of expectations.
Levin et al. (1998)	Psychology	Frames are cognitive heuristics that people use to interpret a situation (risky choice frames, attribute frames and goal frames).
Lewicki et al. (2003)	Conflict and negotiation studies	Frames are interpretations of actors, or ways they make sense of their situations.
Snow and Benford (2000)	Sociology	Frames are collections of idea elements tied together by a unifying concept that serve to punctuate, elaborate and motivate action on a given topic.
Gray (2003)	Conflict studies	“Framing involves shaping, focusing and organizing the world around us. Framing is the activity and process of creating and representing frames” (P. 11).
Hajer (1995)	Policy studies	Frames are ways through which social movements aim to influence public opinion and discourses.
Entman (1993)	Communication sciences	“To frame is to select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described” (p. 52).

Cognitive frames are relatively static categories or mental structures in one’s mind. Cognitive psychologists define frames as cognitive structures in our memory (based on schema theory of memory) (Bartlett, 1932) that can help us to organize and interpret new experiences (Minsky, 1975). In artificial intelligence, according to Minsky (1975, p. 211) frames are structures in memory: “When one encounters a new situation (or makes a substantial change in one’s view of the present problem), one selects from memory a structure called ‘a frame’.” Frames are data structures for representing stereotypical situations.

³Definition as provided in accompanying article; if there is not a clear definition provided, the definition in this table is paraphrased.

Table 2.2 Interactional approaches

Interactional approaches		
<i>Author</i>	<i>Field</i>	<i>Definition</i>
Bateson (1972)	Meta-communication	Frames are interactional alignments or co-constructions.
Goffman (1974)	Sociology	Footing refers to communicator's relationship to a message.
Putnam and Roloff (1992)	Communication sciences	A framing: the definition of meaning constructed in ongoing interaction by cueing.
Donohue (2001)	Relational order theory	Messages create social orders and influence negotiated outcomes with relationship framing as a result.
Creed et al. (2002)	Management studies	Actors deploy frames both to make sense of a decision context and to shape outcomes.

The focus on interaction is important in the work of Goffman (1974). Goffman defines frames as cognitive structures that guide both the perception and the representation of reality. According to Tannen (1979), frames are social constructions. If two or more people define a situation together, they are socially constructing it. In interactional co-construction (Dewulf et al., 2009), frames are communicative devices that individuals and groups use to negotiate their interactions. This means that in interaction one actor reacts to another actor and together they co-construct frames.

To summarize, one could see cognitive frames as meaning 'between the ears' and interactive framing as meaning 'between noses'. Besides the distinction between cognitive frames and interactional framing, a distinction can be made based on what it is that is framed (see Table 2.3): an issue frame, defined as a meaning attached to agenda items, events or problems; an identities and relationships frame, defined as a meaning about oneself and relationships with a counterpart; or an interaction processes frame, defined as interpretations that disputants assign to their interaction process.

Combining cognitive and interactional frames with what it is that gets framed, Dewulf et al. (2009) distinguish six types of frames. Cognitive issue frames are relatively static structures or categories and cognitive heuristics that people use to interpret an issue, meaning, an agenda item, problem or event. A statement like 'sustainability is defined as being good for animal welfare' says something about what the actor thinks is an important element of sustainability. Cognitive identity and relationship frames are frames about self, others and relationships. This is similar to the definition of a characterization frame as given by Gray (2003). Cognitive process frames are cognitive representations of interaction processes. One could also define them as behavioural scripts for diverse social processes. An example

of a process frame is a conflict management frame as defined by Gray (2003); how should the conflict be managed? For example, a statement like “I did expect that the project would proceed faster, but there were a lot of struggles” is a statement about the process in which the project is framed as a time-consuming process.

The interactional framing approach looks for co-construction of issues, identities and processes that are negotiated in the talk. The focus is on how participants try to influence the ongoing definition of issues, identities and processes through meta-communication, how participants propose specific issue definitions and how other participants receive and/or challenge those interpretations. Interactional issue framing focuses on how parties negotiate the meanings of issues in social interaction. It is about one participant proposing a specific issue definition and others receiving and/or challenging that interpretation. Interactional identity and relationship framing is about how parties work out definitions of their identities and relationships by negotiating them in social interaction. The actors formulate their interpretation of the relationships and identities in interaction. Interactional process framing focuses on communication itself and how parties make sense of the interaction. The actors are interactively co-constructing the meaning of the ongoing communication process. So, the review of Dewulf is useful in giving an overview of the diversity in framing approaches. Table 2.3 provides the overview of framing concepts as defined by Dewulf et al. (2009).

Table 2.3 An overview of framing concepts (Dewulf et al., 2009)

Nature of frames	What is it that gets framed?		
	<i>Issues</i>	<i>Identities relationships</i>	<i>Process</i>
<i>Cognitive representations</i>	1. Cognitive issue frames	2. Cognitive identity and relationship frames	3. Cognitive process frames
<i>Interactional co-construction</i>	4. Interactional issue framing	5. Interactional identity and relationship framing	6. Interactional process framing

2.3.2 Levels of framing

Besides the different origins of frames and framing, one could also distinguish different levels of framing. One of the critiques on framing perspectives is that it is “often lacking conceptual precision in its delineation of constituent elements and processes” (Steinberg, 1999, p. 738). As a step towards more precision, we suggest a typology of framing based on three different levels of social dynamics, on which frames reside and operate in distinct ways. These are global discourse, face-to-face interaction and localized collective. These three levels of framing influence each other (Figure 2.1).

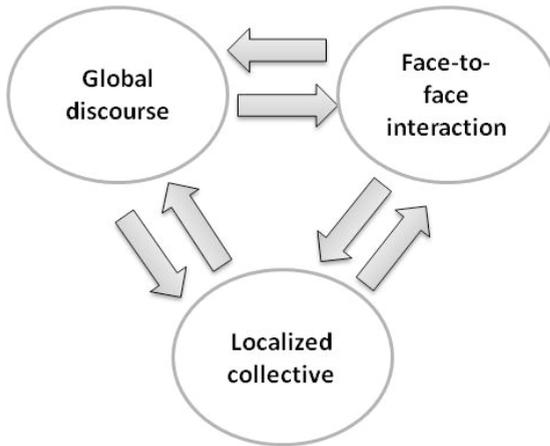


Figure 2.1 Levels of framing

This typology allows us to review the various strands of framing research. Many studies of framing are at the level of *face-to-face interaction*, investigating how frames develop between people, at the level of actors. An example is the study of Lamerichs et al. (2009), in which they study interactional effects of language, rather than individual cognitions, by studying transcripts of conversations. As is explained by Lamerichs and te Molder (Lamerichs and te Molder, 2003), the discursive psychology also focuses on ‘naturally occurring’ conversations at the level of face-to-face interaction between individuals.

In contrast to the forms of framing present at the level of individuals and at the interaction between these individuals, research on discourses and mass media highlights broader, societal forms of framing. Here, framing relates to how issues are presented: what is highlighted, what is ignored and what is the relation with other issues. An example is the study of Feindt and Kleinschmit (2011) about the reframing of responsibility during the BSE crisis (Bovine Spongiform Encephalopathy or ‘mad cow disease’) in German newspapers. This strand of research thus concerns the storylines present in society that frame events and meanings in particular ways. Also, in Elzen et al. (2011), framing is no longer positioned between a differentiated group of individual actors, but in an entire community. According to Hajer (1995) the way through which social movements aim to influence public opinion or discourses can be seen as a framing process. Framing is defined in Elzen et al. (2011) as “a process through which actors define problems, attribute causality and responsibility and generally influence the meaning of issues and problems” (p. 265). In such an approach, framing is regarded as something conscious, that is used to influence public opinion. Frames in society are voiced and reproduced in the media. These frames ‘out there’ have also been described as ‘images’ (Beers et al., 2010), as ‘structuring elements of discourse’ (Hajer and Versteeg, 2005) or ‘master frames’ (Benford and Snow, 2000). Discourse analysis is about the social reality produced and made real through particular ways of talking about the world (van den Brink, 2010). We will call this level of framing *the global discourse* level, stressing its encompassing and general nature.

While most studies tend to focus on framing in face-to-face interaction, which guides

perception and sensemaking, or alternatively on broad forms of framing of societal issues, a third level of framing processes is important for our purpose. In complex multi-actor innovation processes, projects are central to which new ideas are developed and employed. Here, we claim, another form of framing is taking place and seems to be a crucial ingredient. Typically, in projects different actors are trying collectively to position their project and the perspective they have on the components of the project and define what they want to reach with the project. In the end there should be a shared vision to a certain extent in order to continue a project, or in other words, as Bijker (1997) calls it: to what extent is 'closure' needed in order to realize innovation? Participants need to develop a joint idea and a temporal form of coordination in order to increase collectiveness in a project. We propose calling this intermediate level of framing the localized collective level. It is distinct from, but influenced by, personal schemata of the participants. Likewise, framing at the *localized collective level* is enabled and constrained by the global discourse, which resonates in society. Frames at the localized collective level can be very volatile during intense debate, but can also show some stability in the form of the 'shared understanding' that develops over time between the people involved in a common innovation project. This makes it an interesting starting point of this study.

2.3.3 What about materiality?

So far, framing has mainly been seen as pertaining to cognitions and interaction. In this research, we argue that materiality also can determine the way something is framed by actors. The field of science and technology studies has emphatically shown how artefacts and systems are not only shaped by interactions, but also shape interaction in return. We develop that idea further in this section in which we delve deeper into what we can learn from science and technology studies regarding the material characteristics.

A famous example of the influence of materiality in social processes, mentioned by Akrich and Latour (1994), is the key of a hotel room. By adding a large key ring to the key of a hotel room, people cannot put it easily in their trousers, and therefore are forced to leave the key at the desk of the hotel. A material characteristic, namely a large key ring, makes actors perceive the key in such a way that it is not meant to be taken with them. Akrich (1992) launched the notion of 'script' in relation to materiality. According to Akrich (1992, p. 208), "like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act". Or, as Nahuis and van Lente (2008, p. 567) state, "Script is about the action programme inscribed in the material dimension of technological artefacts that determines the behaviour of actors". "Technical objects contain and produce a specific geography of responsibilities, or more generally, of causes" (Akrich, 1992, p. 207). An example is a speed bump that makes the driver drive slowly, in order to prevent damage to the shock absorbers (Verbeek, 2006). So, according to Verbeek (2006), the influence of technological artefacts on (driving) behaviour can be understood in terms of scripts. Another example is the round conference table: it renders the actors around the table equal in the discussion because nobody is sitting at the head of the table. In this way the material characteristics (round table) display agency and define the roles of the actors involved.

Likewise, in design studies the term 'affordances' is used to point to the "perceived and actual

properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used” (Norman, 1988, p. 9). This is an argument that framing may include material dimensions as well, as the properties of a thing determine action. According to Akrich, you “have to go back and forth continually between the designer and the user, between the designer’s projected user and the real user, between *the world inscribed in the object and the world described by its displacement*” (1992, p. 208-209, emphasis present in original). The argument of Akrich, that technical objects define a framework of action, is interesting for the scope of this research, as it is a way to approach the combination of technological and social aspects in an innovation process. We argue that when studying interaction in innovation processes, not only do cognitions and the interactions themselves play a role in framing, but also material characteristics play a role. Whereas script mainly focuses on the action inscribed in technology, we focus on the frames that may come up because of material characteristics, not necessarily from technology. This means that a particular material aspect can influence the way actors frame something. For example a rectangular table can make actors frame the person sitting at the head seat as the chairman.

In science and technology studies, the term ‘frame’ is used as well. According to Bijker (1989, 1997), framing is not only about artefacts, but also involves practices and infrastructure. He introduced the concept of technological frame, in which cognitive, social and material elements such as technological artefacts are all taken into account. The concept of ‘technological frame’ is described as “the set of practices and the material and social infrastructure built around an artefact or collection of similar artefacts” (Bijker, 1997, p. 123). It includes “all elements that influence interactions within relevant social groups and lead to the attribution of meanings to technical artefacts, and thus to constituting technology” (Bijker, 1997, p. 123). According to Bijker (1997, p. 123), “A technological frame is built up when interaction around an artefact begins”. A technological frame structures the strategies to search for new solutions and to use artefacts. It is not an individual’s characteristic, nor a characteristic of systems or institutions; technological frames are located between actors, not in actors or above actors. Technological artefacts and practices are included within the frame. According to Bijker (1997), the technological frame can then be seen as a tool to analyse interaction processes within a relevant social group.

The technological frame concept of Bijker (1989) was the basis for the work of Orlikowski and Gash (1994), because it takes the context of design and use into account as formative aspects of technological frames. The technological frame as defined by Orlikowski and Gash (1994) stems from a social cognitive approach, and is defined as “. . .the subset of members’ organizational frames that concern the assumptions, expectations and knowledge they use to understand the technology” (p. 178). This includes perceptions of the nature and role of the technology itself, as well as the “specific conditions, applications and consequences of that technology in particular contexts” (Orlikowski and Gash, 1994, p. 178). This definition emphasizes the frames concerning and used to understand technology. According to Orlikowski and Gash, technologies are social artefacts and “their material form and function will embody their sponsors’ and developers’ objectives, values, interests and knowledge to that technology” (p. 179).

In communication studies, Leeuwis and Aarts also mention the idea that materials have an effect on the way something is framed (Leeuwis and Aarts, 2010). Framing does not happen in isolation, but in a context which influences the framing. This context consists of bio-physical and social-institutional factors (Leeuwis and Aarts, 2010). By bio-physical they mean technical, geographical, temporal and ecological aspects. Socio-institutional factors include legal, cultural, economic, relational and policy aspects.

Inspired by STS scholars like Akrich (1992, 1994) and Bijker (1989, 1997), we assume that materiality does a play a role in innovation projects as well. A technological frame is a broader concept that does not only take into account material aspects, but is seen as a tool to analyse interaction processes. But the idea that material characteristics influence the innovation process inspired us to take material characteristics into account, as they enable and constrain the way actors perceive something and therefore are useful to take into account when trying to understand framing of actors in an innovation process.

2.4 Theoretical framework

As we showed in the previous section, framing is not only shaped by the perspectives of actors (cognitive frames) or what is discussed in interaction between actors (interactional framing), but is also dependent on the possibilities and constraints of materials and technologies. Material dimensions also shape an innovation and influence the way things are perceived by actors and therefore we propose a third category of framing, namely 'material framing', inspired by the concepts of technological frame and script. So, in order to study framing in innovation processes, we have developed a theoretical framework based on the approaches to framing from literature.

What we have learned so far is that in literature a distinction is made between frames and framing. Based on what we have found in literature, we suggest that frames are less visible than framing. Frames are mental structures in people's heads, which are difficult to measure. One could see frames as sources, which are not always very visible. As Dewulf et al. (2009) suggest, experiments are needed to find cognitive frames. Frames delimit the 'expression' of actors, in which they make sense of issues based on their frames. These expressions can be analysed in order to find the frames. Therefore we follow the line of Gray (2003), who defines framing as "the activity and process of creating and representing frames" (p. 11). Frames are relatively static, but can be changed because of changes in the context. Frames determine the bandwidth in which actors can perceive something or act. In such an inductive approach, expressions are studied in order to find the underlying frames. In literature, it is acknowledged that although the cognitive and interactional approaches are different perspectives to framing, they are quite related. In interaction, cognitive frames come to the fore as every actor will start reasoning from their cognitive frames. Cognitive frames are the basis for interactional framing, but at the same time interactional framing can change cognitive frames. In the example of two boys playing, they both saw their activity as a game. In interaction, one of the boys is hit by the other one, and feels pain. At that moment, the activity is no longer a game for him, but a fight. Interactional framing depends on the interaction and is volatile. When using expressions such as 'game' or 'fight' we are pointing towards 'frames', and when it is about the process of determining whether

something is a game or a fight, we are talking about ‘framing’ (Gray, 2003).

The material frame is also related to both interactional framing and cognitive frames, as material characteristics influence the way something is perceived by actors. Material framing adds the influence of material characteristics to the way actors perceive something. Following that line, and adding the material frame concept, we suggest that expressions can be the result of all types of sources, as presented in Figure 2.2 . On the left side of the figure, the sources, called ‘frames’, are presented. These are difficult to study on their own, as they are not directly visible. The basic assumption of studying framing is that one tries to depict and engage the array of arguments and counter-arguments that surround complex social issues (Gamson and Lasch, 1983; Schön and Rein, 1994).

As soon as frames are expressed, a process called ‘framing’ (expressed by the arrow in the figure), the frames can be traced back by detailed studying of the expressions by the researcher. Framing is then the process of creating and representing frames (in the line of Gray, 2003). Framing is only visible if actors express their thoughts (claiming) or act according to their thoughts. By studying framed perceptions, statements and interaction it will be possible to trace the frames.

As Figure 2.2 shows, an expression can have different sources. It would be possible to isolate certain paths, e.g. from material to the expression (e.g. action), but we would argue that it is not possible to study the different paths separately. A speed bump limits speed, but as soon as someone sees a sign for a speed bump, they recognize that it is not possible to drive fast. This is an example in which cognitive and material characteristics are intrinsically entangled and shows that it is not always possible to isolate them. The point we would like to make in this scheme is that different forms of frames and framing are interrelated.

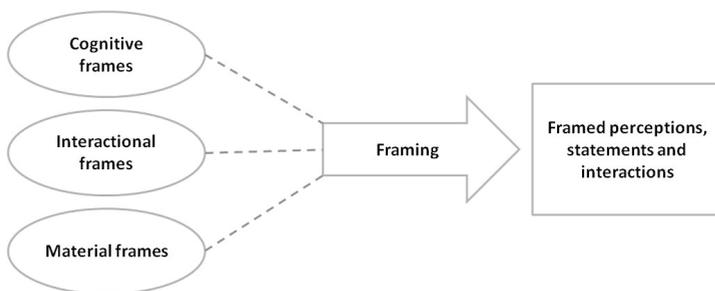


Figure 2.2 Theoretical framework

Based on Figure 2.2 we study framing and trace back the underlying frames. Framing is not about the perception itself, but is the phenomenon that this perception is limited by frames. Our general definition of *framing is that framing is the phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics.*

Based on the idea that there is a distinction between frames and framing, we focus on framing and use that as a starting point to get an insight into the frames. An important point to notice is that Figure 2.2 presents the situation at a certain point in time, and that this situation can change over time. Framing is an ongoing process.

Types of framing

Different types of framing can be distinguished, which are ontologically diverse. They have different origins. Inspired by the different studies on framing we provide below the definitions of the different types of framing as used in this research.

Cognitive frames

Dewulf et al. (2009) define cognitive frames as relatively static structures or categories in one's mind. These are difficult to study as these types of frames are in people's heads, most probably found by experiments or tests and therefore they can be seen as 'sources', as mental maps in people's minds. They are relatively static and not easy to change. Therefore, we define *cognitive frames as relatively static structures in one's mind that enable and constrain understanding, action and interaction.*

Interactional frames

According to Dewulf et al. (2009), interactional framing is about the co-construction of issues, identities and processes as they are negotiated in interaction. In this explanation, interactional framing focuses on framing in interaction, and studies the interaction process itself. As the verb 'framing' already suggests, interactional framing is an ongoing process, and focuses on what is happening between actors. We study the interaction processes at the level of the innovation project and study how frames change during the innovation process. So we do not look at how one interaction moment frames change, but we do focus on the change of framing over time in an interactional setting. We define *interactional frames as the fluid frames that condition interaction.*

Material frames

The material dimension we will call a *material frame*. Material framing is based on the idea that materials influence the way actors perceive something. Inspired by Akrich's 'script', a material frame refers to the artefacts that enable and constrain the developments in the innovation process. Materiality influences the interpretation of (aspects of) the project and thereby enables or constrains the innovation process. Material frames are interpreted by actors as inscribed in materials and are not easy to change. We define the material frame as the *characteristics of artefacts that enable and constrain understanding, action and interaction.* A material frame can have an influence on one or more actors directly or indirectly involved in a project. A material frame is induced by a material, but can be traced back in the expressions of an actor.

2.5 Summary and research questions

Our research focuses on innovation processes in the agro-food sector towards sustainability. The involvement of actors is central to this. As many innovation scholars have shown, e.g. Smits and Den Hertog (2007), Moors et al. (2008), Geels (2011), Boon (2008) and Nahuis et al. (2012), it is important to involve a diverse set of actors in the innovation process. Additionally, various studies in the agricultural field, such as Pretty (1995), Davidson (2006), Klerkx et al. (2009) and Elzen et al. (2011), state the difficulties with involving actors in the innovation process. Literature on innovation processes (Geels, 2011) also emphasized the importance of looking at the level of the actors. In particular, when different actors with

different perspectives are involved in innovation processes, it is useful to get an insight into how interaction between various actors is taking place and influencing the innovation process. From framing literature (Dewulf et al., 2009, p. 155) we borrow the ideas of cognitive and interactional framing and add to these types of framing material framing. Material framing is inspired by ideas in STS literature on the role of materiality in innovation processes. With these three approaches towards framing (cognitive, interactional and material), we look at the interaction between heterogeneous actors in innovation processes towards a more sustainable agricultural sector.

What we also learned from earlier literature studies on framing is that framing can be studied at different levels, varying from a micro-level studying face-to-face interaction, to studying media and framing at the level of society, in what we call the 'global discourse'. Our research is positioned in between, at the level of the localized collective, because we are studying relatively delineated innovation projects. We assume that phenomena at all three levels influence each other and that the three types of framing – cognitive, interactional and material framing – are present at the level of the localized collective.

Based on the developed theoretical framework we have formulated three types of research questions that address system innovations and framing. The first research question investigates what framing is in these complex multi-actor settings. In answering this question we will study the different ways in which framing can occur in innovation processes, based on what we learned from the different theoretical insights.

1. How does framing occur in complex multiple-actor settings in innovation processes?
The second question is about the possible influence of framing on innovation processes and the way in which framing influences the outcome of innovation projects.
2. How does framing facilitate and hinder innovation in complex multi-actor settings?
The third question is an overarching question on the lessons we can learn for system innovations in general.
3. What are the implications of framing for the ambition of transitions in agriculture and for system innovation in general?

3.

Methodology: analysing framing

3.1 Introduction

This chapter outlines the methodology we use in this thesis. The theoretical framework presented in the previous chapter was the basis for the development of a methodology in which we follow topics over time in an innovation process in order to analyse framing. The following section discusses the research design and the case study selection. Section 3.3 discusses how to study framing in the cases. Section 3.4 focuses on the way the data are collected and section 3.5 describes how frames are derived from the data. We will discuss the methodology of analysing topic biographies. Section 3.6 is on the validity and reliability of the research.

3.2 Research design

We chose to make use of a case study approach as we aim to get an in-depth insight into a complex phenomenon, namely framing in innovation projects in the agricultural sector that is occurring in a real-life context. A case study is a rich empirical description of particular instances of a phenomenon that is typically based on a variety of data sources (Yin, 2003). Case studies are useful for analysing phenomena as dynamic processes in their natural, real-life context, when such a rich description is needed (Yin, 2003). Case studies are an appropriate research strategy when *how* or *when* questions are postulated and when the researcher has little control over events. We are studying temporary phenomena that are subject to change during innovation processes. The case study method is a suitable method for studying phenomena that cannot be isolated from their context. In order to study framing, a rich description is necessary, as framing is influenced and determined by the context. The context provides insights on the frames that exist. The unit of analysis is the framing in interaction.

According to Orlikowski and Gash (1994), frames are time- and context-dependent and therefore examined *in situ*. So a case study in which phenomena are studied in their real-life context is a suitable method. We chose a qualitative research design as we are mainly concerned with the nature of the phenomenon of framing. We chose a multiple-case design as more than one case study will yield a more complete understanding of framing in innovation processes and furthermore makes it possible to show complementary effects of framing on innovation processes as well. Each case study provides a narrative based on rich empirical data.

Since case studies require a detailed analysis, only a few cases can be studied in this research. The cases selected for this study have three main characteristics in common. First, the cases which are suitable for a case study are examples of sustainability issues in the agro-food sector, and more specifically in animal husbandry. We did not give a definition of sustainability beforehand, but stay with what the actors mean by sustainability. So, sustainability is taken in its broadest sense, including environmental impact, animal welfare, human health and economic sustainability. Secondly, the cases are examples of innovative ideas or projects that the actors want to realize in order to create a more sustainable agricultural sector. Thirdly, we are interested in interaction between various actors. So a heterogeneous group of actors have to be involved in the cases, such as knowledge institutes, governmental

organizations, societal organizations, businesses and intermediaries. These heterogeneous actors should actively participate in the innovation.

It can be expected that processes of framing will differ over the different phases of development in a project. Therefore, the case selection reflects different phases of development (see Table 3.1) in order to gain an insight in framing in these different phases. We have investigated three cases, namely the Roundel project, the Kwatrijn project and the developments around antibiotics use in animal husbandry.

In the first case study we studied the Roundel project. The Roundel was on the development of a sustainable system for keeping laying hens and the marketing of the table eggs produced in such a system. The innovation project is a follow-up to the project 'Caring for Hens' by Wageningen University, finished in 2004, in which the development of sustainable laying hen systems was central. A design was made in which the 'needs' of the farmer, the citizen and the animal are taken into account (Bos and Groot Koerkamp, 2009). The rough sketch that was made during the 'Caring for Hens' project was further developed in the Roundel project. With the system builder, the businesses, researchers, intermediary organizations and to a lesser extent the Society for Protection of the Animals, a design was made and ideas were explored on how to market the egg. The project is followed from October 2009 until the summer of 2010. The Roundel was a project in its implementation phase. At the time of the study, the system had been designed, the decision was taken that it would be built and the question was how to position the system in the existing economic and political context and how to market the eggs produced in this system.

The second case study was about the Kwatrijn project in which the development of a dairy cow system close to a nature conservation area was central. In such a system, animal welfare, integration in the environment and environmental issues are central. This innovation project also had its origin in a project from Wageningen University, namely 'Cow Power' (Bos et al., 2009), in which the development of sustainable dairy systems is central. A farmer became interested in the idea and wanted to implement such a system on his own farm. Together with the farmers' association, businesses, a researcher and advisory companies, the ideas of 'Cow Power' were translated into a dairy cow system applied in practice. This project was in the phase of designing the system and therefore it focuses on what the system should look like and the technical components of the system. The project started in 2009, but was a follow-up to a broader project on keeping cows that lasted from 2007 until 2009. The project was followed from September 2010 until March 2012. The design of the system and the implementation had not yet been decided, and discussions are mainly about how the system should look, what the most important characteristics are and how to fit the system into the existing landscapes and ideas regarding keeping dairy cows.

The third case study was about antibiotic use in animal husbandry. A clearly defined project was not yet developed, but the study was mainly investigating what the problems are with antibiotic use and how the veterinary sector is dealing with this issue. Compared to human health, the use of antibiotics in animal husbandry is very high. The potential risk is that resistance against antibiotics is developed with consequences for applying antibiotics in humans. There were a lot of developments around antibiotics use in animal husbandry, and

the amount of antibiotics used is decreasing, but there is also a lot of discussion regarding how to deal with this issue and who should take responsibility. The case is an example of how framing determines the way of dealing with problems and solutions of antibiotic use. This case was in a very early phase of development, as actors still were discussing what the exact problem is and what possible solutions might be. The antibiotics case was investigated between July 2012 and November 2012. There was not yet a consortium or project group established that is in charge of setting up projects, although there are some (local) initiatives of, for example, farmers, and discussions are taking place on who has to take responsibility and a leading role.

The three cases differ in the phases of development and different actors are involved. In the starting phase wherein the problem is defined, the emphasis is mostly on (scientific) knowledge, so mainly the initiators and researchers are involved. When a project becomes more concrete, the focus is more on the actors designing the innovation, such as the farmers, constructors and municipalities. In the final phase the focus is on the marketing and financial aspects, what makes that for example marketers are involved. For example, retailers were involved in the later stages. By focusing on different aspects of the agro-food chain, almost the entire value chain is taken into account. Table 3.1 presents the most important aspects of the different cases.

Table 3.1 Overview of cases

	Roundel	Kwatrijn	Antibiotics use
Main goal:	Development system and marketing of egg	Design barn and surrounding system	Reduce use of antibiotics in animal husbandry
Main focus:	How to build a solution	What solutions are possible, because current solutions do not work.	What's the problem? No project yet
Phase of development:	Implementing a solution	Finding a solution for a problem	Deciding what the problem is

While the cases on Kwatrijn and the Roundel project were both about constructing barns, the antibiotics case has not yet developed into a concrete project and it is even unsure whether it ever will. Inherent to the phase of the case, discussions on antibiotics were more directed towards what the problem is and how to solve it. The other two cases were in a phase in which there is a project consortium, and people were already collaborating. Studying these various phases allows us to provide a richer understanding of framing innovation.

3.3 How to study framing in cases

The question is, how can we study framing in these cases? As discussed in the previous chapter, frame analysis is used in different traditions. Dewulf and his co-authors (2009) made a distinction between cognitive and interactional approaches. Researchers interested

in cognitive framing approaches look at the way individuals represent and process information about their world. They rely on various kinds of data such as experiments, tests, interviews and observations. Cognitive frames can be studied by focusing on information representation. The cognitive approach to frames focuses on evidence visible in for example texts (at the surface) that reveals the underlying structures of the participants' cognitions (Dewulf et al., 2009).

The interactional framing research focuses on analysing recorded and transcribed observations of interaction. Researchers studying interactional framing study interaction; in their perspective, framing is an interactional process in which meaning is co-constructed in interaction. In interactional framing it is shown which particular aspects of issues, identities and relationships and processes are emphasized, downplayed or circumscribed when disputants in multi-actor negotiations, challenge each others' issue formulations through subtle linguistic variations (Dewulf et al., 2009). To see the 'subtle linguistic variations' one needs to analyse the discourse between various actors. Tannen (2009) explains framing as a type of discourse analysis that asks questions like 'What activity are speakers engaged in when they say this?' and 'What do they think they are doing by talking in this way at this time?'

Material characteristics play a role as well, as we learned from the 'script' approach of Akrich (1992) from science and technology studies. Material characteristics influence the way actors perceive things, for example the shape of a conference table or a doctor's white coat. Material characteristics are mentioned by actors and are limiting the thinking and acting of actors point at material framing. Only the material characteristics mentioned by actors are taken into account, as the fact that these characteristics are mentioned means that they are perceived as part of a topic.

We make use of definitions of framing other than Dewulf et al. (2009), as we propose that it is important to take cognitive, interactional and material characteristics into account (see chapter 2). We make use of a theoretical framework of framing in which we distinguish three levels at which framing occurs, namely global discourse, face-to-face interaction and the localized collective. Framing at the global discourse level focuses on debates in society and the mass media. Framing can then be studied by studying newspaper articles. An example of global discourse in relation to the topic of research in this thesis is the public discussion about 'mega farms'. Framing studies on the face-to-face interaction level focus mainly on the framing that happens when actors interact. For example, when two people are talking, one actor's statement is framed by another actor when he reacts to it. For example, if person A asks 'Are you feeling well?' and person B reacts with 'I look so tired because I slept badly last night', person B frames the statement of person A differently than if he answers 'Yes'. The third level of framing we distinguish is the level of the localized collective, the level of a project. Within a project, actors frame issues in the context of the project. Furthermore, when the project is presented to 'the outside world', such frames are used to position the project.

As we are interested in studying system innovations with multiple actors involved, it is our main interest to learn how framing in such an innovation process occurs. Typically,

innovation processes take place in the context of an innovation project that is followed over time and in which framing occurs. Therefore we emphasize especially the level of the project, the localized collective framing. However, framing at the global discourse level and framing in face-to-face interactions influence projects as well. These two levels were taken into account when the actors involved indicated they were relevant.

Furthermore, we distinguish three types of framing – collective, interactional and material framing in the analysis. Cognitive, interactional and material frames, however, cannot be observed directly, as they are not present in an isolated form. In order to find out how and when framing takes place we need to determine how topics change over time. Frames can only be inferred by considering what gets framed. In order to study these different types of framing some delineation is needed. This delineation comes to the fore when actors discuss what we call a *topic: problem or goal relevant to one or more participants*. Topics are explicitly or implicitly introduced into the interactions by the actors, and can be traced afterwards by analysing documents and interviews. Topics are mentioned by the actors themselves and in discussing those topics actors express themselves, which provides access to their framing. As frames are latent and become partly manifest in speech and text, it is important to stay as close as possible to the text in order to prevent over-interpretation. Therefore the first step in the investigation of frames consists of the detection of keywords (Koenig, 2004) or labels (Baarda et al., 2005). By coupling labels to different text fragments, the fragments can be organized and separated in groups (Orlikowski and Gash, 1994). This process is called ‘coding’.

3.4 Data collection

In order to gain an insight into the phenomenon of framing we study the cases by using different sources, namely documents, interviews and observations during project meetings.

First, different types of documents were collected, including project reports, project meeting notes, and in the case of the antibiotics case newspaper articles as well. Documents, such as reports and overviews, were found via the suggestions of interviewees and searching on the Internet using keywords related to the project under study. The documents found also mention other reports and documents, which were investigated as well (snowball method). Furthermore, in-depth semi-structured interviews were conducted with actors in the project consortia. The snowball method was used to select the interviewees. People that were selected to interview were strongly involved in the subject, because they were present at the meetings of the consortia or were mentioned by different interviewees. In the Roundel and Kwatrijn projects, the project leader was asked to mention the people who were involved in the project or had an influence on the project. In order to get a view on how different actors perceived the project from various perspectives, actors with different roles or backgrounds were approached, such as researchers, farmers, policy makers, intermediaries and businesses.

The interviews were semi-structured and had open questions. The topics addressed in these interviews are presented in Table 3.2. The goal was to investigate the perception of the actors on how the project was developed and how it proceeded, how they perceived the role of

others, the possibilities for the future, important events and important influences. Asking open questions ensures that the aspects mentioned are important for the interviewees, and that the knowledge of the researcher does not influence the perception of the interviewees. Although the data were a representation of the perception of the actors, the frame analysis was conducted completely by the researchers.

Table 3.2 Topics addressed in interviews

Topics
Actors involved
Roles of the different actors involved
Changes and developments in the project
Important events
Goals
Enabling and constraining aspects
Interaction between actors
Process
Sustainability aspects
Future developments

Furthermore, in the Roundel case and the Kwatrijn case, project meetings were attended and observations were made. Finally, interaction moments were recorded in the Roundel case. These interaction moments were, for example, workshops. As the antibiotics case did not include a clear project, that case was investigated through in-depth interviews with key actors in the field and more than 20 reports, as well as newspaper articles in the LexisNexis database since 1993 (more than 170 articles). We did a search on “LexisNexis” with search terms such as ‘antibiotica’ (‘antibiotics’), ‘veehouderij’ (‘animal husbandry’) and ‘dierenarts’ (‘veterinarian’). The table below (Table 3.3) provides an overview of the data investigated in this thesis.

Table 3.3 Overview of data collected

	Roundel (Oct 2009- Aug 2010)	Kwatrijn (Sept 2010- Mar 2012)	Antibiotics (Jul 2012- Oct 2012)
In-depth interviews	8	8	8
Documents (e.g. reports, plans, notes)	21	18	20
Observations of meetings	6	6	1
Other materials (interviews of colleagues, related reports, newspaper articles)	30	15	170

The semi-structured in-depth interviews, and the interaction moments (of the Roundel project), were transcribed verbatim with the help of the F4 program.⁴ Project material included notes of meetings, project plans, evaluations and end reports. In the following section we discuss in more detail how data were analysed.

3.5 Data analysis: analysing framing

All the data were organized in the qualitative data analysis program Atlas.ti.⁵ Interviews and a lot of the reports studied were in Dutch and the quotes used in this thesis were translated by the authors. We focused on text fragments (called 'quotations' in Atlas.ti) related to sustainability in the interviews and other data material. The transcripts and reports were read and based on the issues mentioned by the actors involved the fragments were coded. Transcripts of interviews and the project documents were coded with words as close as possible to the words the actors used. This is called 'open coding', and means that a huge amount of data is reduced to a collection of codes (Baarda et al., 2005). By coding like this, the quotations can easily be categorized based on content.

Once the quotations are categorized, the quotations can be organized per issue. The step from all codes to constructing main issues or themes is called 'axial coding' (Baarda et al., 2005). By organizing the quotations per main issue, and presenting the different quotations in time order, a *topic biography* is developed. During innovation projects topics may emerge, become salient and dominant, or may leave 'the scene'. It is possible to reconstruct the vicissitudes of a topic based on the quotes of interviewees, traces of interaction processes and project materials in topic biographies.

We emphasize that the topics are not invented by the analyst but brought into existence by the actors themselves: they discussed them, expressed their perspective on them and stressed their importance. When following topics we automatically encounter discussions about the roles of actors in the discussion and the processes around it. The biography of a topic allows a further analysis of the framing around that topic as it shows the different framing of a topic and the changes therein. We consequentially follow three questions to get a complete description of a topic:

1. What is the problem to be addressed?
2. What causes the problem according to the actors?
3. What are the (explicit or implicit) suggested steps forward?

The answers to these questions will produce a complete biography, describing the moments a topic became important, faded away or became an important topic again. Which topics are followed is selected based on what interviewees mentioned as important topics, and the topics that came to the fore a lot when reading all the material. The topics that are discussed a lot are for the actors important topics, because it is not immediately clear how to deal with these topics. The discussions around these topics show many instances of framing. All cases contain more topics than can be presented, but based on reading the materials we chose to develop a topic biography of these topics that are discussed widely by the actors involved in the project. Once a selection was made on which topics to follow, we searched again in all

⁴ <http://www.audiotranskription.de/english/transcription/> - ⁵ Atlas.ti version 6.2.26 source: www.atlasti.com

materials for quotes on the topics by using search terms. For example when searching for the topic outdoor run in the Roundel project, we searched for: ‘uitloop’ (‘outdoor run’). We first started with all quotes about ‘outdoor run’ and based on what we have read in these quotes, we found other search terms that also deliver quotes about ‘outdoor run’ but not mention that term, such as ‘buiten’ (‘outside’), and ‘ruimte’ (‘space’).

By analysing the topic biographies, we focus on how thinking and interacting are limited by mental schemes, interactional patterns and material characteristics. We try to find the underlying sources that can be cognitive frames (language and cognitions/mental maps), interactional patterns, and/or material characteristics (see Table 3.4).

Table 3.4 Definitions of types of frames

	Definition
Cognitive frames	Relatively static structures in one’s mind that enable and constrain understanding, action and interaction
Interactional frames	Interactional frames as the fluid frames that condition interaction
Material frames	Characteristics of artefacts that enable and constrain understanding, action and interaction

3.6 Quality of the research

Although the generalization of the results of case studies is limited, analytical generalization is often possible (Yin, 2003). But as Flyvbjerg (2006) suggests, “often it is not desirable to summarize and generalize case studies. Good case studies should be read as narratives in their entirety” (p. 241). Generalization is based on analytical grounds.

In case study design it is important to make use of different sources of evidence (Yin, 2003). We collected data from different sources, namely interviews, reports, newspaper articles, observations during project meetings and transcripts of workshops. This data triangulation solves the problem of constructing validity (Yin, 2003). We started getting information from project materials like notes, project plans etc. We also made use of audio tapes of interaction moments and interviews with actors involved in the case. Interviews were transcribed verbatim to prevent over-interpretation. The meetings in which stakeholders interacted were particularly useful to study as during interaction the similarities and differences between frames can show up (Orlikowski and Gash, 1994). Furthermore, in the case about antibiotics use, we analysed newspaper articles.

Furthermore, redundancy is important in case study research: collecting plentiful information to avoid missing relevant information. Redundancy is met by collecting as much relevant case material as possible.

Reliability is assured by carefully documenting the process of data collection and data

analysis. The interview questions for each case are based on similar items (see Table 3.2). The data, consisting of documents and transcribed interviews, are systematically coded and the process of coding is replicated in order to make the codes more specific. A first analysis brought issues; these are collected in topic biographies and coded again.

Framing analysis is a type of analysis in which the interpretation of the researcher is key. Investigator triangulation took therefore place by discussing findings with different researchers. Framing analysis is an iterative process in which data is investigated by reading it over and over again. By discussing the results with other researchers the analysis is improved and further developed and the reliability increases.

4.

The Roundel: framing of a sustainable hen husbandry system⁶

Abstract

The agri-food sector is under pressure to move towards sustainability and broad socio-technical changes are needed. In such encompassing innovation processes that concern the whole agri-food chain, actors with different institutional backgrounds are confronted with each others' interests, ideas and perspectives. Framing, then, may both support and hinder the alignment of actors and interests. In this paper we investigate how framing occurs in multi-actor innovation projects and how it facilitates or hinders the continuity of these projects. We first review the broad literature on framing, which leads to a typology of three levels of framing: face-to-face interaction (between individuals), global discourse (within society) and localised collective (in projects). In addition, we add a third category to the traditional distinction between 'cognitive' and 'interactional' framing. We argue that in socio-technical innovations also 'material' framing occurs. In an empirical case study, based on in-depth interviews and document analysis of the Roundel project (2004-2010), a Dutch innovation project aimed at sustainable egg production, we trace and analyse these different forms of framing. The project survived several critical episodes, due to changes in framing. Our study yields general lessons about framing in complex innovation projects, both conceptual and practical.

Keywords: system innovation, transition, framing, agri-food chain.

⁶ This paper is published as: Zwartkruis, J.V., E.H.M. Moors, J.C.M. Farla and H. van Lente (2012). Agri-food in search of sustainability: cognitive, interactional and material framing. *Journal on Chain and Network Science*, **12**(2), pp. 99-110. The appendix of the chapter contains extra data, that is taken into account in the conclusion chapter 7.

4.1 Agricultural innovations towards sustainability

Since the 1950s the agricultural sector in industrialized countries has grown dramatically (Food and Agricultural Organisation of the United Nations (FAO), 2011; Pretty, 2008; Pretty et al., 2010). Increasingly, this growth has been challenged by environmental problems, such as emissions of polluting substances to the air, soil and groundwater (Bos et al., 2003), and by societal concerns about nature conservation, animal well-being and quality and safety of food products (Bekke and De Vries, 2001).

The economic conditions for the agricultural sector have changed as well. Due to globalization, for example, consumers can now choose between many food products from all over the world, and they have higher demands regarding quality, traceability and environmental friendliness of products and processes (Ruben et al., 2006). According to some scholars, it is no longer the producer, but the consumer who determines the rules of production and marketing of food (Bekke and De Vries, 2001). As the agricultural sector is facing a lot of technical, economic, socio-political and ecological challenges, innovations are seen as inevitable (De Groot, 2003; Werrij, 2007). Given the concerns related to animal welfare, biodiversity and environmental problems (Beers et al., 2010), the interest in sustainable practices is increasing (Pretty, 2008). Furthermore innovations in the agricultural sector are needed to maintain the 'license to produce' (social problem), the 'license to operate' (policy problem) and the 'license to deliver' (market problem) (Veldkamp et al., 2008).

Various conditions hinder the agricultural sector to move in a sustainable direction. In the first place, there is no precise definition of what sustainable agriculture will comprise, despite the plethora of studies about the future of the planet in relation to food production (e.g. Kloppenburg Jr. et al., 2000; Nousiainen et al., 2009). As Francis and Hildebrand (1989, p 4) state: 'everyone assumes that agriculture must be sustainable. But we differ in the interpretations of conditions and assumptions under which this can be made to occur.' There is no agreement about how to operationalize and measure 'sustainability' (Nousiainen et al., 2009). Indeed, sustainable development is an umbrella term covering many aspects, and is filled in by various activities and practices (van Lente and van Til, 2008). So, there are many interpretations but not a consensual view on what a sustainable agricultural sector should look like.

Furthermore, the agri-food sector is complex and involves different kinds of actors who produce, process or distribute food and agricultural products. As the agri-food sector consists of complex chains, coordinating change is a daunting task. The actors are interdependent, so if something changes in one part of the chain, it will affect the other parts as well. This condition compels innovation to take account of the different interests and ideas; that is, the change should be systemic.

Inspired by the systems perspective (Smits, 2002), many innovation experiments are being conducted, in particular in the Dutch agri-food context, in which multiple actors are involved. These actors often are interdependent and comprise knowledge institutes, governments, farmers, businesses, intermediary organizations and societal organizations. In interaction actors with different institutional backgrounds are confronted with each other's interests,

ideas and perspectives. The experiences thus far are mixed: the innovation experiments are promising in principle, but also encounter many pitfalls and clashes of conflicting interests and perspectives (Klerkx and Leeuwis, 2009).

In this paper we will investigate a particular phenomenon that seems to stimulate or hinder innovation experiments in settings of interdependent stakeholders with conflicting interests, visions and ambitions: the notion that actors in their perception and interactions are enabled and constrained by ‘framing’. As the social sciences have stressed in various ways and with different terms, framing is needed to guide perception and enable interactions; in this sense framing processes are part and parcel of any social system. Due to different frames, actors will perceive the world and its exigencies differently, and respond differently. Due to different frames, therefore, the required alignment between the many stakeholder parties can be thwarted. Correspondingly, when frames change, new forms of alignment may be established. Therefore, our research question is: How does framing occur between actors of the agri-food value chains and how does framing facilitate or hinder innovation in complex multi-actor settings?

We first discuss the notions of ‘frame’ and ‘framing’ based on a literature study. Our main argument is that in socio-technical changes like in agri-food innovations not only the well-known categories of cognitive and interactional frames are important, but also a category that we label as ‘material frames’. Then we delineate our method to study framing in innovation processes and introduce our case study, the Roundel project, which is about a new way of egg production and marketing. In the results section we compare and analyse instances of framing. The paper concludes with a reflection on the importance of understanding framing in systemic innovations in the agri-food value chain.

4.2 Conceptual reflections on framing

This study should be placed in an interpretative or social constructionist tradition, studying the co-existence of multiple, socially constructed realities which are historically and culturally specific (Berger and Luckmann, 1966). The concept of framing already has a long tradition, or put more precisely, several traditions. It originates from cognitive psychology (Bartlett, 1932) and anthropology (Bateson, 1972). Starting with Bartlett’s schema theory of memory (Bartlett, 1932), cognitive psychologists define frames as cognitive structures in our memory that can help to organize and interpret new experiences. In the work of Bateson (1972) on (meta-) communication, framing is about the understanding of ongoing interaction by focussing on the exchange of cues. His example is the play between two boys, which becomes rougher and ends as a fight. According to Bateson, the ambiguity of how to interpret ongoing interactions – in this example whether the roughness is ‘play’ or ‘fight’ – creates the need for framing.

In later studies, framing has also been used in, for example, sociology (Goffman, 1974; Benford and Snow, 2000), artificial intelligence (Minsky 1975), psychology (Levin et al., 1998), policy studies (Schön and Rein, 1994; Hajer, 1995), communication studies (Entman, 1993; Tannen, 1993; Bryant and Miron, 2004), management studies (Creed et al., 2002) and conflict and negotiation studies (Lewicki et al., 2003). According to Dewulf et al (2009 p 156)

‘the smorgasbord of approaches differs conceptually, ontologically and methodologically’. The common denominator between these different framing traditions, according to Weick (1995), is that a frame is a ‘sense making device’.

A useful overview is provided by Rein and Schön (1996), who describe four distinct (but mutually compatible) meanings of ‘frame’, which cover a broad spectrum of framing research: 1) as an underlying structure giving regularity to events as they unfold over time, 2) as setting a boundary, like in framing a picture, focusing on what is inside the frame, 3) as a schema of interpretation, and 4) as strong and generic narratives that guide both analysis and action in practical situations. The first meaning hints to a lack of adaptability to events as they unfold over time. This emphasizes the constraining force of frames. For instance, a specific frame of a problem will point to specific ‘reasonable’ solutions and obscure other possible solutions (Benford and Snow, 2000). The same holds for the second description; by leaving some parts outside the frame, extra attention is given to the elements that are in the (picture) frame. Related to this, Beers et al. (2010) point to the fact that framed images can have a large, partly unwanted influence because they necessarily simplify complex real-world phenomena. The third meaning points to the enabling properties of frames. Schemes of interpretation make events meaningful, can organize experience and guide action, whether individual or collective (Davidson, 1985). Finally, the fourth meaning treats frames as strong and generic narratives that guide both analysis and action in practical situations. Such narratives tell what the problems are, what needs fixing and how it might be done. An example is the frame of a disease that requires cure or quarantine (Rein and Schön, 1996). Frames, thus, enable certain lines of action while constraining other types of action.

A typology of framing

One of the critiques on framing perspectives is that it is ‘often lacking conceptual precision in its delineation of constituent elements and processes’ (Steinberg, 1999 p 738). As a first step towards more precision, we suggest a typology of framing on the basis of three different levels of social dynamics, where frames reside and operate in distinct ways (see Figure 4.1). This typology also allows us to review the various strands of framing research.

Many studies of framing are at the level of *face-to-face interaction*. They investigate how individual (cognitive) frames develop over time; they consist of deep beliefs as well as more flexible schemes for understanding the world around us. Such individual frames are characterized by the psychological concept of ‘schema’, which is defined by Entman (1993 p 53) as ‘mentally stored clusters of ideas that guide individuals’ processing of information’. In the tradition of symbolic interactionism, schemata are interpretive frameworks that help to make sense of a situation (Goffman, 1974).

In contrast to the individual forms of framing, research on discourses and mass media highlight broader, societal forms of framing. Here, framing relates to how issues are presented: what is highlighted, what is ignored and what is the relation with other issues. An example is the study of Feindt and Kleinschmit (2011) about the reframing of responsibility during the Bovine Spongiform Encephalopathy (BSE), also called mad cow disease, crisis in German newspapers. This strand of research, thus, concerns the storylines present in society that frame events and meanings in particular ways. Frames in society, are voiced and reproduced

in the media. These frames ‘out there’ have also been described as ‘images’ (Beers et al., 2010), as ‘structuring elements of discourse’ (Hajer and Versteeg, 2005) or ‘master frames’ (Benford and Snow, 2000). Discourse analysis is about the social reality produced and made real through particular ways of talking about the world (van den Brink, 2010). We will call this level of framing, *the global discourse*, stressing its encompassing and general nature.

While most studies tend to focus on face-to-face interaction and individual forms of framing which guides perception, sense making and, or alternatively, on broad forms of framing of societal issues, a third level of framing processes is important for our purpose. In multi-actor innovation processes, projects are central in which new ideas are developed and employed. Here, we claim, another form of framing is taking place and seems to be a crucial ingredient. Typically, in projects different actors are trying collectively to position their project and define what they want to reach with the project. Participants need to develop a joint idea, a shared approach and a temporal form of coordination. We propose to call this *localised collective* framing. It is distinct from, but influenced by personal schemata of the participants. Likewise, they are enabled and constrained by global discourse, which resonates in society. Localised collective frames can be very volatile during intense debate, but can also show some stability in the form of the ‘shared understanding’ that develops over time between the people involved in a common project. A similar level of framing is addressed in the studies on social movements (Benford and Snow, 2000). In this study we focused at framing at the localised collective level.

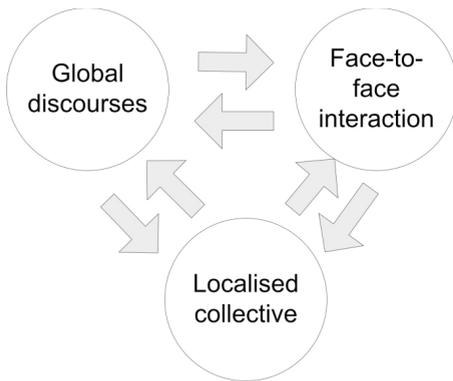


Figure 4.1 A typology of framing

Cognitive, interactional and material framing

The ambition of this paper is to study framing in agri-food innovations. The idea is that innovation projects require – at least to some level – a common understanding of the problems and the preferred solutions. A first conceptual step was to delineate different levels of framing and to limit ourselves to localised collective framing. A next step is to be more precise about how framing takes place. A useful starting point here is the distinction between cognitive frames and interactional framing as described by Tannen and Wallat (1987) and later extended by Dewulf et al. (2009). Tannen and Wallat (1987) make a distinction between ‘interactive frames’ and ‘knowledge schemas’. Interactive frames refer to what is going on in interaction, and knowledge schemas refer to participants’ expectations about

people, objects, events and settings in the world (Dewulf et al., 2009). Cognitive frames are relatively static structures or categories in one's mind. The interactional framing theory investigates the co-construction of issues, identities and processes as they are negotiated in interaction. Cognitive frames and interactional framing are not mutually exclusive categories (Dewulf et al., 2009). As Aarts and van Woerkum (2006) state, 'interactional framing and cognitive frames both emphasize different aspects of the framing process'. Also Tannen and Wallat (1987) point to a relationship between interactive frames and knowledge schemas. For instance, in case of a mismatch in knowledge schemas (cognitive frames) between people, a shift of interactive frames is triggered, and the other way around.

In the case of technological innovation processes, however, the fate of projects does not only depend on the perspectives of people (cognitive frames) and on patterns of interaction (interactional framing), but also on material constraints. Sustainable innovation processes in the agri-food chain, indeed, are socio-technical reconfigurations. The tradition of Science and Technology Studies has emphatically shown how artefacts and systems are not only shaped by interactions, but also shape interaction, in return. The so-called 'script' of technical objects, for example, refers to the action program inscribed in the material dimension of technological artefacts, which constrains the behaviour of actors. An example is the round conference table: it renders the actors around the table equal in the discussion because nobody is sitting at the head of the table. Another example is the speed ramp, which forces drivers to lower their speed. In this way the material aspects define the roles of the actors involved. As Akrich (1992 p 208) puts it: 'Technical objects define a framework of action, together with the actors and the space in which they are supposed to act'. Likewise, in design studies the term 'affordances' is used to point to the 'perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used' (Norman, 1988 p 9). This is an argument that framing may include material dimensions as well. The *material frame*, as we call it, refers to the artefact(s) that enable and constrain the developments in the innovation process. We define the material frame as the *characteristics of artefacts that enable and constrain understanding, action and interaction*.

4.3 Methodology of analyzing frames

In order to find out how and when framing is taking place we need to determine how frames and framing change over time. Cognitive, interactional and material frames, however, cannot be observed directly, as they are not present in an isolated form. Frames can only be inferred by considering what gets framed, as we discussed above. So, one way to study this phenomenon is to follow how *topics* are discussed in innovation projects over time. We define a topic as a problem or a goal, relevant to one or more participants in the interactions. Topics are explicitly or implicitly introduced into the interactions by the actors themselves, and can be traced afterwards by analyzing documents and interviews.

During innovation projects topics may emerge, become salient and dominant, or may leave the scene silently. It is possible to reconstruct the vicissitudes of a topic, or, how we propose to call it, the *biography of the topic*, on the basis of quotes of interviewees, traces of interaction processes and project materials. We emphasize that the topics are not invented by the analyst but brought into existence by the actors themselves: they discussed them,

expressed their perspective on them and stressed their importance. When following topics we automatically encounter discussions about the roles of actors in the discussion and the processes around it. When some actors, for example, are talking about building permits, they implicitly seek to convince the local authorities to give a permit and thereby talk about the process and what they see as the role of the civil servants. The biography of a topic allows a further analysis of the framing around that topic. We consequentially follow four questions to get a complete description of a topic.

1. When, how and why was the topic introduced?
2. How did actors cope with the topic?
3. What was the effect of interactions on the fate of the topic?
4. How did cognitive, interactional or material frames change in due course?

The answers to these questions will produce a complete biography, describing the moments a topic became important and faded away.

Data collection

How did we trace the various framing processes related to the topics? First of all we interviewed the actors involved in the project. The semi-structured, in-depth interviews were transcribed verbatim with the help of the program F4⁷. Besides the interviews also project material and other documents were studied. Project material included notes of meetings, project plans, evaluations and reports. In addition, interaction moments such as workshops have been recorded. These were transcribed verbatim as well. All the material has been coded and organized with the qualitative data analysis program Atlas.ti⁸. The transcripts were coded with words as close as possible to the words the actors use. Once the quotations were categorized, the quotes could be organized per topic. The biographies of topics revealed how the frames changed and why they changed. By studying the biographies and focussing at the changes in frames, one can find cognitive, interactional and material frames. With the help of the definitions as presented in Table 4.1, we define the different types of frames in the biography.

Table 4.1 Definitions of types of frames

	Definition
Cognitive frame	The way actors conceptualize the substantive topics in a dispute as cognitive representations.
Interactional framing	The way parties negotiate the meanings of issues, identities/ relationships and ongoing interactions in social interaction (by cueing and reacting to each other).
Material frame	The way an artefact enables or constrains understanding, action and interaction.

In the next section we provide some case material of a specific agri-food innovation project, the Roundel project, in order to corroborate our ideas. We start with a general case description.

⁷ <http://www.audiotranskription.de/english/transcription/> - ⁸ Atlas.ti version 6. source: www.atlasti.com

4.4 General case description

The project we studied is about the realisation of a novel laying hen husbandry system in the Netherlands, called Roundel (see Bos, 2008; Groot Koerkamp and Bos, 2008; Bos and Groot Koerkamp, 2009;), which aimed to surpass current sustainability standards as in the Netherlands different ways of keeping hens co-exist, namely in cages, in barns, free range and organic.

In 2003 and 2004 the Dutch government initiated and financed a project called 'Caring for Hens' (in Dutch: 'Houden van Hennen'). In this project a visioning experiment was done in which two animal husbandry systems for hens were envisioned with the involvement of multiple heterogeneous actors, such as people from knowledge institutes, poultry farmers, egg and system building businesses, an animal welfare organization, government officials, communication people, journalists, sector organizations, consultancy organizations and advisory organizations. The actors discussed what the system according to them should look like. They came up with a lot of demands that should be met. These ideas were laid down in a Brief of Requirements (Project Team Houden van Hennen, 2005) and drawn up resulting in the first visionary ideas (see Figure 4.2 below).

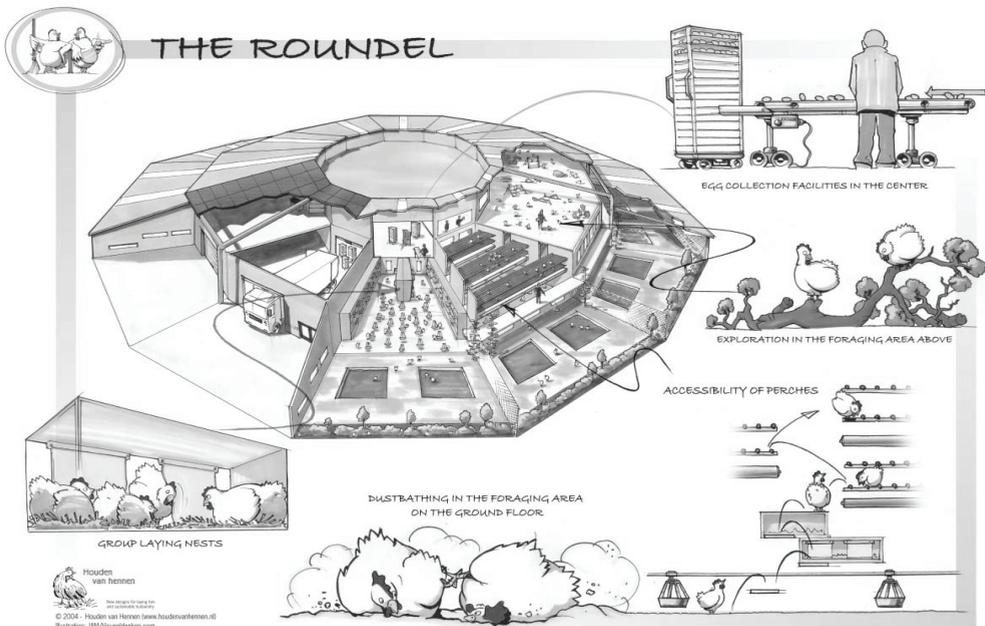


Figure 4.2 Design of the Roundel system and typical aspects. Source: Brochure Laying hen husbandry (Wageningen UR project team Houden van hennen, 2004).

Based on the Brief of Requirements, a programme developed in 2004, in which the needs of hens, farmers and citizens were defined, a consortium was formed in 2005 with a large egg packer and a husbandry systems developing firm, with the goal to redesign one of the two designs into a system to be used in practice. This system was called the 'Roundel' after its typical round form. The aim of the project was to realize 'a system innovation' by developing

and introducing a new ‘socially responsible table egg’ to the market, with a sustainable production system and chain (internal communication, 2009). In the first part of the project (2007-2008) the focus was mainly on the technical development of the new laying hen husbandry system (see Klerkx et al., 2010 for details).

In the second part (2008-2010) the focus was on realisation, development and marketing of an egg, produced in a system that leads to ‘happy poultry, proud farmers and satisfied citizens’ (Wageningen UR project team Houden van hennen, 2004).

Various actors started working on the implementation of the design, and thinking of how to sell the eggs. Core participants in the project team were: the husbandry system builder, a research institute (ASG Animal Science Group, part of Wageningen University and Research Centre), TransForum⁹ as intermediary organization and project funder (since 2007), and a consultant in the field of animal welfare and social corporate responsibility. Besides these core participants, other actors involved were the Society for Protection of Animals, farmers interested in building and exploiting a Roundel system, municipalities in which the Roundel would be built, architects, building contractors, and other consultants and process facilitators. The project team met every six weeks to discuss the progress of the activities. In addition, workshops were organized by the project team. In these workshops experts in the field were invited and topics such as how to position the egg in the market and how to organize the product chain were discussed together with the project team. In spring 2008 Roundel Ltd was formed as a daughter company of the husbandry system-building firm. The timeline below (Figure 4.3) shows some important events in the Roundel project.

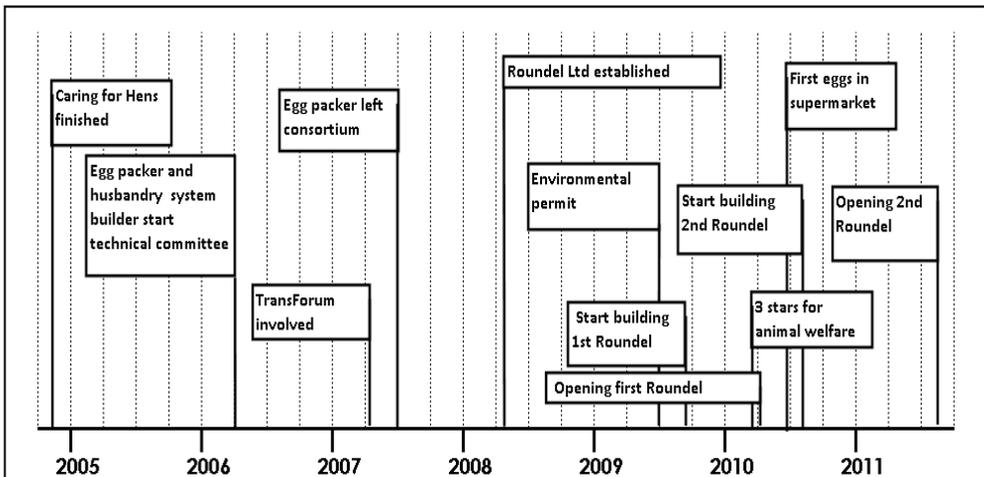


Figure 4.3 Timeline of the Roundel case (partly based on Klerkx et al., 2010).

⁹ TransForum is a Dutch program which hosts many innovation projects in the agri-food sector, with the aim to improve upon ecological, economic and social sustainability, and in which heterogeneous actors, such as the government, societal organizations, businesses and knowledge institutes are involved (Veldkamp et al. 2008).

4.5 Results and analysis: Framing the fit in the landscape

In order to analyse the case, we selected the topic ‘fitting in the landscape of the Roundel system’. This topic was mentioned by the actors involved as a key characteristic of the system. The general idea was to design a totally different way of dealing with egg production, yet it should not conflict with established ideas about the rural environment. Fitting in the landscape is about the way the Roundel system is situated in the landscape, which not only concerns visibility and technical design, but also the image of the system. It is a socio-technical topic, containing different elements of the system. Topic intensive discussions took place between researchers, designers, businesses and civil servants, who had different ideas about when something fits in the landscape and is at the same time manageable, good for animal welfare and does not lead to very high expenses.

One of the needs in the Brief of Requirements (2004) for the farmer was an open and transparent laying hen system, with outside space for chickens. At the same time chickens should be protected against risks from the environment, such as migrating birds, which could ‘distribute’ avian influenza via their excrements. The system should be accessible for visitors (people have to be able to see the chickens), but at the same time the public health should be guaranteed. In order to be able to build the system, it is important that it ‘fits in the landscape’, in an esthetical, economic, technical, regulatory and societal sense.

In the summer of 2006 the first talks with the municipality of Barneveld (the ‘egg capital of the Netherlands’) were conducted. The civil servants were enthusiastic about the first ideas. Already in the first meetings of the project team there was an idea to build the first Roundel system at a ‘sight location’ near the highway. The drawings were elaborated and discussions took place on animal welfare, outdoor run, and what type of egg should be sold. In the meantime (between autumn 2006 and spring 2007) some other possible places to build the system came to the fore, as there were some financial and regulatory issues, which made it uncertain whether the system could be built in Barneveld.

In spring 2007 the actors developed most of the technological aspects of the Roundel system and recognised it was important to start with other aspects as well, such as the marketing of the egg. Since then the focus was again on Barneveld. The project team regularly discussed with the municipality and an advisory company specialised in permits. In these discussions, the differences in what is meant by fitting in the landscape and the role the system needs to fulfil in the landscape came to the fore. The first request for a permit to build the system was done in August 2007; around the summer of 2008 the permission was given. But before the permission was given some hurdles had to be taken, with regard to the design and the regulations. After all, this was a new type of system that needed another way of thinking about permits and design.

At the end of 2009, when all the permits were arranged and also the financial issues were solved, they started with building the first Roundel system in Barneveld, which was finished in spring 2010. A second Roundel was built in a different municipality in 2011, and a third one is planned to be finished in 2012.

In studying the topic ‘fitting in the landscape of the Roundel system’ we find numerous instances of framing, which are grouped below under the different subheadings.

‘Fitting in the landscape’

The general requirement that the envisioned system should ‘fit in the landscape’ was not a straightforward condition. According to one of the researchers, for instance, chickens being outside contribute to fitting in the landscape and the perception of the concept.

...and now we say that it contributes to fitting in the landscape and the perception of the concept, and the chickens are outside. (Researcher)

In this quote ‘chickens outside the barn’ is framed as contributing to fitting in the landscape, meaning that a barn surrounded by space for chickens will better fit in the landscape than a closed system. So, fitting in the landscape is framed as chickens outside. An advisory company, on the other hand, translated the requirement to esthetical concerns. They argued that the typical round shape of the system did make the design look like a big circus tent, which they found problematic. A system with a round shape and a big size has a big impact on the rural environment.

The Roundel actually has an impact on the environment; it is a gigantic construction that is built. It is a circus tent, that was our first thought: what a huge circus tent in the landscape. It is a completely different design than we are used to. But it is good to change that. (Advisory company)

The radical new ideas of the Roundel, thus, resulted in ‘a gigantic construction’ that does, according to the actors, not fit the surroundings. It is as strange and exotic as a circus tent. In this example fitting in the landscape is framed as: not a circus tent.

Eventually, the design had to be changed in 2007. A civil servant recalls:

In principle the Roundel does fit the building blocks, so there are no real changes in that. But the model did change, especially the fit in the landscape of the Roundel. Then you are talking about roofs with grass and plants and trees accompanying the shape of the system in order to not make it rise as a circus tent in the landscape. Some concessions were made to make it fit in the landscape (Municipality).

According to the project team, a natural appearance was needed as well, although it would be nice if the system was visible for the public from a distance. To counter the framing of a circus tent (in 2006) they changed the design: by planting trees around the system it became more integrated in the landscape. Now, it was seen as a ‘hill in the landscape’ (in 2008). Fitting in the landscape now is framed as ‘planting trees around it’, as the quote below demonstrates:

At the commission of the municipality employed to enforce the regulations regarding the external appearance of buildings it first was a circus tent, and in the end it became a ‘Teletubbie hill’ in the landscape. It fits within the rolling of the hills, and that created a basis at the municipality. (Architect)

The quotes above show that ‘fitting in the landscape’ is not only one aspect, but many aspects together. They also indicate that the design changed as a result of changing frames.

While the discussion was about how to fit such a system in the landscape, it also became clear that it is difficult to decide whether something fits in the landscape, and that it is not possible to develop one design that fits everywhere. According to the final report of the project in 2009 it ‘is a personal opinion and it depends on the landscape and the environment of the system’ when the system fits the environment. So it was agreed that the way one Roundel fits the environment could differ from another one. As the architect said:

Every Roundel will be built on another spot. So at this spot it will be built like this, with the plan for the plants and trees surrounding it. And at another spot, for example besides a creek, it has to be fit to that landscape.

So the framing of what had to be designed changed. In the design phase the Roundel system was developed as an isolated object. Now it changed into an object that is part of the landscape and differs per region and has to be defined in interaction with the municipality involved.

Environmental permits

A particular important episode in the Roundel innovation project was the negotiation about permits. In order to get a permit, interaction with the municipality was important. In 2007 the project team was working on obtaining environmental permits of the municipality of Barneveld and had to prove that it met the environmental requirements. Because the Roundel system had a typical round form, it did not fit the existing rules for building in the rural area, as someone from the advisory company said:

It is not easy to get a permit for a round system, with such an impact on the surroundings. We had to work hard in order to make it fit in the landscape.

The people in the project realised that completely new systems had to go through the whole procedure of for example testing and measuring the emissions. Instead of getting a permit for a new system, therefore, the project team decided to make use of existing systems for laying hens. Available techniques were combined in every compartment of the system. For example, the interior of the system was an already existing system of the system builder, although it had to be adapted to the new design. So, instead of framing the system as one new, round system, the system was framed as five separate systems, placed in a circle. This shortened the permit procedures, as these existing systems were already proven to meet the rules. In the middle of the circle there was space for the egg packing machines and between and surrounding the systems an outdoor run was created.

I think in the first instance the concept was a Roundel with a tree in the outdoor run and a really open system. In the final design there are five systems. Systems with a common design, built in a circle. That is different from the first concept. (Researcher)

In this example the way the system is framed has changed in order to meet the criteria regarding permissions. This is an example of how a new framing may support the project.

Public debate

Besides meeting the demands of the building inspector of the municipality, the idea of the project team was that when a system fits in the landscape, the public is willing to accept it better than when it does not. So fitting in the landscape also means creating public acceptance. During the Roundel project, there was an intense public debate in the Netherlands about the desirability of so-called mega farms: systems in which huge amounts of animals were kept at one spot (van Lieshout et al., 2011). As they had a strong and negative connotation, it was important for the project team not to be associated with that type of farms. Especially when a system is very prominent in the landscape, people might find it big, or mega. They tried to counter that danger by seeking forms to open the Roundel system.

The perspective that the public has on livestock farming depends partly on the current big and closed systems in the landscape. (Final report, 2009)

Here we see that the global discourse, in this case about mega farms, is influential. The project team tries to position itself in the global discourse: the Roundel is different, because it is open to the public. We might call this anti-framing. The idea is that by opening up the system, visitors can see how the animals are kept. A system in which visitors can see the chickens was already part of the design in 2004, and with the menace of the mega farms image it gained new urgency. Here the role of the citizen was put central.

The role of the citizen

When in 2007 the openness of the system became urgent, new plans were made, for instance for a visitor's corridor through the housing of the chicken. The corridor was lowered to allow visitors to see the system from the same height as the chicken and to connect to how chicken experience it. According to the project team the 'design of the corridor equals the visitor to the animal'. The openness of the system, and the technological feature of the lowered corridors, also changed the role of the public. The fact that the system is literally open for the public makes the public not only a consumer, but also a spectator. The project team hoped this will change the idea people have on closed systems and the way animals are kept. According to one of the designers the building is '... a place to which excursions are planned'. In this way it also informs citizens about the way of keeping hens. So, by welcoming visitors, the system not only becomes a production site, but an information centre as well. Here we see framing of the role of the public. It is a particular example of material framing: the lowered corridor frames the citizen as a spectator, experiencing the system as a chicken. In Table 4.2, an overview is given of framing in the Roundel case.

Table 4.2 Framing in the Roundel case.

What aspect is framed?	Initial frame	Later frame
Fitting in the landscape	The Roundel is a new system that enables a new form of egg production. Contested as a circus tent.	The Roundel is a natural element (hill) making the system less visible, by changing the colours and by planting trees around the system, adapted to specific rural environment
Environmental permit	The Roundel system is one new large round system	The Roundel system consists of five rectangular systems positioned in a circle
Public debate	Roundel system as a production facility	Roundel system as visitor centre
Role of citizen	The public consists of consumers eating eggs	Citizens are spectators who can appreciate the living/production circumstances of the chickens

4.6 Conclusion and discussion

The aim of this paper was to study how framing occurs between various actors within the agri-food value chain. The basic idea was that framing either facilitates or hinders innovation towards sustainability in complex multi-actor settings. We first investigated the concept of ‘framing’ and the various strands of literature. Clearly, ‘framing’ is an encompassing concept, which is present in social interactions in many different ways. We organized the insights from the literature into a typology of three levels of framing: global discourse, face-to-face interaction and localised collective framing. Since systemic innovations in agri-food typically occur in localised innovation projects we focused on this latter type of framing.

Our case is the Roundel project (2004-2010) in Barneveld, the ‘egg-capital’ of The Netherlands, which aims at developing and exploiting a sustainable and animal-friendly way of keeping hens. It is a typical example of a systemic innovation process in which different stakeholders cooperate. The project faced various difficulties, but in the end resulted in a more or less viable system. We traced the role of framing by following a particular topic in an agri-food innovation project. The so-called biography of a topic allowed us to reconstruct the different forms of framing and their efficacy. In our case study, we selected the topic ‘fitting in the landscape of the Roundel system’.

During the project the general requirement that the eventual system had to ‘fit in the landscape’ appeared in very different and sometimes conflicting ways. The initial framing inspired plans for a visible construction that clearly differed from traditional forms of egg production. This led to contestations from the municipality about the construction being an unwanted ‘circus tent’. Subsequent negotiations within the project team resulted in a framing of the construction as a ‘natural hill’, which succeeded in regaining the support of the municipality. This, thus, is an example of a deadlock due to conflicting frames *and* an example of solving the deadlock

by changing frames. Sometimes, changing frames also helps to solve other, more mundane, problems. In the stage of obtaining environmental permits, the project was forced to pause when it turned out that the plans were not in line with the current regulation. Here, the framing of Roundel as five rectangular systems positioned in a circle, instead of one big circular building, saved the project. A third example of safeguarding the project, due to framing, occurred when the increasing public discontent with mega farms threatened the Roundel experiment. The framing of Roundel as another mega farm was countered by stressing the naturalness of the 'hill' and by opening the system to visitors. People were invited to walk around in lowered corridors and to experience the system differently. Here, the material conditions of the corridor framed the citizens (who might oppose mega farms) as spectators who could relate to the living conditions of hens.

In this paper, we designed and used a typology of three levels of framing. Between the framing in face-to-face interaction studied by symbolic interactionists and discursive psychologists, and the framing at a global discourse level, studied by political scientists and mass media scholars, we position framing processes at a project level, coined as the *localised collective*. Besides distinguishing between levels of framing we also reviewed different ways in which framing occurs. Whereas the literature mainly studies cognitive frames and interactional framing, we concluded that a third category is helpful, material framing, based on the notion of 'script' from Science and Technology Studies. After all, in case of technological innovations, the fate of projects does not only depend on the perspectives of people (cognitive frames) and by patterns in interaction (interactional framing), but also on material constraints. The lowered corridors, for example, enforce visitors to adopt a 'chicken perspective', as a developer once phrased it.

A general lesson, then, for the study of systemic innovations is that material framing may occur, next to what happens in people's minds and in interactions. In further studies we may want to understand better if cognitive/interactional and material frames can be understood as really distinct concepts or should be seen as related aspects of a specific frame. Whichever the outcome, material framing as a concept can add to our understanding of technological innovation processes. A second lesson is that framing refers to different levels, ranging from individual perceptions to societal debates and that these are interdependent. Theoretically, this is maybe not surprising, since both interactionism and political science stress that in daily interpretations people 'enact' general frames, and, by doing so, slightly modify them (Goffman, 1974, Hajer and Versteeg, 2005). Our study, however, shows that this may have pertinent practical implications as well. Remember how the project team recognized the danger of the global discourse on mega farms, and averted the danger by anti-framing, by positioning themselves as something totally different than a closed mega farm.

We conclude, therefore, that framing matters, both conceptually, in terms of understanding complex multi-actor innovation processes, and practically, as it may help projects to avoid imminent deadlocks. In the case of the Roundel project, the developers eventually encountered the force of framing and acted accordingly, often without fully acknowledging the role of framing. In the search for sustainability, other agri-food experiments will encounter many pitfalls and challenges as well. We think that a better understanding of framing helps to make the efforts of developers, stakeholders and society at large less vulnerable to these pitfalls and challenges.

Appendix case study: the Roundel project

Because of word limit in the paper presented on the previous pages, this appendix has some extra empirical material on the Roundel project. This appendix can be read in addition to section 4.5 (Results and analysis). The extra material presented below is taken into account in the concluding chapter (chapter 7) of this thesis.

Topic biography outdoor run

An important element of the design of the Roundel system, related to sustainability, is animal welfare, realized by an outdoor run for hens. An outdoor run is an important part of the system, because according to existing regulations and ideas present in society and societal organisations, a chicken must be able to go outside. In the Programme of Demands (Project Team Houden van Hennen, 2005), the programme in which needs of the farmer, the citizen and the hen were put down, the need was formulated as a 'suitable living environment for the laying hen'. More specifically, the need is to experience freedom, fresh air and elements such as the sun, water, earth and wind. According to the Programme of Demands: hens should be outside.

Access to an outdoor run is not only regarded as an aspect of animal welfare; the firms also wanted to show the consumer that it is possible to keep hens outside. Within the Roundel project group this issue was discussed several times. As will be shown below, some involved actors were quite in favour of an outdoor run while others hesitated over it.

Table 4.3 Ways of keeping hens for the production of eggs in the Netherlands. Based on Voedingscentrum, 2010

	Characteristics of keeping hens	Hens per m ²
Cage eggs*	Inside housing system, 3-5 hens per cage, no daylight	18 hens per m ²
Barn eggs	Inside in a shed or aviary system, litter on 1/3 of the floor, daylight	9 hens per m ²
Free-range eggs	Access to outdoor during the day, daylight outside	Inside 9 hens per m ² , outside 4 m ² per hen
Organic eggs	Organic feed, no beak trimming**, access to outdoor, daylight	Inside: max 6 hens per m ² , outside: 4 m ² per hen

*= Forbidden from 2012 onwards

**= Beak trimming prohibited from 2011 for hens in all systems

At the beginning of the Roundel project, the discussion was mainly about the square metres needed for an outdoor run, as the quote below demonstrates. The initial frame of the shed builder was that outside hens need four square metres of outside space per hen, based on the rules for free-range eggs (see Table 4.3).

That is what [the shed builder] thought: with hens outside, you need a lot of space and you have to deal with regulations.

Furthermore, an outdoor run requires a lot of space:

Keeping hens outside means 2 to 4 square metres per hen. For a system of 30,000 hens you need 6 hectares of outdoor run. That is quite a lot. And in practice it [the space] is not used and it becomes chaos. It doesn't function. (Researcher)

The cognitive frame present in these quotes is that an outdoor run should measure a specific amount of 4 square metres per hen. The frame is that such an outdoor run takes a lot of space, and is therefore difficult to realize. A conventional barn with an outdoor run would need 6 hectares of surface. An outdoor run is materially framed as taking a lot of space, which is not completely used.

At the same time, the outdoor run is also seen as something that causes different types of problems. In the next quote a researcher explains how opponents see an outdoor run:

All that trouble with avian influenza, worms and diseases. Problems, difficulties. Don't do that! (Researcher)

Here an outdoor run is cognitively framed as risky, because the risk of animal diseases is high. This is an example of a cognitive frame, as an outdoor run is framed as a traditional outdoor run. Some of the actors mainly see the negative points of an outdoor run, as they cognitively frame an outdoor run as an open space, 4 square metres per hen. In order to break through the way an outdoor run is framed, namely as needing a lot of space, the discussion turns to what is actually meant by an outdoor run, starting with the needs of the hens. In discussions with, for example, researchers and consultants, new ideas arose about outdoor access, namely that in order to allow natural behaviour the quality of the outdoor run is more important than the actual amount of outdoor space.

A little outdoor run is enough. It is about the quality of the surroundings. (Researcher)

By stating this the researcher is trying to remove the cognitive frame of an outdoor run as a certain amount of square metres, and emphasizing that the quality of the surroundings is more important. This is a turning point in the discussion, as the following quote summarizes:

There are a lot of implicit thoughts behind this idea [access to outdoors], which came to the fore when the design made it possible for the hens to go outside. But we draw a square around [the shed] and that does not have to be 6 hectares, so long as they are able to go outside. So when there is a border 10 metres around the shed with green and trees, absolutely fantastic! At that moment 'the penny dropped'. (Researcher)

The framing of an outdoor run, and thereby animal welfare, changed from the amount of space to the quality of the space. For the Roundel system less than 1.5 hectares is needed, so that is less than the 6 hectares for a conventional barn with an outdoor run. The risk of avian influenza is tackled by the design, in which the outdoor run is, for example, partly covered. According to the farmer, "That is one of the biggest advantages of the system". The covered outdoor run is also an innovative part of the system, and a characteristic that helps to distinguish the Roundel system from other laying hen systems (according to an advisor involved).

The outcome of this discussion was that hens need to have access to an outdoor run, which does not have to be as big as envisioned at the beginning of the project. Furthermore, the outdoor run will be partly covered, taking into account that natural ventilation is important and at the same time serious diseases could be avoided. The outdoor run will also give an opportunity for the chickens to have dust baths, one of the needs of a chicken according to the Programme of Demands.

The framing of an outdoor run has shifted from what in the regulation around keeping hens is written down about the amount of square metres (see the rules in Table 4.3) towards what is animal-friendly from the perspective of the animal (when the animal performs natural behaviour). The outcome is a combination of different ideas (quality, natural behaviour, amount of space) combined into a new framing of an outdoor run.

Topic biography positioning eggs in the market

Another topic discussed in the Roundel project was the positioning of the egg in the market for table eggs. Discussions about the positioning of the egg took place between the knowledge institutes, the shed builder, the government, the egg packager, one of the consultants, a farmers' association and the Society for the Protection of Animals. The socio-institutional context plays an important role in this discussion, because of existing rules (see Table 4.3) about the required characteristics of hen husbandry systems. The labelling of table eggs as organic, free-range or barn eggs is based on regulations about feed and occupancy rates (see Table 4.3). These aspects constrain the positioning of the egg in the market for table eggs.

You have cages; hens that live indoors, those are barn hens; then you have barns with an outside run, and organic. This is how it works. Period. (Researcher)

The egg packer would like to show the consumer that it is possible to keep hens outside, but this is quite difficult as becomes clear from the next quote:

We are in this business, in which we sell the way a hen is kept. The product is the same, but there is diversity in the products on the shelves of the supermarket because of the different ways the hens behave. (Egg packer)

Positioning the egg as a barn egg is unattractive because of large competition from barn eggs produced in cheaper systems without any access to outdoor runs. The need to show this outdoor area is stressed.

I need to sell something to the consumer. And with my knowledge and experience, I want to show just one thing: that this hen can roam outside. (Egg packer)

To sell the egg as a free-range egg, much more outside space would be needed (see the topic biography on the outdoor run). At the same time, many different actors (e.g. the consultants and the researchers) considered the Roundel egg as 'probably better than organic'. Selling the egg as organic, however, is impossible since the Roundel does not take the conditions of organic husbandry (feed and space) into account. Strategically, the choice to position the egg

in the market between free-range and organic creates flexibility for future developments. Depending on the success of the egg, this market position can be adjusted.

One risk of this positioning is articulated as well. Because consumers have little knowledge about the production circumstances of table eggs, and about the meaning of the official egg categories, they may have an idea of egg production that is too optimistic (with regard to space and animal welfare).

There are many people who do not even see the difference. They are totally surprised that a barn hen does not go outdoors. (Invited expert)

The project actors struggle with the idea of whether to raise the awareness of the egg consumer, or to leave them ignorant.

But maybe he [the consumer] is awfully surprised when he sees how the Roundel hen is walking around. And he had a totally different image of the barn hen; a much more emotional, a much better image. (Invited expert)

Related to this the idea of the actors involved was earning the better life label, introduced by the Society for the Protection of Animals. In 2008, the Dutch Society for the Protection of Animals started developing a system, with one to three stars, to indicate products that were produced with respect to specific animal welfare guidelines. Because the star system requirements were not completely developed at the time of the design of the Roundel project, there was still some room for discussion about these requirements.

[Developing the label system] is partly done in consultation with producers. You need to look at what is feasible in practice. We do not have to think of norms which are not realizable. (Society for the Protection of Animals)

By stating that the rules are developed in consultation with producers, the Society for the Protection of Animals frames the label system as a collective initiative. The new focus on having sufficient quality of living environment (instead of having a default large roaming space outdoors) is presented in the quote below by a researcher from one of the knowledge institutes involved.

If you look at the stocking densities in the system, we are approximately organic, but we don't have the free range, whereas organic has 4 square metres of free range. We don't have that, but we say we don't need it because the hens don't use [the space]. A small yard suffices; it's about the quality of the living environment [...]. (Researcher)

At the start of developing the label system the idea was that only eggs from hens with a certain amount of outdoor space could obtain two stars. The frames that consecutively came to the fore were:

- a hen needs a certain number of square metres
- a hen needs to perform its natural behaviour
- if you are able to keep hens without beak trimming, they have enough space.

The framing of what is an important element of the better life label changed from the amount of space towards the quality of the system. That is why in spring 2010 a three-star label was provided for the Roundel egg product. The third star is given because according to scientific research about the quality of the systems in relation to animal welfare and health, the quality of the Roundel building is similar to or even higher than the quality of other systems, even organic systems (Society for the Protection of Animals, 2010). On the website of the Society for the Protection of Animals their argument for rewarding the system with animal welfare stars is presented.

Because of the functional design of the Roundel building the hens do not need as much outdoor space as in systems which have more space but are less fully equipped. The hens make optimal use of the space. There will not be outdoor space left fallow. Also, the quality of the (partly covered) outdoor run is better and less empty than other systems. (Society for the Protection of Animals, 2010).

This topic biography shows that the topic ‘positioning of the egg in the market’ is framed in different ways. The first idea was to sell the egg as a barn egg. In this idea the position of an egg in the market is framed as meeting the rules regarding feed and space. Then the possibility of selling the egg as a free-range egg was discussed by the egg packaging company. But that would mean that more space is needed for the chickens. The outcome of the discussion is that the egg will be *positioned* between free-range and organic eggs. A new position is chosen, which is not based on existing regulations. The idea that the position of the egg is fixed in rules and regulations has changed towards creating a new category. In order to realize that new category, the actors had to develop a common idea on how they categorize this new category, so a new collectively frame is developed.

5.

The Kwatrijn: framing of a sustainable dairy system¹⁰

Abstract

The agricultural sector is changing. While the dairy sector still has sufficient legitimization, there is a societal pressure to change. In this paper an innovation project in the dairy sector is followed over time. The project, called the Kwatrijn, involves a heterogeneous group of actors and has the goal of developing a sustainable dairy system close to a nature conservation area.

The aim of this paper is to find out how framing is visible in and affects an innovation project. We define framing as the phenomenon whereby actors are limited in their perceptions and actions due to underlying cognitive structures, interactional patterns and material aspects. We use so-called topic biographies to trace and analyse framing processes in innovation projects. Topics are raised and discussed by the actors themselves because they are seen as urgent and crucial. They emerge, may exist for a while and may disappear. On the basis of in-depth interviews and document analysis we have been able to follow three topics: the use of straw in the barn, the pasturing of cows and the design of the husbandry system. The data show different, interrelated types of framing. We discuss how frames changed when they clashed with other frames while decisions were needed regarding the concrete design of the system. The framing of straw changed from 'good for animal welfare', via 'straw is old-fashioned' to 'straw is a nutrient in the life cycle and enables innovative designs of machines'. Pasturing is framed as 'good for animal welfare', but made a shift towards 'providing licence to produce' and 'showing the citizen how dairy farming operates'. The design of the system showed a change from a 'large system' towards a system creating the connection between agriculture and the landscape.

We conclude that material framing plays a role in innovation processes in addition to cognitive and interactional framing. Two conditions for changes in framing stand out: when definitions move from abstract towards more specific statements and when frames are openly conflicting. We discuss the practical relevance of our findings and argue that a next step in research is to develop a way to uncover and handle different frames at an early stage of a project.

Keywords: framing, innovation processes, system innovation, dairy farming, sustainability

¹⁰ The text of this chapter is submitted and under review as Zwartkruis, J.V., J.C.M. Farla, E.H.M. Moors, H. van Lente. Dairy diaries: framing analysis of the development of a sustainable dairy system. *Agricultural Systems* (under review).

5.1 Introduction

When the agricultural system, including the dairy sector, has to become more sustainable, innovations are needed (Wiskerke and Roep, 2007; Rains et al., 2011). The dairy sector has to deal with different challenges. The necessary decrease in emissions of methane, nitrous oxide and carbon dioxide (van Calker, 2005; Boone and Dolman, 2010), fluctuating milk prices (Boone and Dolman, 2010), phased-out EU product subsidies (Bos et al., 2009) and the disappearance of the milk quota (limiting the amount of milk a farmer is allowed to produce) in 2015 (Rougoor et al., 2008) mean that changes are needed concerning the whole sector. Furthermore, public concerns regarding animal diseases, antibiotics use (van Calker, 2005), 'mega farms' (van Lieshout et al., 2011) and the discussion regarding the cow in the pasture (Jager, 2012) also make changes necessary in the whole sector.

Attempts to change agricultural systems do occur, but are complex because they involve many stakeholders, and bring contested problems and solutions. In addition, sustainability has many different meanings (Pretty, 1995; Rigby and Cáceres, 2001; Walker and Shove, 2007; van Lente and van Til, 2008). As Francis and Hildebrand (1989, p. 4) have already argued, "Everyone assumes that agriculture must be sustainable. But we differ in the interpretations of conditions and assumptions under which this can be made to occur". While in general interaction between different actors is important in innovation (Oudshoorn and Pinch, 2003; Smits and Den Hertog, 2007; Geels, 2011; Nahuis et al., 2012), it is also difficult to organize because of the diversity of information, resources, ideas and perspectives between the various actors. As the social sciences have stressed in various ways and with different terms, perceptions and actions are always framed in different ways for different actors (Dewulf et al., 2009; Geels and Verhees, 2011). Thus, framing processes are part and parcel of any social system, and may support or hinder innovation projects.

This paper presents a case study on the Kwatrijn project in which an innovative, sustainable dairy system was developed in the Netherlands. We have studied how initial ideas to develop the barn and its direct surroundings, such as the pasture, were transformed into a concrete plan to be implemented. Our case shows how differences in framing may become apparent and frames may even clash. Our goal is to study the role of framing in the development of the innovative Kwatrijn project over time and, in general, to understand how framing facilitates or hinders innovation in complex multi-actor settings. The question we address in this paper is: *How does cognitive, interactional and material framing occur in the innovative design process of a sustainable dairy system?* In the next two sections we will discuss theories on framing and introduce the methodology of *topic biographies* to study framing processes.

5.2 Theoretical background

For the creation of sustainable agriculture, it is not only new technologies and practices that are important, but also the involvement of actors (Pretty, 1995; van de Fliert and Braun, 2002). Since the late 1980s farmer participatory research has received attention, in particular since 'Farmer First' (Chambers et al., 1989), 'Participatory Technology Development' (Jiggins and De Zeeuw, 1992) and the general recognition of the farmer as a resource manager for new technologies (van de Fliert and Braun, 2002).

It is a truism that when people interact, different interpretations come to the fore. In studies on transitions and system innovations there is a growing awareness of the importance of interpretations for change (Sengers et al., 2010; Elzen et al., 2011; Geels and Verhees, 2011).

A core theoretical concept in studies of inter-group interactions, conflicts and negotiations is 'framing' (Dewulf et al., 2009). Framing is the phenomenon whereby actors are limited in the way they perceive an issue, a situation or a person due to underlying cognitive structures, or to established interactional patterns. The study of framing already has a long tradition, or rather several traditions varying from artificial intelligence (Minsky, 1975) to sociology (Goffman, 1974), policy studies (Schön and Rein, 1994) and communication studies (Tannen, 1993). The common denominator is that framing is a 'sensemaking device' (Weick, 1995). The concept of framing originates from cognitive psychology (Bartlett, 1932) and anthropology (Bateson, 1972). Starting with Bartlett's schema theory of memory (Bartlett, 1932), cognitive psychologists define frames as cognitive structures in our memory that can help to organize and interpret new experiences. In the work of Bateson (1972) on (meta-) communication, framing is about the understanding of ongoing interaction by focusing on the exchange of cues. His example is the play between two boys that becomes rougher: is it 'game' or 'fight'? The ambiguity of how to interpret ongoing interactions creates the need for framing.

A useful overview of different framing studies is made by Dewulf et al. (2009). In their broad review of the framing literature they made an ontological distinction between 'cognitive frames' and 'interactional framing'. Cognitive frames are mental representations and interactional framing is "the dynamic enactment and shaping of meaning in ongoing interaction" (Dewulf et al., 2009, p. 162). These categories are not mutually exclusive; as Aarts and van Woerkum (2006, p. 236) state, "interactional framing and cognitive frames both emphasize different aspects of the framing process".

Cognitive frames are relatively static structures, categories or mental structures in one's mind while interactional frames refer to the co-construction of issues, identities and interactions that are negotiated in conversations. Participants try to influence or challenge the ongoing definition of issues, identities and interactions through meta-communication.

The distinction between cognitive and interactional framing is useful, but we argue that a third category, material framing, is needed as well, in particular in technological innovations. We claim that materiality can determine the way something is framed by actors as well. Science and technology studies provide many examples, such as the key of a hotel room mentioned by Akrich and Latour (1994). While customers tend to frame keys as their temporal property, to be taken out of the hotel, hotel owners may try to change the frame by adding a bulky and heavy key ring which people cannot carry easily in their pockets. The key ring reframes the key as 'hotel property' to be left at the desk of the hotel. To capture the material contribution Akrich (1992) launched the notion of 'script': "like a film script, technical objects define a framework of action together with the actors and the space in which they are supposed to act" Akrich (1992, p. 208).

One of the critiques on framing perspectives is that it is "often lacking conceptual precision

in its delineation of constituent elements and processes” (Steinberg, 1999, p. 738). As a step towards more precision, we suggest a typology of framing on the basis of three different levels of social dynamics, where frames reside and operate in distinct ways. Many studies focus on how framing in face-to-face interaction guides the perception and sensemaking of individual actors (e.g. te Molder and Potter, 2005). Another tradition studies framing at ‘the global discourse level’, and focuses on broader societal discourse and the mass media: how issues are presented, what is highlighted and what is ignored. Frames in society, which are voiced and reproduced in the media, have also been described as ‘images’ (Beers et al., 2010), as ‘structuring elements of discourse’ (Hajer and Versteeg, 2005) or ‘master frames’ (Benford and Snow, 2000).

We propose a third level of framing processes between the micro-level of daily interactions and the macro-level of societal discourse. Typically, in innovation projects new ideas are developed and employed, and actors try collectively to position their project and to define the goals. Participants need to develop a joint idea, a shared approach and a temporal form of coordination. We propose calling this level *localized collective* framing which is distinct from, but influenced by, face-to-face framing and by personal schemata of the participants. Likewise, localized collective framing is enabled and constrained by the global discourse in which it is embedded. We expect that localized collective frames can be volatile during intense debate, but will also show some stability in the form of shared understanding that develops over time between the people involved in a common project. The three levels of framing influence each other (Figure 5.1).

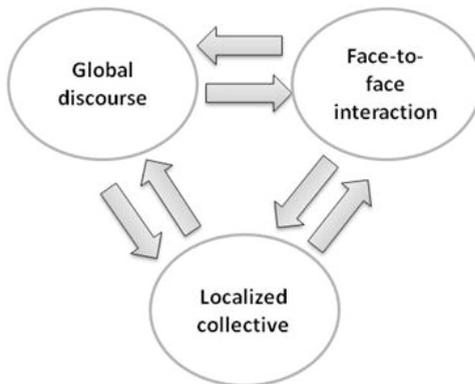


Figure 5.1 A typology of levels at which framing occurs

5.3 Method

We followed and analysed an innovation project in the dairy sector in which a systemic change was envisioned. The Kwatrijn project was a follow-up to the Cow Power project which lasted from 2007 until 2009. We focus on the period from October 2010 to January 2012, when the translation took place from a drawing table concept to a practical system (see figure 3).

Data were collected in eight semi-structured, in-depth interviews with various actors involved in the Kwatrijn project consortium in the summer of 2011 (Table 5.1). All actors were part of the project group. The interviews were triangulated with project material (proposals, reports, notes of meetings). Furthermore, we analysed the project proposals and project plans of the Kwatrijn project, eight meeting notes and observations made during six meetings in the period from October 2010 until January 2012.

Table 5.1 Interviews in the Kwatrijn project

Interviews	Number of interviews
Businesses	2
Advisor	1
Farmer	1
Farmers' association	3
Researcher	1

The interviews were transcribed verbatim with the help of the F4 program. All the documents were organized in the qualitative data analysis program Atlas.ti (version 6.2.26). Framing was mainly followed at the 'localized collective level', but when actors discuss the global discourse level or the face-to-face interaction level, that is taken into account as well. We specifically focused on how frames changed in the development from an abstract idea of a sustainable dairy system towards a more concrete design that can be implemented in practice.

We followed several *topics* over time; a topic is defined as a problem or a goal, relevant to one or more participants in the interactions. Topics thus are introduced by the actors themselves, and can be traced afterwards by analysing documents and interviews. The use of straw, for instance, was raised by the interviewees as one of the important sustainability aspects in the Kwatrijn project. Such a topic can then be followed over time, by searching for words related to straw (straw, grass) in quotes, minutes and documents. Topics may emerge, gain salience, and may also disappear from the stage. By following a particular topic over time and the concomitant interpretations and urgencies, i.e. by reconstructing a 'topic biography', we get an insight into how framing occurs and changes.

5.4 Results and analysis: case description and topic biographies

In the Kwatrijn project, a sustainable dairy system was designed in which environmental, animal welfare, economic and societal aspects are taken into account. According to the project plan (internal report), the goal was to develop a dairy husbandry system with a high degree of animal welfare and low emissions, which fits in the vicinity of a nature conservation area. The focus is on the building, the place in the landscape and the management of the cows. The timeline below (Figure 5.2) gives a general overview of the three phases of the project, which will be described in the following section.

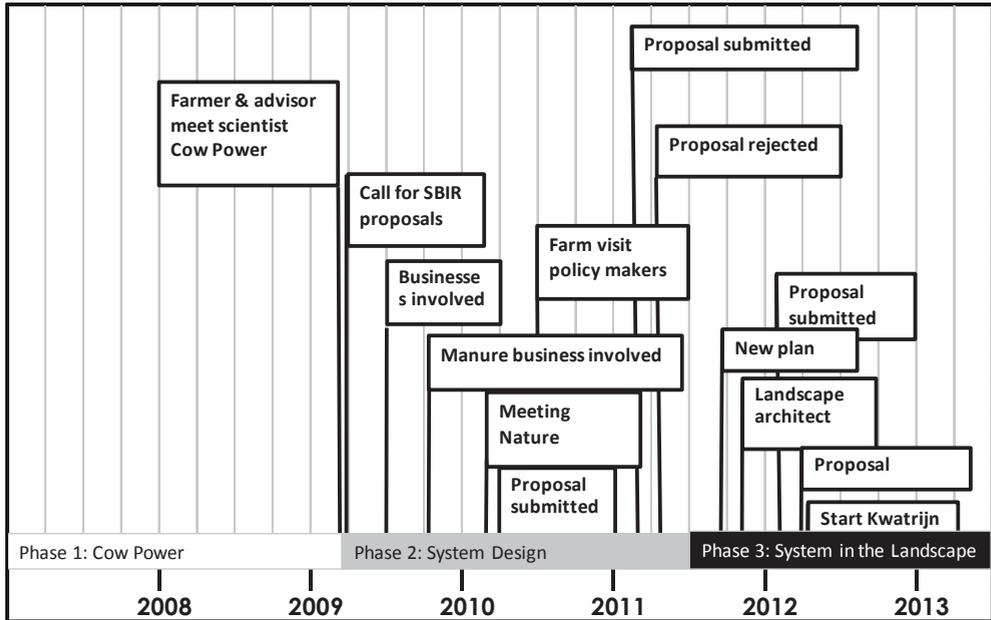


Figure 5.2 Timeline project

5.5 Case Description

5.5.1 Phase 1: Cow Power

From 2007 until 2009, a project called 'Cow Power', commissioned by the Dutch Ministry of Agriculture, Nature and Food Quality, was carried out by the department of Livestock Research of Wageningen University. The goal was to develop examples of sustainable dairy systems. These 'system innovations' would consist of improved technologies and new ways of working and collaboration in the sector. Many actors were involved including researchers, ministries, the Dutch Society for the Protection of Animals, provinces, breeders, farmers, an architect and advisory companies.

According to the report (Bos et al., 2009), the four main ideas in the project were: offering the cows enough space, preserving valuable minerals such as nitrogen and phosphate, making better use of capital assets and labour, and respecting and utilizing the soil ecosystem. These ideas were integrated in four design concepts, to be used as a starting point for follow-up projects (Bos et al., 2009).

One follow-up project was the Kwatrijn project, which had its origin during a meeting of the Cow Power project in 2009. The ideas presented inspired a farmer (part of the 'Duinboeren' foundation) and an advisor, and they further discussed the possibilities of implementing the concept at the farmer's place. At the same time, the Farmers' Association for the Southern part of the Netherlands (ZLTO) was looking for innovation projects for the Small Business Innovation Research programme of the Dutch government which supports innovative solutions for societal issues (Website Min EL&I, 2012). The call of the programme asked for innovation projects with a focus on integrated sustainable barns and husbandry

systems. Co-operation with firms was needed to apply for the subsidy. First, a concrete company specialized in floors and a building constructor became involved. Later, a company specializing in manure-handling systems was asked to contribute to the project.

5.5.2 Phase 2: Design of the system

In 2009 a consortium was formed including the farmer, the advisor, a researcher, a representative from the farmers' association, and three companies (concrete, manure systems and building constructor). Together they developed a concept for a husbandry system for dairy cows, based on the ideas of the Cow Power project. Because of the geographical and personal situation of the farmer, some extra wishes regarding the design of the system were raised: the system should be able to operate near sensitive nature conservation areas, the animal welfare should be high and the system should have a relatively small scale (of about 70 cows). The latter condition would make it financially easier for successors to take over the dairy farm.

Because not all of these wishes were common practice, some hurdles had to be faced. According to the project plan (internal report, 2011), the goal in this phase was to design a dairy husbandry system that was different from existing systems and could ensure a high degree of animal welfare, very low emissions of ammonia and greenhouse gases, and energy neutrality. The combination of these innovations in an integral approach was the most important characteristic of the system (internal report, 2011). Furthermore, the needs of society to be addressed were defined by the project consortium as preservation of transparency in the dairy sector, especially near nature conservation areas.

From February onwards different meetings were organized with NGOs, research institutes and universities, and a field visit with policymakers was organized in the summer of 2010. Contact with advisory companies and firms was arranged to investigate the possibilities for – amongst others – solar panels, movable milking machines and urine-processing systems. Most actors involved were introduced by the advisor. Furthermore, there was contact with local and regional authorities to discuss possibilities and permits for the system.

A first feasibility study was conducted from winter to spring 2010-2011 and addressed environmental, economic and technological possibilities: the floor of the barn; the level of animal welfare; the flows of minerals; the processing of manure and urine; the construction of the system and a movable milking machine. In the same period a discussion took place with the Dutch Society for the Protection of Animals to gain their support for the new idea of the Kwatrijn system. They were positive but opposed the option for farmers to keep their animals inside the barn all year. The Society for the Protection of Animals was in favour of pasturing as much as possible.

The proposal for the research and development plan was not among the three best proposals and was rejected for subsidy in spring 2011. The actors decided to try and find other resources in order to continue the Kwatrijn project.

5.5.3 Phase 3 System in the landscape

In August 2011 a meeting was organized on the progress of the project. A new government

subsidy scheme was launched to ‘fit the system in the landscape’. The consortium decided to continue and asked a landscape architect to develop ideas about the design of the system in relation to the area. At the end of January 2012 the project consortium heard that they could continue with a new feasibility study regarding the system in the landscape. The main goals now were to design a dairy husbandry system that would fit in the landscape, and would bring innovations regarding the floor, urine processing, mineral flows, improved animal welfare, and a movable milk machine and reduced energy use (internal report, 2011).

5.6 Topic biography using straw in the barn

In the first Cow Power phase of the project, straw was not mentioned in relation to animal welfare. It mainly appeared as one of the potential sources of fine dust in the dairy system, and was thus to be avoided. The use of straw in the system was reintroduced by the farmer in the second phase of the project (2009). He connected straw to animal welfare:

So I removed the grids and put some straw-grids with holes and a lot of straw in the boxes. And I discovered that the cows found it wonderful. The boxes with straw were always occupied.

The use of straw is framed by the farmer as ‘improving animal welfare’. This often conflicted with other frames of straw. For instance, a working group of dairy farmers from the farmers’ association opposed such ideas and was afraid it would yield a “Hansel and Gretel barn, a system of the past, like Ot & Sien [a Dutch story for children in the first half of the 20th century]. That is dairy farming of the past, with 70 cows” (quote advisor). Clearly, the working group did not see straw as innovative:

A movable milking machine, grids, and straw grids; these things do already exist. The discussion was whether this is innovative or not... We as a working group were critical in the beginning. Is this innovative? [...] And during the continuation of the project, we saw the complete story and then you see what it is about. You know you need something very exclusive [in order to get the subsidy].

According to the working group, the innovative character was not immediately clear and it labelled the use of straw and the small scale (70 cows) as ‘old-fashioned’.

Not only the working group but also the involved firms were hesitant in the beginning, as straw is not a common practice. In the words of the advisor:

They [the firms] normally build systems for 100-150 cows. That is fine, but not much is said about sustainability of dairy farming, nor about pasturing and absolutely not about straw in boxes and those kinds of things. These elements are no longer used by modern farmers.

The use of ‘straw’ raises associations with deep litter systems (a system in which the manure is kept in the system, straw is added and every once in a while the system is cleaned). Straw is framed as ‘causing a lot of work’, as it is difficult to keep the barn clean when there is straw all around. The material characteristics of straw also constrain the possibilities of the

machines being used in the barn. Because the commitment of the working group and the firms was very important for the project, a deadlock appeared. One of the ways out was to change the framing of straw as 'old-fashioned' into 'innovative'. Indeed, to present straw as part of the cycle of nutrients and the integrated idea of sustainability made the working group more enthusiastic.

As the advisor recalls:

Where farmers lose ground on the level of organic matter in the soil and the amount of soil life and thereby lower the natural capacity of the soil, this project is going in another direction. Because straw is added, the organic matter in the soil is increased. By applying that, you do not only increase animal welfare, but also soil life and biodiversity. That is sustainable.

The idea is that straw improves the structure and quality of the manure leading to improved organic mass. Straw is now framed as 'a nutrient' and relates to biodiversity, eco-systems and sustainability. Straw thus makes the cycle of organic material complete, and ensures the link with environmental issues.

The use of straw in dairy husbandry systems, however, is not very common and required special attention from the firms involved in the design of floors and the processing of the manure. New problems appeared with the legs of cows, the distribution of manure, hygiene and the types of grids.

The floor of the system should not become slippery or cause hygiene problems. Furthermore, straw changes the composition of the manure and brings additional requirements for the manure machine. A new vehicle and control system had to be developed.

The material characteristics of straw constrained the design, and made adaptations of machines and the floor necessary. In the end, the firms discovered that straw helps to separate the manure from the urine, because it helps to filter the solid parts from the fluid parts. This became an important innovative element of the project.

This topic biography shows the different ways in which straw was framed. Straw was first framed as 'good for animal welfare'. This frame was more or less present during all the different phases of the project, but other ways of framing the use of straw came to the fore as well. Instead of being 'old-fashioned', straw entered the scene as an essential part of an integrated system, serving both animal welfare, biodiversity and soil life. This reframing allowed the continued support of the working group and the involved firms.

Framing the system as 'good for animal welfare' also enabled support from the Society for the Protection of Animals. They agreed that straw is a good addition in the system, and thereby reinforced the frame 'good for animal welfare'. In the beginning the business parties were sceptical about the use of straw, but discovered that it made the design innovative. Figure 5.3 presents the four main ways in which straw was framed.

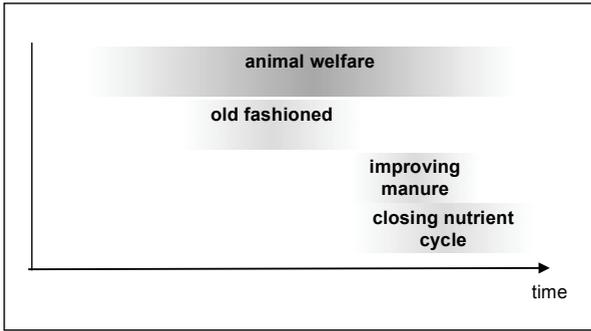


Figure 5.3 Framing straw over time

5.7 Topic biography pasturing of cows

The pasturing of cows was already a topic in the Cow Power project. Although scientists do not agree on whether pasturing is a need for cows or not, pasturing was taken up as a precautionary measure (Bos et al., 2009).

The farmer of the Kwatrijn project saw pasturing as ‘good for animal welfare’. Also, the project plan stated that the Kwatrijn “scores almost as well as a system of year-round pasturing”. The score refers to the Cowel index, a scientific model that determines the animal welfare of a husbandry system compared to other husbandry systems (Groot Koerkamp et al., 2008). It rates and weights 42 characteristics of dairy husbandry systems; the Kwatrijn system scored 266 out of 313 points.

Pasturing was also linked to environmental impact, like higher ammonia emissions. In the working group, for instance, it was remarked:

...animal welfare and manure separation are always a point for discussion. Because when you have the lowest ammonia emissions, you should actually have the smallest space for a cow. And animal welfare requires as much space as possible [...]. And at the moment that you start pasturing, you will always have mineral losses.

The farmer and the advisor also emphasized that pasturing was a societal issue. Especially for the farmer, the view of the public was of importance, and, he argued, the public would like to see ‘good animal welfare’. Only then can one earn a ‘licence to produce’ near a nature conservation area, as the farmer called it. So ‘keeping cows outside’ enables cows to be kept close to a nature conservation area.

I have some problems with the term, but ‘licence to produce’ is a good one hinting at it. In nature conservation areas you have to earn the right to produce there. You have to show you do a good thing. With animal welfare, nature conservation et cetera. By doing that you earn your spot there.

Pasturing thus appeared to be a ‘prerequisite for producing near a nature conservation area’. Other actors in the project also identified pasturing as an important societal issue, and

thus connected the global discourse to the level of the project. The framing of pasturing as ‘providing a licence to produce’ and ‘essential near the nature conservation area’ was linked to the global discourse on agriculture.

I think pasturing is a difficult topic, because some people do not pasture their cows, while their cows are actually also doing well, but I myself think that pasturing is essential for your image. (Farmer)

A system with pasturing was seen by the farmer and the advisor as a contribution to the Dutch landscape. Cows in the pasture add value to the landscape and to the experiences of citizens and recreationists (internal report). Pasturing was framed as a ‘societal issue’ and important for the image of the dairy sector at large. Pasturing would reinforce the link between the public and the agricultural sector.

The discussion regarding pasturing continued in the project, and there was no decision taken whether to include pasturing in the concept or not. The idea was that even if farmers did not decide in favour of pasturing, the system would still be good for animal welfare.

Our system is regarding environmental emissions, transparency, visibility of the cows, animal welfare and labour conditions, the most far-reaching development in the Netherlands at the moment, even if a farmer decides to keep a lot of cows inside. (advisor)

Thus pasturing now was only an option and the project team believed the system was designed in such a way that it is animal-friendly, even when cows are kept inside. Especially in the last phase of the project, optional pasturing became more important, as the landscape architect initiated the idea of a ‘barn catalogue’ with small and large systems, and systems to keep cows inside or to pasture them. The Society for the Protection of Animals continued to see pasturing as an important aspect of animal welfare in dairy farming.

The frame of pasturing changed from ‘good for animal welfare’ towards a ‘requirement for producing near a nature conservation area’. Making pasturing an option in the system had implications for the design. Initially the Kwatrijn project consortium framed pasturing as ‘providing a licence to produce’, but due to commercial reasons refrained from making pasturing a strict requirement of the system. Figure 5.4 presents the different ways of framing pasturing over time. This figure shows that pasturing to increase animal welfare is still important, while other frames also appeared.

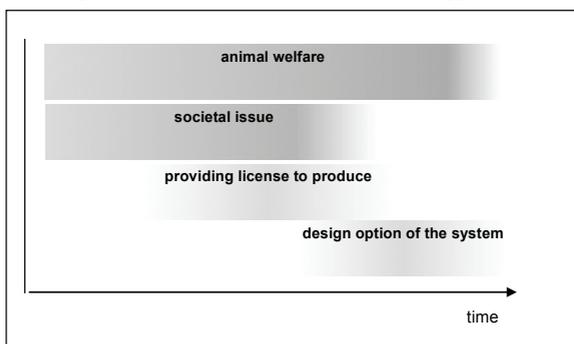


Figure 5.4 Framing of pasturing over time

5.8 Topic biography: the design of the system

The focus of the third phase of the Kwatrijn project was on the integration of the barn in the landscape. One of the goals now was to show that “although the barn is much bigger with its 13.5 square metres per cow, it still fits the landscape” (internal report, 2011). To improve animal welfare, the barn was designed bigger (13.5 m² per cow) than the usual barns (6 m² per cow). The project consortium was afraid, however, that the barn would look like a huge building in the landscape and would be seen as an example of ‘mega farms’ that were controversial in the global discourse. The idea was to design an open barn, which could be easily integrated in the landscape instead of ‘a massive-looking barn’. What would be seen as ‘integrated’ is not straightforward, however. Which material is natural, for instance?

Farmer: This is a vulnerable area. Like a foil arch dairy housing (in Dutch: serrestal); I don't want it there. That thing wouldn't fit in the area. You don't put a foil roof against a nature area? [...] Look, a thatched roof is not necessary, but a foil roof would be extreme. You need something that fits, that seamlessly blends in the area, so to speak. It must be there, but it shouldn't stand out.

This quote shows that the choice of the (roof) material influences if and how the barn would fit in the landscape.

Farmer: Maybe, we should use more wood. Maybe if we do that, it would fit seamlessly in such an area, it is a natural product. And we do have the possibility [...].

Thus far, the barn had been seen as “a thing in the surroundings” (researcher). Now, the call for subsidy required a focus on integration in the landscape. In August 2011, a landscape architect was asked to participate in the Kwatrijn project to create a connection between the landscape and the system and to integrate agriculture into the landscape. Drawing on the general idea that ‘cows belong to the Dutch landscape’ the consortium decided to create a system in which the cows are visible, which changes the shape, the materials, the appearance and visibility of the barns.

The urgency to integrate the barn into the landscape was also fuelled by the general concern to render the dairy sector more sustainable and would not necessarily be at the expense of the economic viability.

Advisor: Because an animal-friendly barn is important, but the most important thing is of course that it fits in the environment and has added value for the Dutch dairy sector. [...] In fact, the sustainability challenge is to fit the integral system in the nature conservation area.

Working group: Bringing the two goals nature and agriculture together. So using pasturing in order to keep the grass on a certain level in nature areas. And I hope that at the point where nature and agriculture are connected, the economy will also come to the fore.

An ‘open’ design that does not use many walls makes it possible to look through the system to the nature, and thus changes the barn as ‘a thing in the landscape’ into something that connects agriculture and nature.

Project plan: *The open system has a strong visual relationship with the landscape and provides opportunities for participation of the public. [...] An open design makes the system look less massive and makes it possible to look in the system.*

Researcher: *...It is no longer about the landscape, it is about how you can improve it [the system] in such a way that it becomes part of the landscape, and adds something to the landscape and biodiversity.*

Furthermore, an open system emphasizes the idea of cows in the pasture, as discussed above. The idea is that by showing what is done in the Kwatrijn project, it might improve the image of the sector in the view of the public.

So, according to the project plan an open system is easier to fit in the landscape:

Project plan: *an open system gives more opportunities for a location-specific design and fitting in the landscape than a closed system.*

To conclude, the design of the system (barn and surrounding) is framed in different ways. First, the system was framed as a ‘huge building in the landscape’. Given the global discourse regarding ‘mega farms’ the project team decided that an open system should make the system less massive and more transparent. The use of natural materials helped to frame the system as ‘fitting in a natural environment’. Furthermore, interaction with the landscape architect made the emphasis on integration in the environment more prominent. The framing of the system changed over time from ‘open barn to be integrated into the landscape’ towards ‘involving the landscape in the system’. The design of the system started with the intention to make the system look less massive. Later on it was also supposed to ‘create a connection between agriculture and the nature conservation area’.

The farmer and the advisor assumed that it is good to make dairy farming visible to the public, and therefore they designed an open system. As a result, the boundary between agriculture and the landscape became blurred and the frame of a huge barn was replaced by a frame in which the system blends in with the landscape, providing ‘a connection between agriculture and the landscape’ because of its shape. This is an example of a material frame, as material characteristics such as the choice of materials determine whether the system is framed as ‘massive’ or ‘natural’. Figure 5.5 gives a schematic overview of the framing of the design of the system.

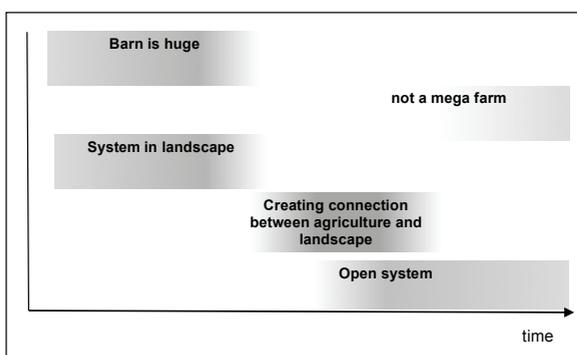


Figure 5.5 Framing of the design of the system

5.9 Conclusion and discussion

This paper has traced the role of framing and changing frames in the course of the Kwatrijn project. Our assumption was that framing matters in innovation projects and that we can better understand innovation processes by getting a detailed view on framing. Our goal was to understand how framing facilitates or hinders innovation in a complex multi-actor project of a dairy system design, the Kwatrijn project. We used the methodology of delineating topic biographies. We started with issues related to animal welfare and followed the topics 'straw', 'pasturing' and 'design of the system'. These topics had a prominent place in the unfolding of the project. In this concluding section we will compare and contrast them.

The topic biography of straw showed how the (cognitive) frame that 'straw is old-fashioned' and not innovative hindered the project. We also saw how material characteristics of straw influenced the design of the system, especially the floor design and machines, and how such adaptations enabled the actors in the project to frame straw as part of an innovative system. Furthermore, the use of straw increased the role of the firms that had to develop the new machines. In interactions within the project team, the cognitive frame of 'straw as good for animal welfare' moved to the background, but was still one of the ideas behind the system. The emphasis shifted to the design of the system. Where straw first hindered the innovation, in the end it facilitated it, by giving room to innovative technical components.

The pasturing of cows is framed by some actors, such as the farmer, as being 'good for animal welfare', while for others, for example the firms, this is not business as usual. The framing at the level of the global discourse of pasturing as 'animal-friendly' and 'belonging to the Dutch landscape' was used in the project to frame pasturing as 'providing a licence to produce near a nature conservation area'. By creating that link, it was possible to situate the system close to the nature conservation area. Two frames existed alongside, namely: 'pasturing is good for animal welfare' and 'pasturing is not a necessary condition for an animal-friendly dairy system'. The first frame took the Society for the Protection of Animals on board, while the second took other farmers on board.

The relationship of agriculture with the landscape was an important topic in the third phase. The global discourse on the controversial 'mega farm' prompted the creation of an open system that allows the system to be looked through, to the landscape, and thereby to connect the system to the landscape and make it accessible for visitors.

We thus found that when a project has to change from abstract plans to more concrete details, changes in framing occur. As soon as the system had to be designed, it had to become clear what, for example, animal welfare implies. We also found that when difficult choices have to be made, or in the case of disagreement between actors, framing becomes apparent. Sometimes frames may clash, for example in the case of using straw or pasturing, which hinders the continuity of the innovation process, at least temporarily. When actors had the same frames at the localized collective level, it was easier to continue the innovation, as the example of pasturing showed. On other occasions, differences in framing existed beside each other, like whether or not pasturing is necessary for good animal welfare. We can draw three general lessons regarding framing and innovation from this dairy system case study.

First, the example of the use of straw shows that materiality does indeed play a role in framing. We added the material to the cognitive and interactional forms of framing which have received more attention in the literature (e.g. Dewulf et al., 2009). The example of straw shows that material is 'stubborn', not easy to change, or to get around, and that limits the way it can be perceived or handled. The actual shape of straw makes it necessary for machines to be adapted. Actors had to take into account the characteristics of straw that come along with it. While there can be cognitive frames of straw, like being 'old-fashioned', the materiality of straw also frames the perceptions and actions of, for example, designers and thus functions as a 'script'.

Secondly, from our case study we can distinguish two causes for changes in frames. When a topic has to be defined from abstract plans to more specific details there has to be more alignment and agreement, thus making it necessary for framing to change. Furthermore, frames may change when they openly conflict. Conflicting frames can exist within a project team (e.g. different frames regarding design of the system), or can be introduced from outside the project, from the global discourse (e.g. pasturing is a societal wish).

Thirdly, it seems that innovation is stimulated when differences in frames hinder a project, and something has to happen in order to create a new frame or a combination of frames. In the first instance different frames can hinder the innovation process, while differences can lead later on to new combinations and innovative ideas. For example, pasturing made it possible to situate the system close to a nature conservation area. New machines were developed to handle straw in the barn. A different way of framing, then, helps to break through existing ideas.

What we can learn from studying framing in innovation processes is that frames can hinder or stimulate the innovation processes by making actors think and act in a certain direction, and see, for example, straw as old-fashioned. Consciously or unconsciously actors frame things, and thereby enable or constrain the possibilities of an innovation. Unintentional effects can lead to hindrances; a change of framing is then needed in order to continue the project.

The practical implication is that being aware of differences in framing is important for the continuation of a project. Also, some method of 'frame management' may be helpful in agricultural transition processes and our case study provided various examples of deliberative interventions to change frames. A next step could then be to develop a way to uncover and handle different frames in an early stage of a project.

6.

Antibiotics use in Dutch animal husbandry: framing of responsible use of antibiotics¹¹

¹¹ A paper based on this chapter will be submitted to Science and Public Policy.

6.1 Introduction

The Dutch agricultural sector is subject to change and is facing sustainability challenges. After a period in which production growth was central, nowadays sustainability issues are getting more attention (Bekke and De Vries, 2001). New societal values have come up, like environmental awareness, conservation of nature and quality and safety of food (Bekke and De Vries, 2001). These changes are putting a lot of pressure on the firms, farms, research institutes and other actors in the agricultural sector. Boundaries of production growth seem to be reached and concerns related to animal welfare, biodiversity and environmental problems have come to the fore (Beers et al., 2010). Pressure on profit margins is increasing and farms are increasing in size, with more animals per farm (van Bruchem and Silvis, 2008; CBS et al., 2012). “To support the growing human population, we have an increasing demand for nutritional support, resulting in intensive agricultural practices, sometimes involving enormous numbers of animals or multiple species farmed within the same region” (Cutler et al., 2010). But keeping many animals together also involves risks for nature, animals and human health (Compassion for World Farming et al., 2013).

According to Rinaldi (2013), different developments have contributed to an increased attention to diseases or infections that are naturally transmissible from vertebrate animals to humans, also called ‘zoonoses’. The first development mentioned by Rinaldi (2013) is that agricultural production is intensifying and at the same time transnational transportation of feed supply, animals and their products is increasing. Furthermore, intrusion of humans in natural habitats has exposed them to new zoonotic pathogens. Finally, climate changes might influence the evolution of pathogens and thereby increase the risk that pathogens can transmit to humans. So, the importance of protecting both animal and human health is increasing and the veterinarian has a responsibility to perform disease surveillance and has to make sure that infections can be stopped at their source in animals (Rinaldi, 2013). That is exactly what this study is about. Since the discussion on the use of antibiotics in farming started in the Netherlands around 2005, measures have been taken by the Dutch government to reduce the use of antibiotics and to develop a way to deal in a ‘responsible’ way with antibiotics in farming.

In this chapter we study the transition towards a novel Dutch agricultural production that depends much less on antibiotics. Our starting point is the observation that the goal of a more ‘responsible use of antibiotics’ in farming is generally supported by all stakeholders, while the question of what this entails is answered in fundamentally different ways. Our central theoretical concept for studying these different ways of perceiving responsible use of antibiotics is ‘framing’: *the phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics*. Problems and solutions are framed differently by different stakeholders, often in conflicting ways, especially in a period of change. Many people are striving for a transition towards a system in which antibiotics is used in farming in a responsible way. We are interested in how framing does affect the development towards a more responsible use of antibiotics in farming. The goal of this research is to better understand the framing of responsible use of antibiotics by different actors involved in animal husbandry and health care.

The research question we investigate is: *What is the role of framing in the development towards 'responsible use of antibiotics in animal husbandry'?*

While the projects in the other two cases (chapters 4 and 5) were clearly defined projects, the situation in this case is in the phase of defining the problem. This phase can be seen as the start of what in a later stadium can become an innovation project. In this case the actors are thinking about a way to arrange the situation in such a way that organisations for example interact with each other. Technology does not play an important role at the moment, but actors need to decide on measures and decisions on who is responsible for what. The actors in the field are searching what has to be on the innovation agenda. Because there is not yet a project defined, it is less obvious beforehand which particular actors to follow and which framing to study. We assume that stakeholders from different backgrounds have different views on what responsible antibiotics use means, but they all agree that 'responsible use of antibiotics' is important. In other words, different frames will be at play. Furthermore, it is also a situation that is positioned in both human health care and veterinary health care, which makes it difficult to realize a change.

We try to unravel frames in this case, in the same way as in the two previous chapters, i.e. with the methodology of topic biographies. We study the frames in which problems and solutions appear. We follow topics that actors involved raise as important and urgent items. The two topics we investigated are 'responsible use of antibiotics' and 'the role of the veterinarian'. Apparently, they are worth the effort to struggle with for the actors we spoke to, and appear somehow as a barrier to envisioned solutions for antibiotics use.

We study the topic biographies by focusing on the framing of problems related to reducing the use of antibiotics by diverse relevant stakeholders, namely people from human health care, veterinarians, researchers, someone from the drug authority, government and product board. Section two explains the theory of framing. Section three describes the methodology used to gather data and find framing. Section four involves the case description, based on information from interviews, newspaper articles and reports gathered. The fifth section gives the different frames of the actors involved in the area of antibiotics use, as present in 'topic biographies'. Section six gives the analysis of the topic biography and section seven presents the conclusions and directions for further research.

6.2 Theoretical framework

Decreasing the amount of antibiotics used in animal husbandry is a complex process, as a lot of different stakes are involved, and the current Dutch farming system is locked in to a way of keeping large amounts of animals together, and using antibiotics routinely for disease prevention or for the treatment of avoidable outbreaks of disease (Compassion for World Farming et al., 2013). This system needs to change in order to realize a decrease in the amount of antibiotics used. In such a transition process, different actors have to agree on the actions to take and have to collaborate in order to make changes possible. In studies on transitions and system innovations there is a growing awareness of the importance of cognitive approaches towards change as well. For example, Sengers et al. (2010), Elzen et al. (2011) and Geels and Verhees (2011) focus on cognitive and/or framing aspects in order

to understand innovations. A theoretical concept that can be used in order to understand inter-group interactions, conflicts and negotiations in which differences in actors' frames are central is called 'framing' (Dewulf et al., 2009).

Framing is studied in a lot of different disciplines, varying from communication sciences (Entman, 1993) to psychology (Levin et al., 1998) and from artificial intelligence (Minsky, 1975) to policy studies (Hajer, 1995). These approaches vary in their definitions of framing, and to what extent framing is mostly seen as a cognitive or interactional phenomenon.

This research defines framing as the *phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics*. When studying framing one studies framed perceptions, statements, actions and interactions and traces back what these expressions are based on. Three types of frames are distinguished by Zwartkruis et al. (2012), namely cognitive frames, interactional frames and material frames. Cognitive frames are relatively static structures in one's mind that enable and constrain understanding, action and interaction. Interactional frames originate from action and interaction, and are very volatile. Material frames are the characteristics of artefacts that enable and constrain understanding, action and interaction. These three ways of framing are interrelated and one expression can be traced back to different ways of framing, as the figure below (Figure 6.1) illustrates.

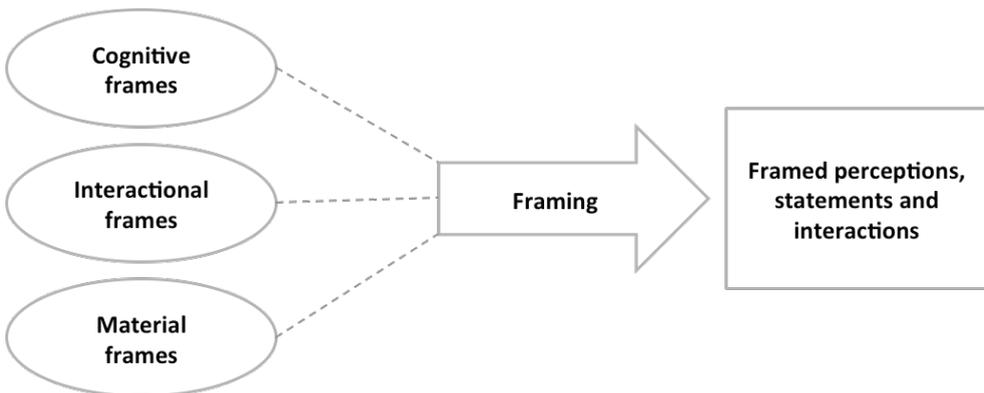


Figure 6.1 Theoretical framework

We argue that it is possible to make a distinction in the literature on framing between two streams of framing studies that differ in the level of framing they focus on. There are studies focusing on the face-to-face level concerning framing at the level of actors (e.g. te Molder and Potter, 2005), and there are studies that focus on framing in the media and the public debate (e.g. Hajer and Versteeg, 2005), which is what we propose to call the global discourse level. In chapter 2 we added a third level, which could be situated in between the two existing levels, namely framing on the level of the localized collective, on the level of projects (Zwartkruis et al., 2012). These three levels are interrelated and influence each other (see Figure 6.2).

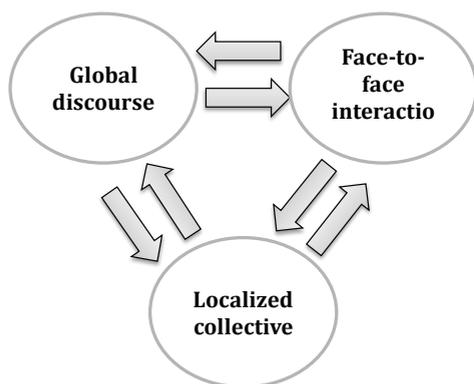


Figure 6.2 Levels of framing

Changes in framing can take place when something changes in the environment (new actors, actors leaving, new technologies), by conflicting frames that hinder the progress of a project, or if the public discourse changes. Global discourse is introduced at the level of the localized collective as a point to take into account. For example, discussions on the risk of keeping many animals together influence the way actors deal with these issues in projects.

6.3 Methodology

To investigate the role of framing in the discussions on responsible use of antibiotics in animal husbandry, we conducted eight in-depth semi-structured interviews (see Table 6.1), and a document analysis in which 20 reports and over 170 newspaper articles were studied.

Table 6.1 Interviews on antibiotics in animal husbandry

Interviews	Number of interviews
Specialist	2
Veterinarian	1 ¹²
Researcher	2
Product board	1
Ministry	1
Veterinary Medicines Authority	1

The interviews were transcribed verbatim¹³ with the help of the F4 program.¹⁴ All the documents were organized in the qualitative data analysis program Atlas.ti.¹⁵

¹² One of the researchers is also a part-time veterinarian.

¹³ Quotes are translated by the authors.

¹⁴ www.audiotranscription.de

¹⁵ Version 6.2.26, qualitative analysis program.

In order to find out how and when framing takes place we focus on the expressions of actors. Cognitive, interactional and material frames, however, cannot be observed directly, as they are not present in an isolated form. Frames can only be inferred by considering what gets framed, and how. One way to study this phenomenon is to follow how topics evolve over time. We define a topic as a problem or a goal, relevant to one or more participants in the interactions. Topics are explicitly or implicitly introduced into the interactions by the actors themselves, and can be traced afterwards by analysing documents and interviews.

During innovation projects topics may emerge, become salient and dominant, and may leave the scene. It is possible to reconstruct the vicissitudes of a topic, or, as we call it, the *biography of a topic* (see Zwartkruis et al., 2012), on the basis of quotes from interviewees, traces of interaction processes and project materials. We emphasize that the topics were not invented by the analyst but brought into existence by the actors themselves: they discussed them, expressed their perspective on them and stressed their importance. A topic biography not only shows the way topics are framed over time, but the roles of actors in relation to the topic are discussed as well. When following topics we automatically encounter discussions about the roles of actors in the discussions and the interaction processes involved. The biography of a topic allows analysis of the framing around that topic. Consequently, we ask the following three questions that define the lifetime of a topic:

1. What is the problem to be addressed?
2. What causes the problem according to the actors?
3. What are the (explicit or implicit) suggested steps forward?

The answers to these questions will produce a complete topic biography, which is our basis on which to study how framing occurs around a certain topic.

By asking questions in the interview regarding the main problems and discussions in the field, important topics come to the fore. Topics mentioned include the daily practices of farmers and veterinarians, the 'responsible use' of antibiotics, the collaboration between human and animal health care, the problems with antibiotic resistance, and the current way of keeping animals in the Netherlands. We chose to focus on two of these topics, because the discussions around these two topics show various frames and can therefore help to get insight in how framing occurs, i.e. defining responsible use of antibiotics, and the role of the veterinarian in antibiotics use. When studying framing it is important to prevent overinterpretation, and therefore we stay as close as possible to the original texts of actors in interviews, reports and newspaper articles, etc. In order to get a better understanding of the project, we first give a general case description of the project, and then we provide more details on the topic biographies.

6.4 Antibiotics use and the problems with antibiotic resistance

Although since the invention of penicillin in 1928 by Fleming antibiotics have greatly improved human health, the success may also turn into a serious threat for human health. Fleming had already warned about the possible effects of resistance to antibiotics, and nowadays problems arise with the resistance of bacteria to antibiotics (Barbosa and Levy,

2000). Antibiotic resistance, or actually antimicrobial resistance,¹⁶ is the phenomenon whereby micro-organisms develop resistance to antimicrobial activity. Recently, the problem seems to have become aggravated. The two main reasons for the increasing problems with resistance of bacteria to antibiotics are, on the one hand, that the development of antibiotics is stagnating and on the other hand that more bacteria are becoming resistant (van't Hoog, 2012). Resistant bacteria reduce the chance of treating diseases, as they hinder the effect of antibiotics. As a result it becomes more difficult to find a cure for an infection (Nethmap/Maran report, 2012). Dutch human health care follows a restrictive policy with regard to the prescription of antibiotics. There is a 'search and destroy' policy in which potential sources of resistant bacteria are traced and controlled with a strict protocol in order to prevent resistant bacteria spreading. People from countries in which there is a less restrictive policy regarding the use of antibiotics have a potentially higher risk of carrying resistant bacteria such as Methicillin-resistant *Staphylococcus Aureus* (MRSA), and are therefore quarantined when they are admitted in hospitals. A tool to provide guidelines for responsible use of antibiotics is the Antibiotic Stewardship Program (Karreman et al., 2011). The Antibiotic Stewardship Program is defined as "an ongoing effort by a health-care institution to optimize antimicrobial use among hospitalized patients in order to improve patient outcomes, ensure cost-effective therapy, and reduce adverse sequelae [aftermath] of antimicrobial use (including antimicrobial resistance)" (MacDougall and Polk, 2005, p. 638).

Antibiotics are used not only in the health sector but also in animal husbandry. Since 1969 there has been a continuous debate about "the extent to which bacterial antibiotic use in food animals promotes resistance in bacteria that infect humans" (Witte, 1998, p. 996). Observations did "suggest that antibiotics use is a driving force for the development of antibiotic resistance in certain pathogenic bacterial species" (p. 997). Besides hospitals, animal husbandry is, according to Witte (1998), another arena for the development of antibiotic resistance. The human and animal microbial ecosystems are inextricably intertwined, which makes antibiotic resistance ready to cross boundaries. It seems that there are two important ways in which people can get in touch with resistant bacteria living in animals, namely via direct contact with animals and via food (Witte, 1998; Health Council of the Netherlands, 2011).

The World Health Organization (WHO) has been investigating antibiotic resistance in animals since the 1990s. Scientific studies on the relation between bacteria present in humans and in animals vary in outcomes. Sometimes a relation is found, for example the transmission of MRSA between pigs and farmers (Voss et al., 2005). Other studies state that there is only a very small risk to human health arising from the use of antibiotics in animals (e.g. Phillips et al., 2004; Wassenaar, 2005). According to Lipsitch et al. (2002), the cause for the controversy about antibiotics use in agriculture is the lack of direct, quantitative information about the magnitude and nature of agricultural use of antibiotics.

Although it might not be very clear to what extent antibiotics use in agriculture influences

¹⁶ Antimicrobial is the broader term. Antibiotics are one category of antimicrobials, and are directed towards bacteria, but fungi or viruses can also become resistant. Nevertheless, in this chapter we mainly discuss antibiotics, so therefore we use the term 'antibiotic resistance'.

risks to human health, relations are found between antibiotic use in the animal husbandry sector and antibiotic resistance in humans (Witte, 1998). Furthermore, for the animal husbandry sector itself it is also important to limit the amount of antibiotics in order to prevent antibiotic resistance in animal husbandry. That is why governmental organizations also draw attention to this topic. According to the Dutch Central Veterinary Institute, the combination of consequences of antibiotic resistance for human health and the growing debate on animal-friendly ways of keeping animals are both stimuli to change the way antibiotics are used in the animal husbandry sector (Central Veterinary Institute, 2012).

While there is a restrictive policy towards using antibiotics in human health care, the veterinary sector of the Netherlands was until the beginning of the 21st century much less restrictive about antibiotics than, for example Scandinavian countries. Although comparisons between countries are difficult to make because of differences in measurement, the overall average use of antibiotics in the Netherlands is approximately 40% higher than that in Denmark (Bondt et al., 2013).

In the Dutch veterinary sector a lot of antibiotics are used for one of the following three reasons mentioned by the Central Veterinary Institute (2012). First, antibiotics are used to treat diseases in animals. In a lot of cases not only the animal that is ill, but also the other animals, are treated preventively. Second, antibiotics are used in a prophylactic way in order to prevent animals with a higher risk from becoming ill, like animals that have to be transported. Third, since the early 1940s and 1950s, antibiotics have been added to the feed in order to let animals grow faster, in less time and with less feed. Since January 2006 the use of antibiotic additives as an antimicrobial growth promoter has been banned in the European Union, but antibiotics are still used for preventive reasons.

In 2005, a relation was found between human and veterinary health care in the Netherlands, when a woman was infected with a type of MRSA. It turned out not to be the hospital variant, but a variant that also occurs in pigs. It turned out that a lot of pig farmers carried the MRSA stem. Furthermore, there was transmission of MRSA between an animal and a human (pig and pig farmer), between family members and between a nurse and patient in the hospital (Voss et al., 2005). Later on, a relation between extended spectrum beta-lactamase (ESBLs) and antibiotic use in animal husbandry was found (Kluytmans et al., 2010; Overdeest et al., 2011). According to the Health Council of the Netherlands (2011), MRSA, ESBLs and vancomycin-resistant enterococci (VRE) form a microbial risk for human health. The problems with resistant bacteria are mainly present among people with lower resistance. If someone in a hospital is carrying a resistant bacterium, the patient has to be quarantined; not only causing higher costs, but also having social implications, such as the patient feeling alone and people can less easily visit the person because they have to take a lot of measures.

Using a lot of antibiotics in animal husbandry can cause resistant bacteria, which can form a risk for humans if they are in touch with animals or eat meat or vegetables produced with the use of manure (Phillips et al., 2004; Witte, 1998). In order to prevent the risk of resistant bacteria, it is important that the amount of antibiotics used in animal husbandry decreases.

The Dutch government announced in 2010 target figures to decrease the use of antibiotics in animal husbandry. The amount of antibiotics used in 2009 was set as a starting point and the goal was to realize a reduction of antibiotics use of 20% in 2011 and of 50% in 2013 (Bleker and Schippers, 2010). A monitoring and registration system was set up, and the Dutch Authority of Animal Medicines was installed in 2011. In 2012, the amount of antibiotics used in animal husbandry decreased by approximately 50%, but a bigger reduction is probably needed in order to solve the problems of antibiotic resistance. At the end of 2012, when the target figure of 2013 had almost been reached, a new target figure was announced to reduce the amount of antibiotics used even further: antibiotics use in animal husbandry should be decreased by 70% in 2015 (with 2009 as a starting point) (Bleker and Schippers, 2012).

Against this background to the case, we followed the two topics, responsible use of antibiotics and the role of the veterinarian. In the following section we provide the biographies of these two topics.

6.5 Topic biographies: Responsible use of antibiotics in animal husbandry and the role of the veterinarian

6.5.1 Topic biography 'Responsible use of antibiotics' in animal husbandry

When studying the topic 'Responsible use of antibiotics', we see framing of responsible use of antibiotics in the broader discussion around sustainable agriculture and health, and framing of what 'responsible antibiotic use' actually means for the different actors involved.

According to the interviewees, the entire discussion around antibiotics use in animal husbandry started when a relation was found between antibiotics use in animal husbandry and resistant bacteria in humans, for example MRSA in 2005 and ESBLs in 2010. The discussion on the impact of animal husbandry on human health was also fed by other developments such as the Q fever outbreak in 2009.¹⁷ Although Q fever was not related to antibiotic resistance, it made people aware of the relation between disease and the animal husbandry sector and the current way of keeping animals. In 2008 the Dutch government installed a task force (Werner Commission) with the task of developing a covenant to reduce antibiotic resistance and realize responsible use of antibiotics in animal husbandry.

The Werner Commission proposed in their report (2010) a combination of quantitative reduction and qualitative improvement of antibiotic use, which can be seen as one way to frame 'responsible antibiotic use'. According to the commission there is an important role for the government, as using antibiotics in a responsible way is framed as a societal issue. Applying a responsible use of antibiotics in animal husbandry is seen as one of the solutions to preventing antibiotic resistance. Furthermore, reduced dependency on antibiotics is framed as part of the goal to reach sustainable food production as the following quote shows:

*A reduced dependency on antibiotics and as a result healthier animals does fit in the goal to realize sustainable food production*¹⁸. (Bleker and Schippers, 2010)

¹⁷ A zoonosis mainly present in goats and sheep and transferable from animal to human. - ¹⁸ Original text in Dutch. Translated by the researcher.

According to the letter of the state secretaries of Economics, Agriculture and Innovation and Public Health (Bleker and Schippers, 2010), a decrease in antibiotics use should be linked to broadening of practical knowledge in order to prevent health problems, such as measures to keep animals healthy by improving barn climate, good quality of feed and clean barns.

The policy was directed towards reducing antibiotics use in animal husbandry. In 2011 the Health Council of the Netherlands proposed recommendations to reduce the use of antibiotics in general, and specifically some groups of antibiotics. They framed antibiotics resistance as an international problem, because a lot of meat is imported and Dutch meat is exported, and furthermore suggested that it is not only a problem for producers of food, but the trading business and the consumer should also take their responsibility (Health Council of the Netherlands, 2011). This implies a shift of responsibility from the government towards the animal husbandry sector. The veterinary sector is aware of the risks, and is trying to reduce the amount of antibiotics used. Because of public pressure and governmental concern, measures were announced to prevent the overuse of antibiotics. In the covenant it is stated that registration of antibiotics use should occur at the farm level, which makes it possible to lay down the responsibilities for the farmer and the veterinarian (Bleker and Schippers, 2012).

All actors – veterinarians, researchers and specialists – state that very selective use in animal husbandry of medicines that are used in human health is important. Nevertheless, there are differences in the reasons for dealing in a responsible way with antibiotics. Someone from the product board (product board animals, meat and eggs) stated that antibiotics are “fantastic medicines”, and that it is in the interest of both the animal husbandry sector and human health to use antibiotics carefully, so that it will also be possible to use antibiotics in the future. Hereby responsible use of antibiotics is not only framed as important for human health, but also for animal husbandry.

Besides the discussion on who is responsible for action regarding responsible use of antibiotics, there are also differences in how actors frame ‘antibiotics use’ in general and more specifically ‘responsible use of antibiotics’.

In the past, antibiotics were sometimes used to solve problems in farm management with, for example, climate in the barn, and antibiotics were not only used as a medicine to treat sick animals, but also in a preventive way. When something was wrong with the ventilation or barn climate, it was cheaper to use antibiotics than to invest, for example, in new technical systems, as the quotes below demonstrate. Therefore the use of antibiotics is cognitively framed as a ‘management tool’.

Veterinary medicines agency: In the past antibiotics were cheap tools to realize a growth in production and meet the idea to produce in a cheaper way. It costs money and effort to change that system.

Researcher/veterinarian: Veterinarians should change their habits. Antibiotics can no longer be used to challenge symptoms.

The idea that antibiotics are a cheap tool to keep animals healthy is presented in these quotes as a cognitive frame of farmers and veterinarians. The idea that it is possible to use antibiotics if there are problems in the animal husbandry system is difficult to change as it is embedded in current daily practices. As the above quotes show, practices need to change in order to transform that idea. Furthermore, the current way of keeping often large amounts of animals in one open space makes it difficult to treat animals individually. The current shape and design of systems probably makes it difficult to change daily practices (e.g. prevent crossover of diseases). The current design of systems is difficult to change, because changes will cost a lot of effort and money. Nevertheless, changes in the design are needed in order to transform the current manner of keeping animals. This is an example in which material characteristics, the actual barn design, constrain a development towards another system.

Monitoring of the use of antibiotics was the first step, as there was no clear monitoring system available at that time. Within two years a monitoring system was set up. Discussions began in 2009 regarding the idea that reduction of antibiotics should not only be about the amount of antibiotics (the initial idea), but also about the amount of active ingredients. The focus was mainly on reducing the amount of antibiotics used, but at the same time (2009), especially in the dairy sector, it was stated that it is not only about the amount of antibiotics used, but about the type of antibiotics used (Bondt et al., 2009). The report of the Dutch authority for animal drugs also states that reduction of the number of animal-day-doses (in Dutch: 'dierdagdoseringen') must not lead to wrong ways of applying antibiotics, for example using too low doses or a too short therapy time. For example, antibiotics used in human health must only be used very selectively: only in cases where nothing else can be used. This is an example of differences in defining what responsible use of antibiotics is: namely 'reduced' or 'selective' use.

The idea of selective use also fits with the following quote, which states that reducing antibiotics should not be a goal in itself, but that in the end it is all about reducing the risk of resistant bacteria.

Product board: *This is only about reducing the use of antibiotics and we are not talking yet about measures to reduce antibiotics resistance. That is difficult and we do not have the solutions ready.*

Furthermore, the different interviewees had different definitions of what responsible use of antibiotics means in their daily practice. This varies from "the right medicine, in the right dose, the right therapy time and fitting the diseases" (veterinarian) to "not preventive and not treating the whole herd (veterinarian/researcher)". There is discussion on when antibiotics use is 'responsible', as from the viewpoint of human health, using antibiotics is not responsible, while from the perspective of making animals healthy it is a responsible choice to use that antibiotic. The same counts for preventive use of antibiotics: in some cases it is important to treat animals preventively in order to prevent animals from becoming ill and to prevent other animals getting infected as well; while in other cases it is not necessary to treat animals in a preventive way. Furthermore, as the following quote shows, according to one of the vets preventive use of antibiotics can be important in taking care of the sector.

Veterinarian/researcher: *That is difficult to determine [what responsible use is]. In some cases it can be preventive use, without a clear diagnosis or indication. There are instances in which preventive use is necessary, for example in veal production. Calves from different places are brought together in one spot, and that is an important source of infections. A cure with antibiotics at the start can prevent diseases spreading. If you do not provide this start-up cure it can be the case that you use a lot of antibiotics at a later stage.*

Responsible use of antibiotics is, according to this veterinary actor, closely related to the idea that antibiotic use is embedded in the current system and it is difficult to keep this system functioning without antibiotics. But there are also people (from human health care) opposing this position and framing responsible antibiotics use as using it in as restricted a way as possible due to human health and safety goals.

According to all the actors interviewed, it might be possible to use fewer antibiotics when the system of keeping animals changes. One could translate that by stating that in the current system it might not always be possible not to use (a lot of) antibiotics. Being restrictive and selective with using antibiotics is mentioned as an important element of restrictive use by all actors.

The future of responsible antibiotics use

Regarding the future of 'responsible uses of antibiotics', all actors acknowledge the importance of reducing antibiotics use in animal husbandry, and most sectors have taken measures to reduce the amount of antibiotics. Four possible solution directions can be distilled from the ideas of the actors. The first solution mentioned is taking policy measures regarding reducing the amount of antibiotics used, by taking into account animal and human health. The use of antibiotics is framed as a problem of too much use that can be limited by taking measures. The second direction is framing responsible use as making selective use of antibiotics. Therefore it is important that antibiotics for human health are used less in animals. In order to make selective use of antibiotics it is important to create more awareness of the potential risks of antibiotics resistance and of how antibiotics are used and need to be used, not only by farmers, but also by veterinarians and feed providers. By monitoring and evaluating antibiotic use and comparing the use between actors, one can become more aware of how much antibiotics he is using or prescribing compared to other, similar farms or veterinarians. A third solution concerns the way animals are currently kept and takes the animal production system into account and focuses on e.g. barn climate, keeping less animals in one unit/(sub)system, healthier and more robust animals, and structural changes in animal husbandry systems (alternative systems, e.g. organic). In this direction responsible use of antibiotics is framed as a 'system problem' and a change of the system can help to solve that problem. The current manner of keeping animals is gaining attention nowadays in society in, for example, discussions regarding mega farms. The use of antibiotics is also mentioned in relation to that discussion. The fourth solution is about sustainable food production, a broader theme in which antibiotics use is one of the elements. Responsible use of antibiotics is then framed as necessary to create sustainable and healthy food. In this solution it is important that differences between animal husbandry systems are acknowledged. Measures around synchronization of rules for the whole value chain, such as antibiotics use in different parts of the chain, and changes in the way profit

margins are divided and prices are set, are needed in order to change the whole chain. By decreasing the selling prices of products produced with fewer antibiotics, these products will become more attractive for the consumer.

Changes towards increasing awareness have already been made, but the actors interviewed also see that in order to create a greater reduction of antibiotics, more difficult measures should be taken, involving the whole system. Another important point raised by some actors is the international component. As soon as the Netherlands has created a system in which less antibiotics is used, it does not have to mean that products in the Dutch supermarket contain fewer antibiotics as there is a lot of trade. Furthermore, it becomes hard for farmers to compete with products produced in a cheaper way in countries with fewer rules. Production costs will increase in case farmers have to adapt their systems and products will also become more expensive.

6.5.2 Topic biography: the role of the veterinarian

The second topic we studied is the role of the veterinarian. As in the Netherlands antibiotics are prescribed by the veterinarian, he plays an important role in relation to antibiotic use in farming in the Netherlands. As the following quote from the speech of the chairman of the Royal Dutch Society for Veterinary Sciences (KNMvD) suggests, the role of the veterinarian is changing over time:

*Within veterinary sciences, developments are caused by changing societal perception of animal welfare and health care for humans and animals, and this would definitely lead to changes in animal husbandry, but also changes in the role, task and responsibility of the veterinarian... the focus of our profession is actually changing from a primary focus on animal health, towards a focus on animal welfare and public health, and thereby in fact the step is taken towards sustainability and thereby One Health.*¹⁹ (Hellebrekers, 2012)

In the past the veterinarian was held in high regard in the Dutch countryside. One veterinarian had 40 different pig farmers as clients. Nowadays only three farmers are left, but they do have very large farms. In the last 15 years the scale increase and specialization of animal husbandry has influenced veterinarian practice (Newspaper article by Bijlsma, 2005). In the past the veterinarian was asked to treat a sick animal, while nowadays the focus is more on preventing an animal becoming sick, by vaccination and keeping the conditions for keeping animals in barns at a high level.

The veterinarian has different roles in different situations. The veterinarian is framed as having for example the role to control by the situation in which he acts. Sometimes these roles conflict as the following quote from a newspaper for farmer shows (News paper article: Muller, 1999):

The veterinarian has two functions that do sometimes conflict. He serves his clients, but is also more and more involved in controlling them as well.

¹⁹ "One Health is about the welfare and health of humans and animals within the ecological context in which humans and animals live together" (Hellebrekers, 2012).

After the BSE crisis (Bovine Spongiform Encephalopathy) around 1996, the Dutch government framed the veterinarian as the one responsible for signalling infectious diseases at an early stage and reporting them when necessary. The government tried to establish the position of the veterinarian, and at the same time the farmer is more restricted.

Since the outbreak of BSE there is an extra responsibility for the veterinarian. They have to signal infectious diseases at an early stage and ring alarm bells when necessary. The government sees the dependent position of the veterinarian with regard to his client the farmer as a risk. (Newspaper article: Muller, 1999)

This external event meant not only that the veterinarian was framed as controlling, but the role of the veterinarian also changed into that of a person responsible for public health. "The veterinarian is a gatekeeper for public health" (person from Animal Drug authority).

Two other conflicting roles of the veterinarian were the role of seller of medicines and using the medicines in a responsible way. This conflict is described in the quote below:

Veterinarian: The image was [that] veterinarians are 'bastards' with two hats. On the one hand they deal with antibiotics in a responsible way, and on the other hand they earn money with every dose they sell. That is what they call a 'perverse stimulus'.

According to the white book of the KNMVD (2010), 'the veterinarian is in a situation in which societal issues like public health, food safety and animal welfare are on bad terms with the economic interests of certain groups'. Also, the role of the veterinarian in relation to the farmer was discussed again in 1999, around the BSE crisis. Because of this external event, the role of the veterinarian changed. It was mentioned that the veterinarian should also keep track of the mental and physical problems of farmers as they are very close to the farmers.

Furthermore, the veterinarians played an important role in the economic position of the farmer, as only healthy animals help to earn money. In particular, farmers with big farms are important clients and the veterinarian does not want to lose such clients by refusing to provide antibiotics. The farmer is under economic pressure as well, as he needs healthy and productive animals in order to be able to produce and earn an income. Stories were told that farmers were putting pressure on their veterinarian to not make public possible risks among their cattle.

One of the problems mentioned in one of the interviews was that in the past a farmer, but also the whole animal husbandry sector in general, had a huge influence on whether or not antibiotics were applied, while in fact the veterinarian should be responsible. A similar point was made in 2008 by the FVE (European Federation of Veterinarians). They had the idea that the veterinarians were seen by the public as an 'extension tool of the agricultural sector', just doing what the farmer wants. This frame of the public influenced the discussion as the FVE wanted to change that image. Veterinarians should be independent and act between farmers and society. Here again the relation between the farmer and the veterinarian was discussed, and the global discourse influenced the way the veterinarian was framed. In the

media the veterinarian was framed as playing a societal role, by making animals healthy and thereby also helping to develop a healthy food chain. Nowadays there are different initiatives to change the dependency on selling antibiotics, which also frames the veterinarian in a different way.

In 2009 the idea of ‘unlinking’ (in Dutch: ‘ontkoppeling’) – separating the task of selling and prescribing medicines, at that time both done by the veterinarian – was raised. LTO Nederland, the Dutch farmers’ association, is in favour of this idea, because they feel there is no economic incentive for the veterinarians for selling medicines. According to the report of Beemer et al. (2010), the position of veterinarians in relation to farmers will in principle not change, as they will remain dependent on the relation between task provider and task fulfiller. In that case, recipes for medicine need to be sold by the veterinarian. So the idea of unlinking the task of selling and prescribing medicines has not been further developed.

The role of the veterinarian changed from incidentally and curatively treating animals around the 1990s towards advisory work (2005). The focus moved towards preventing animals becoming ill – not by using antibiotics in a preventive way, but by taking care of the conditions on the farm. “You are going to help the farmer with advice on feed, housing, climate and fertility,” stated a veterinarian in a newspaper in 2005 (Bijlsma, 2005). In poultry and pigs the advisory role is especially important, because there are different steps in the chain in which antibiotics play a role (breeding, rearing, etc.). In dairy the treatment of sick animals is still the most important thing, although the role of the veterinarian as an advisor is also increasing in that sector (Hellebrekers, 2012). By framing the veterinarian as an advisor instead of a doctor, the client expects other actions from the veterinarian, such as providing advice on the farm level. And the veterinarian expects other actions from his client as well, namely providing regular insight into how the animals are performing. According to a veterinarian who was interviewed, you can see the need for a decrease in antibiotics as a way to visit a farm more often, especially if you can no longer earn money by selling medicines. By visiting a farm regularly a veterinarian can monitor the situation of the farm and adapt some things when needed. That is more in the direction of advising. So, the role of the veterinarian is changed in interaction with the farmer. This change in framing of the role of veterinarian means that the role of other actors, such as feed providers, will also change. Interaction between different actors involved in farming and animal health is seen as a possible solution, but is not very easy to realize in practice.

In cases where the feed advisor and the veterinarian collaborate, one and one makes three. In practice this structural collaboration is difficult. (Newspaper article: Stevens, 2006)

This difficulty arises because feed providers are sometimes framed by veterinarians as advising farmers while they ‘do not know everything about health’, and on the other hand veterinarians are framed as interfering in the working field of feed providers, by giving advice on feed and manure use. According to the cited newspaper article, there are some hurdles to take in order to develop a good collaboration. The focus needs not only to be the collaboration between the veterinarian and the feed provider, but also on veterinarian and farmer and the sector in general, according to an interviewed veterinarian. According to the veterinarian, the feed providers in particular do not always see the importance of their role,

while the feed they sell to the farmer can play an important role in the health of the animal. According to someone from the Animal Drug Authority, “The veterinarian is sometimes framed as the one setting the rules, but at the same time having conflicts of interests”. But actors agree that collaboration is important and will be even more important in the future. This is especially the case in the one-to-one relation between farmers and veterinarians. One of the rules created by the government is on establishing one-to-one relations between one farmer and one veterinarian, to prevent that farmers are buying antibiotics from different veterinarians. If the veterinarian is not framed as a ‘stringent person’, but an advisor on the same ground as farmers, it might be easier to help the farmer.

The veterinarian will become a supervising and advising person instead of someone only prescribing. (Product Board)

Therefore the responsibility of applying antibiotics in a responsible way is not only pinned on the veterinarian, but on the farmer as well. This advising role of a veterinarian in the future will also change the earning model of the veterinarian: the veterinarian will no longer be paid per treatment, but per hour.

Around 2008 there was a change in dealing with antibiotics, because of the possible relation between MRSA and antibiotic use in animal husbandry. That was an external event involving the veterinarian even more in human health issues.

Veterinarian: I think that a lot of the veterinarians are convinced that fewer antibiotics should be used. That is partly because of resistant bacteria, and partly because of social responsibility. [...] but there are also veterinarians who see the reduction of antibiotics as a stringent measure they have to abide by.

Reducing antibiotics is seen as important, but as the following quote demonstrates, it is sometimes difficult for the veterinarian to choose between taking care of animals and using as few antibiotics as possible, which means that the veterinarian has to search for a balance between providing antibiotics and keeping animals healthy.

Ministry: You can imagine that there is friction between, on the one hand, animal welfare and on the other hand the need to decrease the use of antibiotics.[...] The veterinarian has a duty to take care of animals but also to use antibiotics in a responsible way. That should be balanced.

The minister (2009) endorses the point that the societal role and independency of the veterinarians should be improved in order to make them able to play a role in animal welfare, food safety and human health. Here again the veterinarian is seen as preventing human health.

Researcher: In order to make the farmer aware of the importance of human health, there is an important role for the veterinarian.

In order to create a better link between animal and human health care, veterinarians should

have a role in the debate about public health as well. As a human specialist states:

A lot of things are changing [the way veterinarians earn money] but good regulations are necessary and furthermore there should be agreements between human and animal health care on which medicines can be used in animal husbandry and which ones cannot. And good monitoring is necessary.

In 2012 the focus in the Netherlands was mainly on the one-to-one relationship between the farmer and a so-called secured veterinarian ('geborgde' dierenarts). In order to prevent the farmer being able to buy medicines at different veterinarians, the farmer should have a contract with one veterinarian. That makes it on the one hand easier to control the amount of antibiotics used and on the other hand prevents farmers putting pressure on veterinarians in order to provide medicines when not strictly necessary.

Because of a monitoring system in which the data of the farmers and the veterinarians are collected it is possible to compare data about the use of antibiotics between different farmers and veterinarians. Benchmarking makes veterinarians and farmers aware of the amount of antibiotics they use, and therefore it is a powerful tool for reaching consciousness and taking action to decrease the amount of antibiotics used.

The future of the role of the veterinarian

In this topic biography we also see actors talking about how they see the veterinarian in the future. First of all, the actors do not see a system of decoupling as a solution, as there may be another way in which the veterinarians might be accused of earning money (e.g. via new companies or by selling recipes for medicines). Furthermore, the farmers' unions think that the farmers are going to pay extra money for the extra institution selling the medicines. So, they are not in favour of this idea. According to the veterinarians themselves, the veterinarian becomes a company supervisor and helps the farmer with strategic decisions together with the feed advisor and the bank. Another future they propose is that the veterinarian sells knowledge instead of only providing medicines. The role of the veterinarian will then change from a doctor for animals to a company advisor. But that change also has economic consequences for the veterinarian. Therefore, among other things, veterinarians plea for the design of a different value system in which the veterinarian is paid per hour instead of per treatment.

New rules regarding so-called UDD (only by veterinarians; 'uitsluitend door dierenarts') measures state that only the veterinarian is allowed to administer medicines, except when the farmer fulfils certain requirements, such as a one-to-one relationship with one veterinarian, a company health plan and does not use many antibiotics. This rule leads again to discussions regarding practical issues, such as are there enough veterinarians, to what extent is it possible for them to visit the farm for every treatment, and who is going to pay for the costs?

Someone from the KNMvD stated that "in the future veterinarians will be viewed as keepers of animal welfare, animal health, food safety and public health". This is a typical example of how the framing of the role of the veterinarian has changed. The picture presented here is

an example of how this organization frames the future.

One possible way to get to grips with antibiotics prescriptions is by monitoring and benchmarking. By getting more information on the use of antibiotics and the provision of antibiotics by the veterinarian, it will make veterinarians aware of how many antibiotics they prescribe in comparison with other veterinarians. A system in which veterinarians are controlled and sanctions can be used if a veterinarian is prescribing too many antibiotics can, according to the actors interviewed, help to decrease the amount of antibiotics used in animal husbandry.

Nowadays, in the Netherlands a system is set up in which the veterinarian should be 'registered' (in Dutch: 'geborgd'). Since January 2012 this has been the case for veterinarians in the dairy sector, since October 2012 for IKB-registered farms in the pig sector, and for poultry and veal it will be arranged in the future as well. If farmers have a contract with a 'registered' veterinarian (and comply with some other rules) they are allowed to administer antibiotics. This is important, because rules are proposed to limit the administration of antibiotics by anyone other than the veterinarian.

6.6 Analysis of topic biographies

In this section we first summarize the framing visible in the two topic biographies and thereafter we discuss the possible connections and relations between the two topics.

Summary framing responsible antibiotic use

After the finding in 2005 that there is probably a relation between antibiotic use in animal husbandry and resistance against antibiotics in human health, the discussion regarding responsible use of antibiotics started in the Netherlands. The topic biography shows us mainly three discussions related to 'responsible use of antibiotics', namely: 'how are antibiotics used', 'in which situations is use of antibiotics 'responsible' use', and 'which actor has to take the responsibility regarding responsible use of antibiotics'? In these three discussions we see various frames.

To start with the discussion on how antibiotics are used, in general we see that antibiotics use is framed (by e.g. farmers and veterinarians) as a 'management tool' to deal with health and production issues in farming. This discussion shows different ways in which antibiotics are framed, namely as a 'management tool' and as 'medicine'. These two frames are conflicting, and current practices make it difficult to change the idea of antibiotics as a management tool. The cognitive frame that antibiotics are needed to produce for low prices to increase margins is difficult to change, as that involves the whole value chain, including the consumer, who is difficult to reach. If a tool is used like an injection (when animals are treated individually), the antibiotic is seen as a medicine, while when it is added to feed (herds are treated collectively), it is framed as a management tool, or as part of the system. This is an example of material framing, as an injection or pill makes it possible to treat an individual animal.

The second discussion is on 'what is responsible use of antibiotics?' The meaning of

'responsible' is disputed, as differences are visible in the way actors see the role of antibiotic use. Every actor agrees that responsible antibiotics use is important. Aspects of responsible use of antibiotics mentioned by all actors interviewed are: using the right product for the disease, right dose, right therapy time, preventing treating herds if possible and being very selective about using antibiotics used in human health care. We see conflicting frames regarding what 'responsible use of antibiotics' means in the daily practice of doctors, farmers, policymakers and veterinarians. Responsible use of antibiotics is framed as 'reduction', 'selective use' and 'no preventive use'. These ways of framing make actors agree that responsible use of antibiotics is necessary, but they differ in what the practical implications are. The exact definition of what is meant by responsible use has not yet been defined, but the point that selective use of antibiotics in animal husbandry is necessary is taken for granted by all actors. Differences in framing are still allowed, because there is not yet a need for similar ways of framing responsible use of antibiotics.

The third discussion is on which actor needs to take responsibility regarding antibiotics use. This responsibility is moved from the government to the veterinarian, the farmer, the (feed) industry and the consumer. Veterinarians and farmers are asked to monitor the use, the government sets rules and regulations, and the feed industry should no longer use antibiotics in feed and develop feed that improves the health of animals.

Summary of framing the role of the veterinarian

In the biography of the role of the veterinarian we saw mainly conflicting frames of their role. The role of the veterinarian is framed as 'serving clients', 'controlling clients', 'gatekeeper of public health', 'doctor treating animals' and 'farm advisor'. These different frames exist next to each other, but they change over time.

One reason for changes in framing the role of the veterinarian is an external event. For example, following the outbreak of BSE in the 1990s and the problems with MRSA the discussion was raised on these different 'hats' of the veterinarian. The veterinarian was framed as the one who is responsible for taking care of public health issues in relation to animals.

Furthermore, the role of the veterinarian is framed in interaction with, for example, the farmer. The question is how the farmer frames the veterinarian as he is entering his farm: as a person who controls him or as a person providing him with advice. The farmer will approach the veterinarian in a different way if he frames him as an advisor to if he frames him as a controller, even though it is the same person. The veterinarian in his turn will react to that, which makes this an example of interactional framing.

Thirdly, the idea that keeping animals healthy is not only a matter of applying the right medicine, but improving the whole system of feeding and keeping animals, changed the role of the veterinarian towards a company advisor or coach that is not only treating curatively but also taking preventive measures. Preventive in this sense means that the veterinarian discusses together with the farmer the way they can prevent the animals becoming ill by means of management measures (and not by using antibiotics in a preventive way). By framing the veterinarian in this way, he is seen as a coach, helping the farmer to keep

his livestock healthy. Then the veterinarian is no longer framed as the one controlling the farmer. The veterinarian has become a company advisor not only treating animals, but also keeping an eye on the whole farm, including advice on growing crops and using manure. In this role the tasks of the veterinarian conflict with other advisors visiting the farm, such as feed specialists.

The fourth way in which framing is present in this topic biography is that due to the discussion on responsible use of antibiotics, the different hats of the veterinarian are under discussion again. The veterinarian has to deal with interests of industry, farmers and the public. The framing of the veterinarian as a caretaker for animal health conflicted with the frame of the veterinarian as a representative of the pharmaceutical sector, selling medicines.

6.7 Conclusion and discussion

The goal of this study was to gain a better understanding of the framing of responsible use of antibiotics by different actors involved in that subject. We started this study with the research question: *How does framing occur in the development towards 'responsible use of antibiotics in animal husbandry'?*

This case differs from the cases discussed in the previous chapters, because no decisions have been taken yet. The subject of antibiotics use in animal husbandry is of growing concern, and although there is not a well-defined project, the topic biographies show different ways of framing 'responsible use of antibiotics' and 'the role of the veterinarian'.

The topic biography of 'responsible use of antibiotics' shows that different frames on this topic can exist next to each other. All actors agree that responsible use is necessary. One could expect that as soon as ideas on how to realize a more responsible way of dealing with antibiotics become more specific and detailed, these differences come to the fore. The different frames on what responsible use is are conflicting, but can exist next to each other in the current situation. The second topic biography shows the different ways in which the role of the veterinarian is framed that are conflicting and even depend on the specific situation the veterinarian is in – for example, if the veterinarian is entering the farm as a controller or as an advisor. Because the veterinarian is gaining a more prominent role in society, we found that global discourse influenced the way the role of the veterinarian was framed as well.

Although conflicting frames can be difficult to deal with for the veterinarian, the topics are not yet in a phase wherein a decision needs to be taken about how to deal with them. The phase of the discussions, in which the main concerns are what is the problem, who is responsible and how are we going to solve this, makes it a messy process in which frames are continuously changing and different frames can exist next to each other. When decisions need to be taken, frames probably do have to change, or become dominant in order to get alignment between actors.

Furthermore, in both topic biographies we see that possible future developments are mentioned. This may have to do with the nature of this subject, in which the people involved

discuss what the problem is, what possible solutions are and who is responsible. Because there is a lot undecided, actors frame the future based upon their daily practice. So, framing does not only occur in past and present situations, but also the future is framed. Actors sketch certain routes towards solutions. Futures are embedded in the present, and scenarios can be built drawing on such embedded or 'endogenous' futures (Rip and te Kulve, 2008). Paths and other stable patterns enabling and constraining actions and views will shape further development. Thus, they lead to an 'endogenous future': further developments are predicated on the pattern of the present situation (Rip and te Kulve, 2008, p. 51). As Mattingly (1991, p. 237) points out, narratives not only provide information on the past or "current situation, but also provide a forward glance and help to anticipate situations even before we encounter them and allow to envision alternative futures". These endogenous futures can help to gain an insight into the framing of differences between actors and prevent misunderstandings in later stages.

7.

Conclusion: Framing in innovation

7.1 Introduction

The goal of this research is to gain an insight into how innovation processes are shaped by framing, the phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics. Three cases were investigated that are examples of sustainability issues in animal husbandry, namely the development of new animal husbandry systems for chicken (Roundel case) and cows (Kwatrijn case) and the use of antibiotics in animal husbandry. In all case studies multiple actors were involved in the innovation projects under study. To investigate framing, we formulated three research questions at the beginning of this research, namely:

1. How does framing occur in innovation processes in complex multi-actor settings?
2. How does framing facilitate and hinder innovation in complex multi-actor settings?
3. What are the implications of framing for the ambition of sustainability transitions in agriculture and system innovation in general?

In this final chapter we answer these questions. The three empirical chapters analysed and discussed the phenomenon of framing in the cases. In this chapter we will compare and contrast our findings based on the eight topic biographies studied within these three cases. In these eight topic biographies we traced the framing of topics by closely following the way in which actors articulate problems and solutions. Topic biographies, by definition, start with actors discussing the topic; otherwise a topic is not an agenda item or issue. Typically, we then see differences in framing, struggles about problems and solutions, and alignment of frames in various forms and degrees.

In the following section (7.2) we first describe the framing as we found it in the three cases and the eight topic biographies. Section 7.3 discusses specifically the different phases in the framing of a topic and thereby answers the first research question. Section 7.4 is about the general lessons gained in this research and answers the second research question by discussing the role of framing in the innovation process. Section 7.5 points to the theoretical contributions for innovation studies and framing studies. Section 7.6 addresses the third research question and discusses the role of framing for the sustainability challenge the agricultural sector is currently facing.

7.2 Framing in the topic biographies

In this section we discuss the framing in the eight topic biographies analysed in the three different animal husbandry cases. These three cases differed with regard to the phase of the innovation process and the actors involved. While the antibiotics case is in the phase of defining the problem, the other two cases have been developed into more or less defined innovation projects. In chapter 3 we argued that framing is not visible at the 'surface' of interaction, but has to be traced via following topics (agenda items mentioned by actors involved) over time. The actors put these forward in the discussions and express their opinions and ideas regarding the topics. In the expressions of actors, frames are manifested. It is possible to reconstruct what the underlying frames are, based on how an actor acts and talks. By reconstructing the biography of a particular topic, it is possible to find the various framings of that topic. The unit of analysis in this research is the framing of topics

in innovation projects. This is studied in a topic biography, which shows the vicissitudes of a topic over time. In order to be able to study how framing influences innovation, we explore all topic biographies in order to find changes in framing. We made a distinction between three types of framing, namely cognitive, interactional and material framing. Furthermore, we can also distinguish between three levels where framing takes place: face-to-face interaction, localized collective and global discourse. We start with an overview of the different topic biographies followed in, Table 7.1.

Table 7.1 Topics studied per case

Case	Topics studied
<i>Roundel</i>	Fitting in the landscape
	Outdoor run
	Positioning the egg in the market
<i>Kwatrijn</i>	Using straw in the barn
	Pasturing of cows
	Design of the system
<i>Antibiotics use in animal husbandry</i>	Responsible use of antibiotics
	Role of the veterinarian

Roundel

The Roundel case was about the development of a new type of laying hen system and the marketing of the egg produced in that system. We investigated three topics that occurred in this case, namely fitting in the landscape, the outdoor run, and positioning of the egg in the market. The first topic is described in chapter 4 and the second and third topic biographies are described in the appendix of chapter 4.

In the biography of the topic ‘fitting the landscape’, differences in the framing of the laying hen system are clearly present. For some actors, ‘keeping chickens outside’ is part of how the system fits in the landscape, while others discuss the shape of the system in more detail. The initial idea was to make a system that is clearly visible in the landscape, but that conflicted with ideas of the municipality, and led to contestations. There was a difference in framing, and as a consequence, differences of what ‘fitting in the landscape’ means according to the different actors. This is where our topic biography started. Differences in the framing of the system in the landscape caused deadlock when the ideas of the project team conflicted with the ideas of the municipality. The actors had to find a solution in order to solve this. Framing the system in the landscape, changed from a building that is clearly visible to a system that became integrated in the landscape. This is an example of how conflicting frames between actors caused a change in the framing of the design of the system (from ‘clearly visible’ to ‘integrated in the landscape’) and this also influenced the design. This turning point was caused by the idea that a solution had to be found in order to continue the project.

A parallel discussion closely related to fitting in the landscape was about the environmental permit. It was not easy to get an environmental permit, as the system was based on new

ideas. A long procedure had to be started in order to get a permit, but by framing the system as based on existing systems, the whole procedure took less time. Another way of framing the system appeared to be helpful to deal with difficulties in regulation. By framing the system as a new combination of existing systems, the procedures for getting a permit were much shorter, as the actors could connect to existing measures. Here again, external factors, namely rules and regulations, made the framing change.

Furthermore, the framing present in the global discourse is that large barns are so-called mega farms, and the actors involved in the project do not want their system to be labelled as a mega farm. Integrating the system in the landscape reduces that risk, because a system integrated in the landscape does not look like a huge barn. In order to make sure that the system is not framed as a mega farm, the idea was to open the system for the visitor. Material characteristics helped to frame the system from the chicken's perspective. A low corridor made it possible for citizens to experience the system from a chicken's perspective, with the result that the visitors will not see it as a too small or industrial surface for the animals.

The topic biography on the 'outdoor run' started with the question of whether or not to create an outdoor run for the chickens in the laying hen husbandry system. Two contrasting ideas are visible, one stating that an outdoor run needs a lot of space and the other that hens should have the opportunity to go outside. The idea that an outdoor run needs a lot of space is based on framing an outdoor run as 'a certain amount of square metres', according to rules for free-range hens. At the same time an outdoor run is, according to the opponents of an outdoor run, framed as causing health issues for the hens. There was deadlock in the discussion as the different viewpoints were not moving towards each other, until the discussion turned to what is actually meant by an outdoor run, takes the 'needs of the hens' as a starting point. In discussions with researchers, consultants and others, new ideas arose about outdoor access, namely that in order to have natural behaviour the quality of the outdoor run is more important than the amount of outdoor space. By stating this, the researcher tried to remove the cognitive frame of an outdoor run as a certain amount of square metres, and emphasized that the quality of the surroundings is more important. The framing of an outdoor run, and thereby animal welfare, changed from the amount of space to the quality of the space. For the Roundel system less than 1.5 hectares is needed, so that is much less than the 6 hectares for an organic barn with an outdoor run. The risk of avian influenza is tackled by the design, in which the outdoor run is partly covered. The covered outdoor run is seen by the actors as an innovative part of the system, and a characteristic that helps to distinguish the Roundel system from other laying hen systems. The framing of an outdoor run has shifted from what is written down about the amount of square metres per hen in the regulations about keeping hens, towards what is animal-friendly from the perspective of the animal: when the animal behaves naturally. The outcome is a combination of different ideas such as quality, natural behaviour and amount of space, combined into a new framing of an outdoor run.

The topic biography on positioning of the egg in the market shows a similar pattern. Different ideas on how to position the egg are present among actors, varying from fitting in the existing categories of table eggs towards creating a new category. Frames vary from adapting the system to the rules of the category the egg is in, to finding a way to create a new category

of eggs in the table eggs market. The socio-institutional environment, consisting of specific rules and regulations regarding different ways of producing eggs, was very influential in this topic biography. Furthermore, the actors would like to have a 'better life label' from the Society for the Protection of Animals, as that label frames the egg as good for animal health. The whole idea of the Roundel project – to start from the idea of what is good for the animal instead of applying the rules regarding space and feed – meant that this egg was the first egg that was not organic, but had three stars in the better life label. Therefore the egg was framed as being comparable to organic eggs with regard to animal welfare.

Kwatrijn

The Kwatrijn case was about the development of a new system for dairy cows close to a nature conservation area. In the Kwatrijn project actors wanted to develop a new and more sustainable way of keeping dairy cows. The Kwatrijn project was about developing a sustainable dairy system, a barn and the pastures around it, in such a way that it is possible to keep dairy cows close to a nature conservation area, in an animal-friendly and environmentally friendly way.

The topic of straw started with the idea of the farmer that straw is good for animal welfare, but other actors framed it as old-fashioned and causing a lot of work. Neither frame is easy to change or to reconcile. An advisor framed straw completely differently, by framing straw as a nutrient improving the nutrient cycles on a farm. Straw became part of the system, but in order to be able to do that, adaptations to the system, such as the design of the barn and (manure) machines, were needed. When the actors realized that the use of straw can be a starting point for developing new machines and new floors, it turned out to be an innovative part of the project. The use of straw became part of the system, although the different frames of the use of straw continued to exist next to each other.

The second topic studied in this case was the topic of pasturing of cows. The topic biography started with a discussion on whether or not to include the obligation to pasture cows. Pasturing was framed as good for animal welfare by the farmer. That was a reason to develop a dairy system in which it is possible to pasture cows. At the same time, pasturing is also framed as a societal issue that provides licence to produce near a nature conservation area. For some citizens, cows in the meadow are seen as a natural element, belonging to the Dutch landscape. Nevertheless, for other actors pasturing is not necessarily needed, and some of the actors refer to the idea that pasturing has a negative environmental impact (e.g. emissions). In interaction between the actors it was eventually decided that different design options will be created – with or without the opportunity to pasture cows. This is the way the actors deal with pasturing at the localized collective level, so on the level of the project, while their individual framing of pasturing might still differ. The different frames were reconciled by the idea that whether or not pasturing is applied in the system is a choice of the farmer. The system can be developed with or without an opportunity for pasturing, depending on the wishes of the farmer.

The last topic biography of the Kwatrijn project is the design of the barn, especially the shape and the technical details. This topic was discussed a lot as different ideas regarding the design of the system were prominent among the actors involved. The cognitive frame

is that a huge barn might be framed as a mega farm (see also the Roundel case). In order to prevent this, the new barn system should be integrated into the landscape. It is a huge building, because the cows get more space per cow. The actors downplayed the size by emphasizing the created connection between agriculture and landscape, and an open system was designed. This can be regarded as material framing, where the idea of a new open system created visually a link between agriculture and landscape, because one can look through the system (and still view natural landscape elements). This design helps to frame the system as a connection between landscape and the environment and thereby makes it possible to locate the new system close to a nature conservation area.

Antibiotics use

The case of antibiotics use was about the problems around antibiotic use in animal husbandry. Measures are taken to reduce the amount of antibiotics used in farming, as there might be human health risks involved as a result of too many antibiotics used in farming. In the case about antibiotics use we focused on the framing of two topics that evolved in the discussion, namely the responsible use of antibiotics and the role of the veterinarian.

The topic 'responsible use of antibiotics' starts with the idea that in the current way of treating animals, too many antibiotics are used, resulting in problems with resistance towards antibiotics in humans. Responsible use of antibiotics is often framed as reducing antibiotics use. But in practice, responsible use of antibiotics is something under discussion and not that clear-cut. Dealing with antibiotics in a responsible way becomes more important, and discussion about what is meant by 'responsible' is increasing. For some actors 'responsible use' is using as few antibiotics as possible, while for others it depends on the situation. The difference is clear in the dilemma that the veterinarian sometimes faces: do you immediately treat all animals with antibiotics, or do you first only treat the animal that is ill, with the risk that other animals become ill as well? The difficulty is that it is not clear whether treating an animal is also the responsible choice for human health. Material framing is visible in this topic as well. Administering antibiotics with an injection syringe, for instance, will frame antibiotics as a medicine. Treating a lot of animals at the same time through the feed or water frames antibiotics as a management tool. As the discussion on these topics is still ongoing, there is no clear alignment in framing, except that everyone agrees it is important to reduce the amount of antibiotics used.

The role of the veterinarian is a topic discussed as well. The topic biography starts with the importance of the role of the veterinarian in the discussion around antibiotic use in animal husbandry. The role of the veterinarian is changing from keeping animals healthy (curing diseases) towards taking care of animal health, animal welfare and human health. Conflicting ways of cognitive framing can be distinguished when people talk about the veterinarian, namely as a person serving clients (farmers), controlling clients, a gatekeeper for public health, a person treating animals and an advisor. These different ways of framing can conflict in various ways. In the past the veterinarian mainly provided animals with curative antibiotics. That changed towards treating animals preventively and preventing animals from becoming ill. Nowadays the veterinarian helps farmers by giving advice on, for example, barn climate to keep animals healthy and the focus is not only on providing medicines.

In this antibiotics case the role of the global discourse was more prominent than in the other two cases. Discussions on the role of the veterinarian mainly take place in the media and at conferences or meetings of stakeholders. As there is not yet a well-defined project, the global discourse is the main level where the problems with antibiotic use are framed. Furthermore, in this case the actors tend to articulate their ideas on problems and solutions in the future tense. In what we called 'endogenous futures', i.e. futures as discussed by actors, one can see how actors frame the topic and how this framing enables and constrains the possible routes to be taken in these topics.

7.3 Phases in framing: start, struggles and turning to alignment

Our first research question was: *How does framing occur in innovation processes in complex multiple-actor settings?* As the previous section shows, the general pattern we see in the topic biographies is that a topic starts when there is repetitive discussion between actors in the project. Often there is a clash of frames, and this may become clear for the actors themselves as well. Some actors try to solve problems with differences in framing and try to align frames in order to be able to continue the project. At a certain moment actors turn to alignment: the moment a breakthrough is realized and alignment is (almost) there. This can be one specific moment in time, for example an event, or it can gradually happen over time. This move can, for example, be influenced by new insights or an event. This alignment does not necessarily mean that actors have the same frame, as actors can also act when different frames exist next to each other, provided that they acknowledge the differences. In this section we draw more general lessons regarding the way framing occurs in innovation processes, focusing on the start of a topic biography, the struggles and the turning to alignment. Nevertheless, framing is a continuous process. Table 7.2 only shows the framing at a certain point in time.

Table 7.2 Phases in the topic biography

Topic	Start of topic biography	Struggles and turning to alignment	Alignment
Fitting in the landscape	Framing of the system in the landscape as clearly visible (first ideas of project team), was conflicting with ideas of municipality on how a system should be integrated in the landscape. This is an example in which framing at the localized collective level was influenced by external rules and regulations.	The moment that the actors realized that another framing of fitting in the landscape was necessary in order to continue the project. Different frames came to the fore and the actors started discussing the rules of the municipality bearing in mind how they could meet these rules.	Topic ended with a new collective frame of what fitting the landscape is. The actors frame it as integrated in the landscape and open for citizens to visit so the citizens can see how the eggs are produced. Furthermore, the system is framed as a new combination of existing systems which helped to get a permit.
Outdoor run	System builder saw an outdoor run as a certain amount of square metres, while a researcher framed it as the opportunity to go outside. There is deadlock because these frames are not known, and therefore there was discussion regarding whether or not an outdoor run will be built. Differences in framing an outdoor run caused a conflict on the level of the localized collective.	The moment a researcher asked the different actors how they frame an outdoor run, the understanding that there are differences in framing an outdoor run became visible. The frames varied from: access to outdoor to a number of square metres. When the actors realized that other ways than the usual way to create an outdoor run could be realized in order to meet all needs.	A completely new frame of an outdoor run was developed in which the outdoor run was collectively framed as access to outdoor space, and not related to a certain amount of square metres. Furthermore, it is about the quality of the space, and not the amount of space. That is a completely new idea.
Positioning of the egg in the market	Actors differed in framing of the position of the egg in the market. Some frame the egg as between organic and free-range; others frame the egg as one of these existing categories. A choice had to be made on how to position the egg. Rules on characteristics of egg production systems made it difficult to position the egg.	The Society for the Protection of Animals provided a three-star label for the system, while so far only organic eggs got that label. In collaboration with the supermarket the egg was in terms of price positioned between organic and barn eggs. The ideas behind this system did not fit the regular rules regarding table eggs.	In interaction the actors decided together to position the egg in between categories. The system was more expensive than a barn system and the actors argued that the system is good for both animals and the environment. The label of the Society for the Protection of Animals helped to position the egg in the market.
Using straw in the barn	The farmer framed straw as good for animal welfare, while the working group saw it as old-fashioned. The frame of some of the project team members conflicts with actors in the environment and actors involved in the project.	When businesses realized straw opens doors to innovative ideas regarding floors and machines, the actors also saw new opportunities instead of difficulties and started to think of how they could change the system in such a way that straw could be used.	A new frame that straw is very innovative has become prominent. This is a new frame, developed collectively. The innovative aspects that are needed to apply straw helped the project to become a success. Cognitive frames regarding straw became less important.

Topic	Start of topic biography	Struggles and turning to alignment	Alignment
Pasturing of cows	Pasturing is framed by the farmer as good for animal welfare, and later on as providing licence to produce, but other actors were not completely convinced. Frames between actors in the project team were conflicting.	Pasturing is framed as creating a 'licence to produce' for dairy farming close to a nature conservation area. Thereby the actors connected to the global discourse in which cows in the meadow are seen as 'nature'.	Different frames existed beside each other and complement each other, leading to a new developed frame in which pasturing is seen as an option of the system. The decision is postponed to the farmer that is going to build the system.
Design of the system	The topic design of the system starts with the idea that a huge barn can be framed by the public as a mega farm and that is not what the actors in the project team wanted. They started to think about other ways of dealing with this global discourse. There was a conflict between how the system is framed by actors in the project and the global discourse.	The idea that via an open system the actors can show that it is not a mega farm and at the same time it was creating a link between agriculture and nature. The actors would like to connect to the global discourse and take that into account in their design. They think about how they can influence the framing of the barn by citizens.	Multiple frames existed beside each other and a new frame, namely that an open system can create a bridge between agriculture and nature, was developed. By looking through the system one can see nature from within the barn and the barn is not a massive block in the landscape. This prevents citizens getting the idea of a mega farm.
Responsible use of antibiotics	There were different frames on what responsible use of antibiotics implies. Actors do agree that responsible use is needed, but the way they frame 'responsible use' differs between actors.	The amount of antibiotics used was declining because of measures taken by government, so the discussion shifts towards what exactly responsible use of antibiotics is. The frames on responsible antibiotics use still differ as there currently is no need to define more precisely what is meant by it.	Multiple frames did exist, but the main topic becomes: 'what is meant by responsible antibiotic use?' When actors need to take decisions on, for example, regulation, a clearer idea of what responsible use of antibiotics is will be needed, and a shared idea on what the actors are going to strive for is necessary.
Role of the veterinarian	Different frames on the role of the veterinarian exist and conflict, because the veterinarian had different tasks. The veterinarian is framed as serving clients, controlling clients, gatekeeper of public health, treating animals and advisor.	There is no clear turning point yet. Different frames are present, but the discussion is on the idea that the veterinarian has to take care of animal health, human health and animal welfare. So far different frames on the role of the veterinarian can exist beside each other.	Multiple frames exist beside each other, because the discussion on the role of the veterinarian is still ongoing. Similar to the topic above, as soon as there is a need for e.g. regulation, differences between frames can become problematic.

7.3.1 The start and changes of framing of a topic

The table on the previous pages (Table 7.2) shows that there are different conditions and ways in which something becomes a topic. In general, a topic emerges when the plans of actors cannot unfold smoothly, and are thwarted by hindrances. In this section we systematically discuss the starting conditions²⁰, the struggles and the turn to alignment. A topic is kept alive when struggles arise and continue. When there is a clash between different frames, something has to change in order to continue the innovation process. It appears that frames are more resilient than opinions or interpretations and are not easy to change. What follows is a confusing struggle between different frames. Because of differences in framing, it is not easy to solve a problem, as every actor has his own framing of the problem and the solutions. One of the effects of deadlock is that framing may become visible for the actors as well. Some actors make use of this knowledge in order to resolve the deadlock.

We can distinguish different conditions for the start, struggles and turning to alignment in framing. The moment the actors turn to alignment is often when a decision has to be taken in order to continue the project. Reasons for this sense of urgency can arise because of external events or because the actors have the feeling they need to continue the project and take a decision. We can make a distinction between internal and external aspects influencing the framing in a project.

Firstly, a project internal conflict can be a cause for the start of a topic, as shown in the examples from the Kwatrijn case and the Roundel case, where differences in the framing of the outdoor run and pasturing were visible. Also, in the antibiotics case we see that actors involved frame things differently. Within a project actors can feel the need to deal with conflicting frames that arise due to their heterogeneity, including different interests, education, world views, goals etcetera. Actors can also have different roles or tasks in an innovation project, depending on timing and topic. Someone, say a farmer, could act as a protector of the landscape, while at another moment the same actor is positioned as someone who is supposed to earn money. This means that framing by one person can differ per situation. The moment actors realize that different actors in the project frame a topic differently can be the start of a turn to alignment. Often framing by actors is not immediately clear for other actors and that leads to deadlock. An example is the discussion on what counts as an outdoor run. The outdoor run was framed differently by the actors involved, as some actors framed an outdoor run as a certain amount of square metres, while others framed it as access to outdoor space. In this example actors were not conscious that they framed an outdoor run differently, while using the same words.

Secondly, a topic can start when the ideas in a project conflict with external conditions such as rules and regulations. If the frames of the actors in the project conflict with the existing regulations, a way to deal with this situation has to be found. So, there are factors in the environment that influence framing, by forcing actors to frame the topic in another way. Examples of this type of starting a topic can be found in the topics on fitting in the landscape and positioning of the egg in the market. Both are examples in which external rules and regulations influence the framing. Also in a later stage new rules and regulations can be

²⁰ The start of the topic is the moment that we started to investigate the topic and develop its biography, but it may be the case that the start of the topic is actually a follow up of a previous topic.

introduced, what can lead to a change of direction and/or turn to alignment. In the Roundel case, for example, the supermarket asked for an environmentally friendly and animal-friendly produced egg. This created new ideas on how to frame the egg in comparison to other eggs in the market. Furthermore, new developments in, for example, reduction in antibiotics use can also cause changes in framing. For example, a huge reduction in the amount of antibiotics used means that responsible antibiotics use is no longer framed only as a reduction, but also as a specific use of antibiotics.

Thirdly, another external aspect is that frames of the project team can conflict with frames of other actors who are not part of the project team, but are essential for the actors in the project to align with. Or at least their ideas are influential for the project or their support is needed. An example is to get the Society for the Protection of Animals involved in the case of the positioning of the egg in the market or in the pasturing topic of the Kwatrijn system. A new actor can also bring new insights in a later phase of the project and thereby change the direction of the project. Remember how in the Kwatrijn project pasturing was a necessary part of the project in order to get the Society for the Protection of the Animals involved and thereby pasturing became an optional part of the system, because actors did not agree on whether or not to create space for pasturing. In the Roundel case, a workshop in which actors discussed ways to market eggs led to new ideas on positioning of the egg in the market. New ways of framing the egg in the market were mentioned and thereby actors were inspired to frame the position of the egg in the market in another way.

Fourthly, the frames of the project team can conflict with frames present in the global discourse, while for the project team it is important that the system is accepted by society. This is also an example in which an external aspect is influencing the framing in a project. These environmental triggers, as they are called by Davidson (2006), are present in the topic 'the design of the system' in the Kwatrijn case, where the actors in the project think it is important that the society does not frame their system as a mega farm. Global discourse can also change during the project and thereby change the direction of the project. For example the framing of the role of the veterinarian in the global discourse changed because of the BSE crisis from doctor to controller.

7.3.2 Alignment of framing

When frames get aligned and struggles end, a new framing situation occurs. If a shared idea is needed to a certain extent in order to continue the innovation process, it is necessary that the actors come to alignment, and that they recognize the alignment. This alignment does not necessarily require actors to have similar frames, but can also occur when the actors agree that different frames can exist beside each other. An example is the case of the Kwatrijn project, in which the framing of straw as being good for animal welfare coexisted beside straw as closing the nutrient cycle. On other occasions frames have to leave the stage in order to make continuation of the project possible. For example in the decision on whether or not to develop an outdoor run in the Roundel system, frames that an outdoor run takes too much space obstruct the decision to create an outdoor run. That frame has to be changed in order to continue the project and the frame that an outdoor run is an important part of the system became most important. Seemingly there are decisions for which agreement between actors is necessary, while for other decisions it is not. The cases

show that the sense of urgency among the actors can be influential in determining whether a collective solution should be found or not. Different ways of alignment can exist, and the case of Kwatrijn showed that even no alignment, on pasturing, can exist while the project continues.

Furthermore, alignment may lead to different situations. First, in the topic biographies we discovered that multiple frames can exist beside each other, such as various frames on the pasturing. Nevertheless on the level of the project actors did agree that different ways of pasturing are possible. In other topic biographies we see that frames complement each other and that actors combine ideas in a 'distributed' frame. For example, in the topic biography on pasturing of cows different ways of framing pasturing are combined, namely pasturing as a 'licence to produce' and as being good for animal welfare. A third type of outcome is when actors have the same frame. This 'collective' frame can be a frame of one of the actors involved that becomes dominant and is taken over by the other actors, for example the importance of the use of straw. Or it can be a totally new way of framing. Examples are fitting the landscape of the Roundel or the design of the outdoor run in the Roundel project.

These three types of outcomes are similar to the outcomes as defined by Rölting (2002) in his study on cognitions in social learning, namely collective, distributed and multiple cognitions. Although Rölting focuses on cognitions instead of frames, the types of alignment he distinguished are comparable. Rölting (2002) defines *collective* cognitions as outcomes in which actors have the same theories, values or ideas. *Distributed* cognitions are different but complementary and can lead to concerted action. *Multiple* cognitions are different cognitions about the same object. According to Rölting "multiple cognition can grow into collective or distributed cognition" (Rölting, 2002, p. 35). This distinction inspired us and provides us with an interesting categorization of types of outcomes.

7.4 The role of framing for innovation processes

Typically, innovation processes become difficult when they run into limits of existing ideas and developments. This is not about smooth changes: in this confusing period, established heuristics are questioned and new, conflicting ways to formulate problems and solutions emerge. In this thesis we have studied this transition period in various ways. The second research question in this thesis is: *How does framing facilitate and hinder innovation in complex multi-actor settings?* In order to answer this question, we studied the role of framing in innovation processes and the effect it had on the innovation process. Basically, we can distinguish two different ways in which framing influences innovation processes.

First of all, when studying the topic biographies, we see that framing can hinder innovation processes when conflicting frames obstruct passing a point at which a decision should be taken. In particular, when actors are not aware of the differences in framing it can be difficult to continue an innovation process. An example is the outdoor run in the Roundel project. That was an important design criterion, where the actors had to take a decision on whether or not to create an outdoor run in order to be able to continue the project. Also, the use of straw in the Kwatrijn project is a point at which a decision needed to be made in order

to continue the project. Nonetheless, the choice for pasturing in the Kwatrijn project is an example where the decision is taken to develop more than one system in order to let the farmer decide. In cases where there is not yet a point at which a decision should be taken, it is possible that different frames exist next to each other on the level of the localized collective – for example, actors framed responsible use of antibiotics in different ways, but all agreed that it was necessary to deal with antibiotics in a responsible way.

Secondly, what strikes us in the three cases is that topics that are extensively discussed between actors lead in the end to innovative solutions. Examples are the outdoor run in the Roundel case and the use of straw in the Kwatrijn case. Both topics were subject to prolonged discussion and because of differences in framing those conflicts arose. As these topics were very prominent in the project the actors did feel the urgency to take a decision and keep all actors involved. Therefore actors were forced to think in a completely different way in order to develop an agreement, what can lead to innovative solutions. Innovation can be seen as a side product of frame alignment, as the urge to work towards alignment did lead to innovative solutions. So, differences in framing can change the innovation processes in cases where the actors need to overcome differences and are forced to look for ways to deal with these differences. Framing can also facilitate innovation in complex multi-actor settings in cases where actors find a common understanding and collectively frame aspects of the project.

Studying framing shows how actors try to find a common understanding and thereby provides additional insight into the creative dimension of innovation. Studying framing shows how new ideas develop through an innovation process.

7.5 Lessons for innovation studies and framing studies

In this research we studied innovative processes by focusing on framing. In this section we draw theoretical lessons for innovation studies and framing studies. First we discuss how studying framing contributes to a better understanding of innovation processes and in particular of agricultural innovation processes. Thereafter we discuss the lessons that contribute to framing studies, in particular what material framing adds to the existing ideas on cognitive and interactional framing and the importance of distinguishing levels of framing.

Contribution to innovation studies and agricultural innovation studies

This research contributes to innovation studies in three ways. First, it shows why problems can be difficult to tackle; especially in the case of transitions that entail complex changes and involve many actors, and where solutions are not straightforward. When actors with different frames collaborate, it can be expected that frames are conflicting and that can hinder the innovation processes, but can also lead to creative solutions. Framing plays a role in cases in which very broad concepts such as sustainability have to be filled in. These concepts are often used to bring actors together, but when such broad concepts need to be further defined, different frames can be brought to the fore by different actors. For example, everyone agrees that sustainable agriculture is important, but when actors start to discuss sustainable agriculture, differences are visible in how they frame it. Studying framing not only focuses on what the innovation is about, but also shows how innovation is developed.

Studying framing provides insights into how new and creative ideas are developed in the messy process of developing innovations.

The second contribution is that this research shows how local visions and strategies are coupled to more general ideas and discourses. We argue that the three different levels we distinguished, face-to-face interaction, global discourse and the localized collective level, are inter-connected. In innovations in which the societal context is prominent, for example in innovations in the field of sustainability, it is important to also take the global discourse into account. Elzen et al. (2011) have already pointed in that direction in their work on normative contestation, in which they study how the normative pressure of existing regimes is effective in influencing the orientation of transitions in the making.

The third contribution is that we demonstrated that a creative solution can reconcile diverse frames and thereby help to realize a system innovation. As earlier research in the field of innovation studies demonstrated, interaction between actors is important and inter-personal processes are of great influence for the outcomes of innovation projects. In order to better understand these inter-personal processes, we had specific attention for framing by actors. By focusing on that micro-level, we explore the dynamics of how unusual ideas develop into practical applications, such as a round system, or a barn close to a nature conservation area. We argue that by focusing on framing, the creative dimension of innovation becomes visible, as we can show how new ideas are discussed and developed in order to find a way out of conflicting frames.

For innovation literature focusing on the agricultural sector, we can add that it is useful to study framing at different levels, in particular in the agricultural sector, wherein the global discourse is prominent, for example in its focus on animal welfare, mega farms, human health and animal disease issues. In all three cases the global discourse influenced the projects, and therefore we argue that it is important to not only study the level of individuals or projects, but also to take the global discourse into account. By following topics one takes into account the different levels at which framing occurs as it can be traced back in topic biographies.

Contribution to framing literature

In this research we started with the distinction between cognitive framing and interactional framing. Our first contribution to framing literature is that we have elaborated a third type, namely material framing. We argue that this third category, material framing, is an interesting and relevant addition to the categories of framing, because material characteristics influence, similar to cognitions and interaction, the way things are framed and thereby influence the way actors act or think. Like cognitive structures, material is stubborn, not easy to change, and has a passive role because it makes, for example, certain designs possible or impossible because of its material characteristics. On the other hand, material characteristics can also have an active role, as they force actors to deal with something in a certain way. For example sitting at the head site of the table frames someone as the chairman. One clear example from the case study on the Roundel project is that a low corridor in the barn frames the image the citizen has regarding the size of the barn. Because of the material characteristics, a low corridor, the citizen is forced to take the 'hens' perspective'.

Our second contribution is the explicit recognition that framing is a multilayered phenomenon, occurring at different levels. In general, literature on framing can be categorized based on the level of studying framing. Some literature focuses on the level of media debates or societal issues (Hajer and Versteeg, 2005). We propose to call that the global discourse level. Others specifically focus on how actors act and react to each other in face-to-face interaction (te Molder and Potter, 2005). We add in this study a third level, namely the level of projects, which is collective, yet localized, hence the localized collective: focusing on the framing within a project team and how the project is positioned in its context. We argue that framing on this level differs from the global discourse and face-to-face interaction. The localized collective level can be seen as an intermediate level, as actors in a project can together develop framing on the level of the project, but still individually hold different frames. We argue that the level of the localized collective is the preferential starting point for studying innovation, because innovation processes typically occur in projects. Yet, at this level the other levels are introduced as well. Frames that are present in the global discourse or face-to-face interaction are connected by the actors. Especially in projects with a complex multi-actor context and a focus on sustainability it is important to take the global discourse into account, as societal acceptance is often important for sustainable animal husbandry projects. The global discourse provides 'preconditions' for an innovative idea (e.g. a system should not look like a mega farm). Furthermore, we suggest that the level of the localized collective is essential when creating innovation, as on that level consensus is crucial to get all the actors involved. While on the global discourse level or in face-to-face interaction actors frame things differently, it may be possible that they agree on the localized collective level in order to get a project up and running. An example is that an individual actor can frame an outdoor run to be not necessary for animal welfare, but that the project team agrees that the outdoor run is an important element of their project, because it is necessary to get, for example, the Society for the Protection of Animals on board and gain societal acceptance.

The third contribution is that we developed a way to study framing by means of topic biographies. Framing studies are "often lacking conceptual precision in their delineation of constituent elements and processes" (Steinberg, 1999, p. 738). Therefore we proposed to follow the vicissitudes of topics over time. From topic biographies framing from different actors can be reconstructed. Topic biographies put the topics central and therefore differences between actors and levels such as global discourse and face-to-face interaction can be taken into account as well. Studying framing is an interpretative method, and collecting data from different sources, levels and actors can help to construct a very complete idea of how framing of a topic develops over time.

7.6 Contribution for transitions in agriculture and system innovations in general

Our third research question was: *What are the implications of framing for the ambition of transitions in agriculture and system innovation in general?* In this section we discuss what the insights gained in this study can learn us about system innovation in general and more specifically the transitions in agriculture towards sustainability. Knowledge of framing can help us to understand developments in projects and to understand the messy process of innovations, especially when conflicting ideas need to be combined into a sustainable solution. In our cases we saw that actors have certain goals at the beginning of an innovation

project, but in the end are happy with results that deviate from the original ideas. Taking this into account, we could state that although there is a common starting point necessary to get all the actors involved in an innovation project, this starting point does not necessarily define the outcome of such a project. The first lesson is that framing provides an insight into the creative process of interacting actors in sustainability challenges, as it shows how different frames are developed and innovative ideas are created. Differences in framing can sometimes even force actors to become very creative to find a solution for these differences leading to innovative outcomes. The possibility to get a creative outcome can plea for involving various actors, with diverse frames, in innovation processes. Related to that, we saw different types of alignment of frames. Actors can have the same collective frame, or aspects of different frames are combined in a new, 'distributive' outcome. Differences in framing can enhance innovation, provided there is also a sense of urgency to continue the project, as for example the discussion around the outdoor run of the Roundel project demonstrated.

The second lesson is that global discourse affects the innovation process, especially in cases in which societal accepted solutions, such as dealing with animal welfare and the environment, are needed. The cases show how actors introduced aspects from the global discourse in the project, in particular when societal acceptance is important. Frames present in the global discourse, such as mega farms, animal welfare or environmental concerns, provide important boundary conditions that have to be taken into account in projects related to sustainable development, and are introduced by the actors.

The third lesson of this study for transitions in agriculture and system innovations in general is the insight that material characteristics should not be overlooked in transition processes. Material characteristics, such as the shape of a barn, affect the way innovations are framed, both in a project, between actors, and in society as a whole. Material characteristics are fixed and often not easy to change and may both facilitate and hinder innovation processes. They can form a barrier because they limit the possibilities of for example design, but they can also help to generate new ideas. So, in case of the sustainability challenge, not only opinions of people matter, but also material characteristics.

Fourthly, as we know from studies on actor participation in innovation processes, it is important to involve heterogeneous actors and to take different perspectives into account. Yet, heterogeneous actors will have different frames, and should deal with these differences in order to get a project up and running. The practical lesson is, then, that it helps when actors are aware of their own frames and the frames of others and make them explicit. If actors discuss animal welfare, for instance, but frame it in different ways, it can be that they disagree because of these different frames. Deadlocks often occur when actors do not know what the (cognitive) frames of other actors are, so the practical lesson is to clarify the different frames in an interaction process by starting with defining some key topics and discuss how the actors frame it. Our cases showed that when actors realize they frame topics in different ways, there is space to discuss that and to move together towards an idea on how to deal with these differences. Being aware of differences in framing, and trying to make frames explicit, helps to speed up and enrich the innovation process. A relative

outsider is in a good position to enable this by asking questions about things that seem logical for actors in the project.

Finally, some remarks on how these insights could be further developed and in what direction more research would be helpful can be made. We showed that framing is influential in innovation processes and can determine the course of a project. Besides framing there are, of course, other aspects that influence innovation processes, such as power (Grin et al., 2010; Grin, 2012). As Grin (2012) stated, at the level of experiments, relational power, like money, knowledge and social capital, is exerted. Our case studies indeed provide examples that confirm that power is influential as well. For example, the egg packer had an important position at the beginning of the Roundel project and he made use of this power, but when he left the consortium, there was room for innovative ideas regarding the packaging of the eggs. This example highlights that power is important, but also makes clear that studying power alone does not explain the entire innovation process. In return, differences in frames are one of the reasons why creative ideas can or cannot be realized. We therefore argue that framing is an interesting phenomenon to study and a justified addition to the field of innovation studies.

To come back to the quote of Louise Fresco at the beginning of this thesis, this study confirms that “words and labels” add to “the confusion and polarization” in the area of agriculture and food; yet, they are also necessary to develop innovative solutions.

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Summary

The agro-food sector in the Netherlands has grown tremendously between the 1950s and 1980s. Since the end of the 1980s the growth has been declining, and issues regarding the profitability of farms and societal issues regarding animal welfare and environmental pressure have become increasingly important. In order to deal with sustainability issues and to further sustain the agricultural sector, innovations are deemed necessary. Only introducing new technologies is not enough, system innovations in the entire socio-technical system are required, including technology, infrastructure, regulation, cultural meaning and user practices. Such system innovations, however, are not easy because the Dutch agro-food system is very complex and involves a great diversity of actors, varying from farmers to processing industries, and from societal organizations to farmers' associations. Actors have different backgrounds, goals, ideas and stakes, which make interaction between them less productive and sometimes difficult. The phenomenon highlighted in this thesis is that different actors have their own way of *framing* issues related to the challenges of sustainability, which often leads to problems in collaborations. The objective of this thesis is to understand framing of sustainability problems in innovation projects in the agro-food sector, and more specifically in the animal husbandry sector.

Chapter two introduces the theory used in this thesis. So far, most studies focusing on transitions and innovation systems have focused on the macro- and meso-level, but more recently innovation scholars have called for more attention to the micro-level of actors, in order to better understand innovation processes. The question, then, is how to study interaction at the micro-level of innovation processes. In this research we focus on the idea that actors frame things differently because of their diversity. Framing is defined as the phenomenon that actors are limited in the way they think and act due to underlying cognitive structures, interactional patterns and/or material characteristics. In particular, umbrella terms such as 'sustainability', involving different meanings, can be expected to be framed in different ways by various actors. A focus on framing foregrounds the actors, and their interaction in processes of change, and thereby helps to understand innovation processes.

The study of framing already has a long tradition, or put more precisely, several traditions. Besides the different origins of frames and framing, one could also distinguish different levels of framing. As a step towards more precision, we suggest a typology of framing based on three different levels of social dynamics, on which frames reside and operate in distinct ways. These are *face-to-face* interaction, global discourse, and the localized collective. These three levels of framing influence each other. This typology allows us to review the various strands of framing research. Many studies of framing are at the level of face-to-face interaction, investigating how frames develop between people. Discourse analysis, on the other hand, is about the social reality produced and made real through particular ways of representing the world in the media and elsewhere; that is what we will call *the global discourse level*, stressing its encompassing and general nature.

In complex multi-actor innovation processes, we distinguish an additional level of projects at which new ideas are developed and employed. Here, we claim, another form of framing is taking place and seems to be crucial. Typically, in innovation projects different actors are

trying collectively to position their project and the perspective they have on the components of the project and define what they want to reach with the project. Participants need to develop a joint idea and a temporal form of coordination in order to increase collectiveness in a project. We propose calling this intermediate level of framing the *localized collective level*. It is distinct from, but influenced by, personal schemata of the participants. Likewise, framing at the localized collective level is enabled and constrained by the global discourse, which resonates in society.

So far, framing has mainly been seen as pertaining to cognitions and interaction. In this research, we argue that materiality also determines the way something is framed by actors. The field of science and technology studies (STS) has emphatically shown how artefacts and systems are not only shaped by interactions, but also shape interaction in return. Inspired by STS scholars like Akrich and Bijker, we assume that materiality also plays a role in innovation projects. Material characteristics enable and constrain the way actors perceive something and act upon it, and therefore are useful to take into account when trying to understand framing of actors in an innovation process. In addition to cognitive and interactive framing, we therefore propose a third category of framing, namely 'material framing', inspired by the concepts of technological frame and script. In this thesis we define *framing* as the phenomenon that thinking and acting are limited by mental schemes, interactional patterns and material characteristics. We define *cognitive frames* as relatively static structures in one's mind that enable and constrain understanding, action and interaction. *Interactional frames* are the fluid frames that condition interaction. We define the *material frame* as the characteristics of artefacts that enable and constrain understanding, action and interaction.

Based on the developed theoretical framework we have formulated three types of research questions that address system innovations and framing. The first research question investigates what framing is in complex multi-actor settings. In answering this question we study the different ways in which framing can occur in innovation processes, based on what we learned from the different theoretical insights.

1. How does framing occur in complex multiple-actor settings in innovation processes?
The second question is about the possible influence of framing on innovation processes and the way in which framing influences the outcome of innovation projects.
2. How does framing facilitate and hinder innovation in complex multi-actor settings?
The third question is an overarching question on the lessons we can learn for system innovations in general.
3. What are the implications of framing for the ambition of transitions in agriculture and for system innovation in general?

Chapter three is on the methodology. This qualitative research is based on a case study design in which multiple cases are investigated. The cases selected for this study have three main characteristics in common, namely the cases are examples of sustainability issues in the agro-food sector, and more specifically in animal husbandry; the cases are examples of innovative ideas or projects that the actors want to realize in order to create a more sustainable agricultural sector; and the cases involve a heterogeneous group of actors, such as knowledge institutes, governmental organizations, societal organizations, businesses and intermediaries. This heterogeneous group of actors should actively participate in the

innovation projects. We have investigated three cases, namely the Roundel project, the Kwatrijn project, and the developments around antibiotics use in animal husbandry. These cases differ in the development phase they are in. In order to study these cases we take an interpretative approach wherein the process of how meaning is created and negotiated is central.

Cognitive, interactional and material frames, however, cannot be observed directly, as they are not present in an isolated form. In order to find out how and when framing takes place we need to determine how topics change over time. Frames can only be inferred by considering what gets framed. In order to study these different types of framing some delineation is needed. This delineation comes to the fore when actors discuss what we call a *topic*: problem or goal relevant to one or more participants. Topics are explicitly or implicitly introduced into the interactions by the actors, and can be traced afterwards by analysing documents and interviews. Topics are mentioned by the actors themselves and in discussing those topics actors express themselves, which provides access to their framing. In order to gain an insight into the phenomenon of framing we study the cases using different sources, namely documents, semi-structured interviews and observations during project meetings. By organizing the quotations per main issue, and presenting the different quotations in time order, a *topic biography* is developed. During innovation projects topics may emerge, become salient and dominant, or may leave 'the scene'. It is possible to reconstruct the vicissitudes of a topic based on the quotes of interviewees, traces of interaction processes and project materials in topic biographies.

The biography of a topic allows a further analysis of the framing around that topic as it shows the different framing of a topic and the changes therein. The topics to be followed are selected based on what interviewees mentioned as important topics, and the topics that very often came to the fore when studying the data. The topics that are often discussed are important topics for the actors. The discussions around these topics show many instances of framing.

Chapter four describes and analyses the first case study, the Roundel project. The Roundel was envisioned as a sustainable system for keeping laying hens and the marketing of the table eggs produced in such a system. The project is followed from October 2009 until the summer of 2010. The Roundel was a project in its implementation phase. At the time of the study, the system had been designed, the decision was taken that it would be built and the question was how to position the system in the existing economic and political context and how to market the eggs produced in this system. We followed the topics 'fitting in the landscape', 'the outdoor run' and 'positioning of the egg in the market'. In the case of the Roundel project, the developers eventually encountered the force of framing and acted accordingly, often without fully acknowledging the role of framing. We think that a better understanding of framing helps to make the efforts of developers, stakeholders and society at large less vulnerable to these pitfalls and challenges.

Chapter five is about the second case study, the Kwatrijn project, developing a dairy cow system close to a nature conservation area. In such a system, animal welfare, integration in the environment and environmental issues are central. This project was in the phase

of designing the system and focused on what the system should look like and on the technical components of the system. The project was followed from September 2010 until March 2012. The design of the system and the implementation had not yet been decided, and discussions are mainly about how the system should look, what the most important characteristics are and how to fit the system into the existing landscape and ideas regarding keeping dairy cows. We started with issues related to animal welfare and followed the topics 'straw', 'pasturing' and 'design of the system'. We can draw three general lessons regarding framing and innovation from this dairy system case study: firstly, materiality does indeed play a role in framing. Secondly, we can distinguish two causes for changes in frames: details of a project have to become more specific or conflicts need to be solved to continue the project. And thirdly, it seems that innovation is stimulated when differences in frames hinder a project, and something has to happen in order to create a new frame or a combination of frames.

Chapter six deals with the third case study on antibiotic use in animal husbandry. A clearly defined project was not yet developed, so the study investigates what the problems are with antibiotic use and how the veterinary sector is dealing with this issue. Compared to human health, the use of antibiotics in animal husbandry is very high. The potential risk is that resistance against antibiotics is developed with consequences for applying antibiotics in humans. There were a lot of developments around antibiotics use in animal husbandry, and the amount of antibiotics used is decreasing, but there is also a lot of discussion regarding how to deal with this issue and who should take responsibility. The case is an example of how framing determines the way of dealing with problems and solutions of antibiotic use. The antibiotics case was investigated between July 2012 and November 2012. The two topics we investigated are 'responsible use of antibiotics' and 'the role of the veterinarian'. Apparently, these topics are worth the effort to struggle with for the actors we spoke to, and appear somehow as a barrier to envisioned solutions for antibiotics use because they differ.

The topic biographies show that in the early phase in which a problem needs to be defined, different frames next to each other. All actors agree that responsible use is necessary, but how they frame this responsible use, differs. Although conflicting frames can be difficult to deal with, the topics are not yet in a phase wherein a decision needs to be taken about how to deal with them. When decisions need to be taken, frames probably do have to change, or become dominant in order to get alignment between actors. Furthermore, in both topic biographies we see that possible future developments are mentioned. This may have to do with the nature of this subject, in which the people involved discuss what the problem is, what possible solutions are and who is responsible. Because there is a lot undecided, actors frame the future based upon their daily practice. So, framing does not only occur in past and present situations, but also the future is framed.

In *Chapter seven* we compare and contrast our findings based on the eight topic biographies studied within the three cases. In these eight topic biographies we traced the framing of topics by closely following the way in which actors articulate problems and solutions. Regarding the first research question, addressing the way in which framing occurs, we can state that topic biographies, by definition, start with actors discussing the topic; otherwise a topic is not an agenda item or issue. Typically, we then see differences in framing, struggles

about problems and solutions, and alignment of frames in various forms and degrees.

We can distinguish different conditions for the start, struggles and turning to alignment in framing. The moment the actors turn to alignment is often when a decision has to be taken in order to continue an innovation project. This alignment does not necessarily mean that actors have the same frame, as actors can also act when different frames exist next to each other, provided that they acknowledge the differences. A sense of urgency can arise because of external events or because the actors think they need to continue the project and take a decision. We can make a distinction between internal and external aspects influencing the framing in a project.

A project can start with a project internal conflict; with a situation in which the ideas in an innovation project conflict with external conditions such as rules and regulations; with frames of the project team conflicting with frames of essential external actors; or with frames of the project team conflicting with frames present in the global discourse. When frames get aligned and the struggles end, a new framing situation occurs. If a shared idea is needed in order to continue the innovation process, it is necessary that the actors come to alignment, and that they recognize the alignment. On other occasions frames have to leave the stage in order to make continuation of the project possible. Seemingly there are decisions for which agreement between actors is necessary, while for other decisions it is not. The cases show that the sense of urgency among the actors can be influential in determining whether a collective solution should be found or not. Alignment may lead to three different situations: firstly, 'multiple' frames can exist beside each other; secondly, frames complement each other and actors combine ideas in a 'distributed' frame; or thirdly, actors have the same frame, a 'collective' frame.

The second research question addressed the way in which framing influences innovation processes. Typically, innovation processes become difficult when they run into limits of existing ideas and developments. This is not about smooth changes: in this confusing period, established heuristics are questioned and new, conflicting ways to formulate problems and solutions emerge. Basically, we can distinguish two different ways in which framing influences innovation processes. Framing can hinder innovation processes when conflicting frames obstruct passing a point at which a decision should be taken. In particular, when actors are not aware of the differences in framing it can be difficult to continue an innovation process. Secondly, topics that are extensively discussed between actors can eventually lead to innovative solutions. Actors are forced to think in a completely different way in order to develop an agreement, leading to innovative solutions. Innovation, thus, can be seen as a side product of frame alignment, as the urge to work towards alignment did lead to innovative solutions. So, differences in framing can change the innovation processes in cases where the actors need to overcome differences and are forced to look for ways to deal with these differences. Studying framing shows how actors try to find a common understanding and thereby provides additional insight into the creative dimension of innovation. Studying framing shows how new ideas develop through an innovation process.

The third research question is on the implications of framing for transitions. This research shows why innovation problems in agro-food can be difficult to tackle; especially in the case

of transitions that entail complex changes and involve many actors, and where solutions are not straightforward. Furthermore, this research shows how local visions and strategies are coupled to more general ideas and discourses. We demonstrated that a creative solution can reconcile diverse frames and thereby help to realize a system innovation. We add to the innovation literature that it is useful to study framing at different levels, in particular in the agricultural sector, wherein the global discourse is prominent, for example in its focus on animal welfare, 'mega farms', human health and animal disease issues. By following topics one takes into account the different levels at which framing occurs as it can be traced back in topic biographies. Regarding framing literature, we have elaborated a third type of framing, namely material framing. We state that material characteristics should not be overlooked in transition processes and it is important to involve heterogeneous groups of actors and to take different perspectives into account. Furthermore, we explicitly recognize that framing is a multilayered phenomenon, occurring at different levels and developing over time. The heterogeneous set of actors in agro-food systems will have different frames, and they should deal with these differences in order to get an innovation project up and running. The practical lesson is, then, that it helps when actors are aware of their own frames and the frames of others and make them explicit. The concepts and approaches of this study are helpful for this practical purpose, as well.

Samenvatting

De Nederlandse agro-food sector is enorm gegroeid tussen de jaren 1950 en 1980. Sinds het einde van de jaren 1980 is deze groei afgeremd. Kwesties met betrekking tot de winstgevendheid van de bedrijven en maatschappelijke kwesties zoals dierenwelzijn en milieudruk zijn steeds belangrijker geworden. Om deze duurzaamheidsvraagstukken in de agrarische sector op te lossen worden innovaties noodzakelijk. Alleen de invoering van nieuwe technologieën is niet genoeg: systeeminnovaties zijn nodig waarbij ook de infrastructuur, regelgeving, gebruikerspraktijken en culturele betekenissen veranderen. Echter, systeeminnovaties zijn niet eenvoudig omdat de Nederlandse agro-food systeem zeer complex is en het een grote diversiteit aan actoren betreft, variërend van boeren tot verwerkende industrie, en van maatschappelijke organisaties tot boerenorganisaties. Actoren hebben verschillende achtergronden, doelen, ideeën en motivatie, die de interactie tussen hen minder productief en soms moeilijk kunnen maken. In dit proefschrift staat het fenomeen framing centraal. Actoren hebben hun eigen manier om duurzaamheidsuitdagingen te framen, die vaak leiden tot problemen in samenwerkingsverbanden. Het doel van dit proefschrift is dan ook om beter te begrijpen hoe framing van duurzaamheidsproblemen in innovatieprojecten in de agro-food sector plaatsvindt, met name in de veehouderij.

Hoofdstuk twee introduceert de theorie die in dit proefschrift centraal staat. Tot nu toe richten de meeste studies op het gebied van transitie en innovatiesystemen zich op het macro- en meso-niveau, maar meer recentelijk werd er in innovatiestudies gepleit voor meer aandacht voor het microniveau van de actoren, om innovatieprocessen beter te begrijpen. De vraag is dan, hoe je deze interacties op microniveau kunt onderzoeken. In dit onderzoek focussen we op het idee dat actoren verschillend framen vanwege hun diversiteit. Framing is gedefinieerd als het verschijnsel dat actoren beperkt worden in hun manier van denken en handelen door onderliggende cognitieve structuren, interactie patronen en/of materiële kenmerken. Juist containerbegrippen als 'duurzaamheid' zullen op verschillende manieren geframed worden. Een focus op framing benadrukt de rol van actoren, en hun interactie in veranderingsprocessen, en helpt zodoende om innovatieprocessen beter te begrijpen.

Framing theorieën hebben een lange traditie, of beter gezegd, een aantal tradities. Naast de verschillen in oorsprong van frames en framing, kan men ook verschillende niveaus van framing onderscheiden. Als een stap naar meer precisie, ontwikkelden we een typologie van framing gebaseerd op drie verschillende niveaus van sociale dynamiek, waarbij frames op verschillende manieren een rol spelen. Dit zijn het niveau van de globale discours, face-to-face interactie en het lokale collectief. Deze drie niveaus van framing beïnvloeden elkaar. Deze typologie maakt dat we verschillende onderdelen van framing kunnen onderzoeken. Veel framing studies richten zich op het niveau van face-to-face interactie en hoe frames zich ontwikkelen tussen mensen. Discoursanalyse gaat juist over de sociale werkelijkheid gevormd door maatschappij en de media. Dit noemen we in dit proefschrift het globale discours niveau.

In complexe multi-actor innovatieprocessen, onderscheiden we een extra niveau, het niveau van projecten, waarbij nieuwe ideeën worden ontwikkeld en toegepast. We beweren dat hier een andere vorm van framing plaatsvindt die van invloed is op het innovatieproces. Juist in projecten waarin verschillende actoren samenwerken, zullen verschillende perspectieven bestaan die mede bepalen hoe het project gepositioneerd zal worden. Actoren moeten een

gezamenlijk idee en een (tijdelijke vorm van) coördinatie ontwikkelen om de collectiviteit te verhogen in een project. Wij noemen dit tussenniveau van framing het lokale collectieve niveau. Framing op het niveau van het lokale collectief wordt gevormd door de globale discours, die resoneert in de samenleving en de persoonlijke frames van de betrokkenen.

Tot dusver wordt framing voornamelijk gezien als gebaseerd op cognities van mensen of gevormd in interactie tussen mensen. In dit onderzoek pleiten we dat materialiteit ook van invloed is op framing door actoren. In wetenschap- en technologiestudies is aangetoond hoe artefacten en systemen niet alleen gevormd worden door interacties, maar interacties ook gevormd worden door artefacten. Geïnspireerd door STS onderzoekers zoals Akrich en Bijker, gaan we ervan uit dat materialiteit een rol speelt bij innovatie projecten. Materiële eigenschappen bepalen en beperken de manier waarop actoren iets waarnemen en handelen. Daarom is het nuttig om rekening te houden met materialiteit wanneer we proberen om framing van actoren in een innovatieproces te begrijpen. We hebben daarom een derde categorie van framing toegevoegd, namelijk ‘materiële framing’. De algemene definitie van framing die we in dit proefschrift hanteren is dan ook: het verschijnsel dat denken en handelen, worden beperkt door mentale schema’s, interactie patronen en materiaaleigenschappen. We definiëren cognitieve frames als relatief statische structuren in het hoofd die inzicht, actie en interactie mogelijk maken en beperken. Interactionele frames zijn fluidere frames die in interactie gevormd worden. We definiëren het materiële frame als de kenmerken van de artefacten die inzicht, actie en interactie beperken en mogelijk maken.

Op basis van het ontwikkelde theoretische kader hebben we drie soorten onderzoeksvragen geformuleerd die systeeminnovaties en framing adresseren.

1. Hoe vindt framing plaats in complexe multi-actor settings in innovatieprocessen?
2. Hoe hindert of stimuleert framing innovatie in complexe multi-actor settings?
3. Wat zijn de implicaties van framing voor de ambitie van transitie in de landbouw en voor het innovatie systeem in het algemeen?

Hoofdstuk drie behandelt de methodologie die gebruikt is in dit onderzoek. Dit kwalitatieve onderzoek is gebaseerd op een case studie ontwerp waarbij meerdere cases worden onderzocht. De voor deze studie geselecteerde cases hebben drie belangrijke kenmerken gemeen. Ten eerste: het zijn voorbeelden van duurzaamheid in de agro-food sector, vooral in de veehouderij. Ten tweede: het zijn voorbeelden van innovatieve ideeën of projecten die de actoren willen realiseren met het oog op het verduurzamen van de agrarische sector. En ten derde: er is een heterogene groep van actoren betrokken, zoals kennisinstituten, overheidsorganisaties, maatschappelijke organisaties, bedrijven en intermediaire organisaties. Deze heterogene groep van actoren is nauw betrokken bij het innovatieproject. We hebben drie cases onderzocht, namelijk het Rondeel project, het Kwatrijn project en de ontwikkelingen rond antibioticagebruik in de veehouderij. Deze gevallen verschillen in de fase van ontwikkeling waarin ze zich bevinden. Om deze cases te bestuderen nemen we een interpretatieve benadering waarin het proces van hoe betekenis wordt gecreëerd en onderhandeld centraal staat.

Cognitieve, interactionele en materiële frames kunnen echter niet direct waargenomen worden, omdat zij niet in een geïsoleerde vorm zichtbaar zijn. Om te achterhalen hoe en

wanneer framing plaatsvindt, onderzoeken we hoe topics veranderen in de tijd. Frames kunnen alleen worden afgeleid door uitingen van actoren te bestuderen. Een afbakening is nodig omdat het niet mogelijk is om alle framing te bekijken. We bestuderen daarom de framing van wat we een 'topic' noemen: een probleem of onderwerp wat voor één of meer deelnemers relevant is. Topics worden expliciet of impliciet geïntroduceerd in de interacties tussen de actoren, en kunnen daarna worden getraceerd door het analyseren van documenten en interviews. Topics worden door de actoren benoemd, en doordat ze besproken worden, kunnen we de framing achterhalen. Om een inzicht te krijgen in het fenomeen framing bestuderen we de cases door het gebruik van verschillende bronnen, namelijk documenten, semigestructureerde interviews en observaties tijdens projectvergaderingen. Door het organiseren van de citaten per topic, en de presentatie van de verschillende citaten in volgorde van tijd, kan een topic biografie ontwikkeld worden. Tijdens innovatieprojecten kunnen topics ontstaan, minder belangrijk worden en verdwijnen. Het is mogelijk om de 'lotgevallen' van een topic te reconstrueren op basis van de verschillende materialen die verzameld zijn.

Verschillen in framing van een topic en de veranderingen daarin over de tijd kunnen worden gereconstrueerd aan de hand van een topic biografie. De topics die worden gevolgd, worden geselecteerd op basis van wat de actoren als belangrijke onderwerpen naar voren brachten en de onderwerpen die naar voren kwamen bij het herhaaldelijk lezen van de data. De topics die veel worden besproken zijn voor de actoren blijkbaar belangrijke thema's, omdat deze besproken worden met andere actoren en daarbij verschillen in framing zichtbaar worden.

In hoofdstuk vier wordt de eerste casus, het Rondeel project, beschreven en geanalyseerd. Het Rondeel gaat over de ontwikkeling van een duurzaam stalsysteem voor het houden van leghennen en de marketing van de consumptie-eieren die in dit systeem geproduceerd worden. Het project is gevolgd vanaf oktober 2009 tot de zomer van 2010. Het Rondeel is een project in de uitvoeringsfase. Op het moment van de studie was het systeem ontworpen en de beslissing genomen dat het zou worden gebouwd. De vraag was hoe het systeem in de huidige economische en politieke context zou passen en hoe de eieren geproduceerd in dit systeem op de markt gepositioneerd zouden moeten worden. We volgden de topics 'passen in het landschap', 'de uitloop voor kippen' en 'de positionering van het ei in de markt'. In het Rondeelproject kregen de ontwikkelaars te maken met framing en ze handelden er naar, door bijvoorbeeld bij het ontwerpen van het houderijsysteem uit te gaan van bestaande frames, vaak zonder volledige erkenning van de rol van framing. Wij denken dat een beter begrip van framing helpt om de inspanningen van de stakeholders en de samenleving in het algemeen minder gevoelig te maken voor valkuilen, zoals het laten beïnvloeden door bestaande frames, en de uitdaging om frames te combineren en te veranderen aan te gaan.

Hoofdstuk vijf behandelt de tweede casus, het Kwatrijn project, waarin een systeem voor melkkoeien ontwikkeld wordt nabij een natuurgebied. In een dergelijk systeem staan dierenwelzijn, integratie in de omgeving en het milieu centraal. Dit project was in de fase van het ontwerpen van het systeem en gericht op hoe het gehele systeem en de technische componenten ervan eruit zouden moeten zien. Het project werd gevolgd vanaf september 2010 tot maart 2012. Het ontwerp van het systeem en de uitvoering waren nog niet duidelijk en de discussies gingen vooral over hoe het systeem eruit moet zien, wat

de belangrijkste kenmerken zijn en hoe het systeem in te passen in het landschap en het ontwikkelen van ideeën met betrekking tot het houden van melkkoeien. De topics 'stro', 'weidegang' en 'ontwerp van het systeem' werden gevolgd. We kunnen drie algemene lessen trekken over framing en innovatie in deze casus. Allereerst speelt materialiteit wel degelijk een rol in framing. Ten tweede kunnen we twee oorzaken voor veranderingen in de frames onderscheiden, namelijk wanneer details meer specifiek moeten worden gemaakt of conflicten moeten worden opgelost om het project te continueren. Ten slotte kunnen juist verschillende frames innovatie stimuleren omdat er gezocht moet worden naar een nieuw frame of een nieuwe combinatie van frames.

Hoofdstuk zes bespreekt de derde casus: het gebruik van antibiotica in de veehouderij. Er is nog geen duidelijk omschreven project, maar er wordt een probleem gedefinieerd. Ten opzichte van het gebruik van antibiotica in de humane gezondheidszorg is het gebruik van antibiotica in de veehouderij zeer hoog. Het potentiële risico is dat bacteriën resistentie tegen antibiotica ontwikkelen met gevolgen voor de toepassing van antibiotica bij mensen. Er zijn veel ontwikkelingen rondom antibiotica gebruik in de veehouderij, en de hoeveelheid gebruikte antibiotica neemt af, maar er is ook veel discussie over hoe deze kwestie aan te pakken en wie de verantwoordelijkheid moet nemen. Deze casus is een voorbeeld van hoe framing van invloed is op de manier waarmee men omgaat met problemen en oplossingen voor het gebruik van antibiotica. De antibiotica casus werd onderzocht tussen juli 2012 en november 2012. De twee topics die we onderzochten waren 'verantwoord gebruik van antibiotica' en 'de rol van de dierenarts'.

We zien dat in deze vroege fase van een probleemdefiniëring verschillende frames naast elkaar kunnen bestaan. We zien dat alle actoren het erover eens zijn dat verantwoord gebruik noodzakelijk is, maar wat zij onder verantwoord antibioticagebruik verstaan verschilt. Hoewel conflicterende frames moeilijk kunnen zijn, is in deze fase van een probleem nog geen beslissing noodzakelijk en zullen verschillen naast elkaar kunnen blijven bestaan. Wanneer besluiten moeten worden genomen, zullen verschillen en veranderingen in framing zichtbaar worden. Bovendien laten topic biografieën zien dat mogelijke toekomstige ontwikkelingen worden genoemd. Dit kan te maken hebben met de aard van dit onderwerp, waarbij de betrokkenen spreken over wat het probleem is, wat de mogelijke oplossingen zijn en wie verantwoordelijk is. Er zijn nog weinig beslissingen genomen en actoren framen de toekomst op basis van hun dagelijkse praktijk. Framing speelt dus niet alleen een rol in het verleden en de huidige situaties, maar ook de toekomst wordt geframed.

In hoofdstuk zeven vergelijken we onze bevindingen op basis van de acht topic biografieën die we in de drie cases bestudeerd hebben. De eerste onderzoeksvraag was gericht op het verkrijgen van inzicht in hoe framing plaatsvindt in innovatieprocessen. Topic biografieën beginnen per definitie met actoren die het topic bespreken, anders is het topic geen agendapunt of probleem. We zien dan verschillen in framing, de strijd tussen framing van problemen en oplossingen, en de verschillende manieren waarop de actoren op één lijn komen.

We kunnen verschillende omstandigheden onderscheiden voor de start van een topic, de strijd tussen frames en het op één lijn brengen van framing. Het moment waarop de actoren

op één lijn moeten komen is vaak wanneer een beslissing moet worden genomen om het project voort te zetten. Eén lijn betekent niet noodzakelijkerwijs dat de actoren hetzelfde frame hebben. Er kunnen ook verschillende frames naast elkaar bestaan, op voorwaarde dat actoren de verschillen erkennen. Een gevoel van urgentie om tot één lijn te komen kan ontstaan als gevolg van externe gebeurtenissen of omdat de actoren het gevoel hebben dat ze een beslissing moeten nemen om het project voort te kunnen zetten. We kunnen een onderscheid maken tussen interne en externe aspecten die framing beïnvloeden. De start van een topic kan ontstaan door een project intern conflict, een conflict door externe omstandigheden, zoals regels en voorschriften; een conflict van frames van het projectteam met frames van essentiële externe actoren, of wanneer de frames van het projectteam conflicteren met frames aanwezig in de globale discours. Wanneer frames op één lijn komen, en de strijd tussen frames eindigt ontstaat nieuwe framing. Als een gedeeld idee noodzakelijk is voor de voortgang van het project, is het van belang dat actoren op één lijn komen. In andere gevallen zullen frames verdwijnen om het project door te laten gaan. Blijkbaar zijn er besluiten waarbij het nodig is dat actoren het met elkaar eens zijn, terwijl dat voor andere besluiten niet zo hoeft te zijn. De cases laten zien dat een gevoel van urgentie kan bepalen of een collectieve oplossing moet worden gevonden of niet. Er kunnen drie mogelijke uitkomsten zijn. Allereerst kunnen meerdere frames naast elkaar bestaan. Ten tweede kunnen frames elkaar aanvullen of kunnen actoren ideeën combineren in een 'gedistribueerd' frame. Ten slotte kunnen actoren hetzelfde frame hebben, een 'collectief' frame.

De tweede onderzoeksvraag adresseerde de manier waarop framing van invloed is op innovatieprocessen. Innovatieprocessen worden moeilijk wanneer ze de grenzen van bestaande ideeën en ontwikkelingen overschrijden. Op dergelijke momenten zijn de gevestigde ideeën niet meer haalbaar en ontstaan nieuwe, tegenstrijdige manieren om problemen en oplossingen te formuleren. In principe kunnen we twee verschillende manieren onderscheiden waarop framing innovatieprocessen beïnvloedt. Ten eerste kan framing innovatieprocessen hinderen wanneer conflicterende frames het passeren van een punt waarop een besluit moet worden genomen belemmeren. Vooral wanneer actoren zich niet bewust zijn van de verschillen in framing kan het moeilijk zijn om een innovatie proces voort te zetten. Ten tweede kunnen topics die uitgebreid aan bod komen in interactie tussen actoren ook leiden tot innovatieve oplossingen. Actoren worden gedwongen om op een heel andere manier een oplossing te ontwikkelen, wat kan leiden tot innovatieve oplossingen. Innovatie kan dus worden gezien als een bijproduct van het op één lijn brengen van frames, zoals de drang om te werken aan de aanpassing heeft geleid tot innovatieve oplossingen. Verschillen in framing kunnen innovatieprocessen veranderen wanneer actoren moeilijkheden moeten overwinnen en gedwongen worden om met verschillen om te gaan. Het bestuderen van framing laat zien hoe actoren proberen om een gemeenschappelijk begrip van bijvoorbeeld duurzaamheid vinden en biedt daardoor extra inzicht in de creatieve dimensie van innovatie. Het bestuderen van framing laat zien hoe nieuwe ideeën in een innovatieproces ontwikkeld worden.

De derde onderzoeksvraag gaat over de consequenties van framing voor transitities. Dit onderzoek laat zien waarom innovatie problemen in de agro-food sector moeilijk zijn aan te pakken. Met name in het geval van transitities die complexe veranderingen met

zich meebrengen en waarbij veel verschillende actoren betrokken zijn, is het vinden van oplossingen niet eenvoudig. Bovendien laat dit onderzoek zien hoe lokale visies en strategieën worden gekoppeld aan meer algemene ideeën en discours. We toonden aan dat een creatieve oplossing diverse frames kan verbinden en zo kan helpen om een systeeminnovatie te realiseren. We voegen aan de innovatie literatuur gericht op de agrarische sector toe dat het nuttig is om framing te bestuderen op verschillende niveaus, namelijk globale discours, face-to-face en op lokaal collectief niveau van innovatieprojecten. Vooral in de agrarische sector, waarin de globale discours prominent is, bijvoorbeeld in de focus op het welzijn van dieren, ‘megastallen’, de menselijke gezondheid en dierziekten. Door topics te volgen in topic biografieën is het mogelijk om de verschillende niveaus waarop framing plaatsvindt terug te vinden. Daarnaast hebben we in dit onderzoek een derde soort framing geïntroduceerd, namelijk materiële framing. We stellen dat materiaaleigenschappen niet mogen worden vergeten in transitieprocessen. Het is belangrijk om heterogene actoren te betrekken en rekening te houden met de verschillende perspectieven. Verder expliciteren we dat framing een verschijnsel is dat op verschillende niveaus plaatsvindt en verandert over de tijd. De heterogene groep van actoren in agro-food systemen hebben verschillende frames, en ze moeten omgaan met deze verschillen om een innovatieproject te kunnen doorlopen. De praktische les is, dan is, dat het helpt wanneer actoren zich bewust zijn van hun eigen frames en de frames van anderen en deze expliciet maken. De concepten en benaderingen die in dit onderzoek zijn ontwikkeld zijn dan ook toepasbaar voor dit praktische doel.

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Curriculum Vitae

Joyce Zwartkruis was born on November 30th, 1983 in Nijmegen, The Netherlands. In 2003 she graduated secondary school (VWO) at Merlet College Land van Cuijk in Cuijk and started studying Organic Agriculture (BSc) at Wageningen University in Wageningen (the Netherlands). Her BSc thesis was on the effects of day care at care farms for demented elderly. After her Bachelor degree she started in 2006 her Master Applied Communication Sciences, also at Wageningen University. She did her internship with Goede Waar & Co (a Dutch organization for consumer issues regarding sustainability) and wrote her Master thesis on the knowledge and information sharing between care farmers. She graduated in 2008 and started her PhD Research in august 2008 at Innovation Studies, Faculty of Geosciences, Utrecht University. During that time she was also involved in ProUt (Promovendi Overleg Utrecht), as representative of the faculty Geosciences and member of the activities committee. At the faculty of Geosciences she was involved in UGG (Utrecht GeoGrads) as one of the representatives of the department. Since April 2013 Joyce works as a research scientist at TNO, the Netherlands Research Institute for Applied Research in the department Behaviour and Societal Sciences, in the group Human Behaviour and Organisational Innovation. Her main focus is on collaboration building.



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