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Endogenous regime change: Lessons from transition pathways in Dutch dairy farming

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ABSTRACT

Sustainability transitions are commonly considered impossible without regime change. Theoretical work on regime change has mainly focused on niches and landscapes and less on change 'from within'. Empirical analysis helps theorising endogenous regime change. Conceptualising regimes as semi-coherent entities composed of multiple 'institutional logics', we analyse the endogenous regime change in Dutch dairy farming. Practices in this sector have become more and more market-driven. This dominant logic however was increasingly challenged by institutional logics centring round cultural identity and sustainability. Tensions particularly centred round the increased indoor housing of cows. The contestation of this practice eventually led to a first 'crack' in the regime, as it weakened the dominance of the market logic and enabled opportunities for more sustainability. Our case study shows that the presence of alternative institutional logics is necessary to crack the regime, but opportunities to patch it back together are similarly crucial to enable sustainability transitions.

1. Introduction

It is commonly assumed that sustainability transitions - the large-scale adoption of cleaner or otherwise more sustainable technologies or practices - require radical, deep-structural transformations (Markard et al., 2012; Köhler et al., 2019). The underlying assumption is that unsustainable consumption and production processes prevalent in many industries cannot be improved by incremental changes or mere technological fixes but instead require systemic change in markets, technologies, policies, regulations, networks and cultural expectations.

Different theoretical frameworks have been developed to conceptualise transformative, systemic change towards more sustainability. One of the most prominent frameworks is the *multi-level perspective* (MLP) (Rip and Kemp, 1998; Geels, 2002). It understands transitions as resulting from the interplay of three different levels: socio-technical regimes (hereafter: regimes), technological niches and the socio-technical landscape. A regime is *"the 'deep structure' that accounts for the stability of an existing socio-technical system. It*

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refers to the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems" (Geels, 2011, p. 5). Technological niches refer to protected spaces where more radical innovations can develop outside of the pressures of the dominant regime (Smith and Raven, 2012). The socio-technical landscape refers to external pressures and macro developments. According to the MLP, a transition represents a shift from one regime to another because new, more sustainable niche alternatives put bottom-up pressure on the regime, while landscape forces exert top-down pressures and create windows of opportunity for niche diffusion.

Many studies have analysed the interplay between these three levels, showcasing different transition pathways like transformation, technological substitution, reconfiguration and de-alignment and re-alignment (Geels and Schot, 2007). While these pathways are shaped by the interplay of all the levels, empirical studies have tended to focus on niche activities while ignoring regime particularities and their implications for transition dynamics. By emphasising sources of change *outside* the regime, there has been a tendency to neglect a more endogenous conceptualisation of change, i.e. change from *within* the regime. This has led to some criticism and increasing efforts to reconceptualise regimes (Berkhout et al., 2004; Smith et al., 2005; Schot and Geels, 2008) and a range of empirical studies that started to assess regime dynamics more closely (e.g. Karltorp and Sandén, 2012; Ottosson and Magnusson, 2013; Geels et al., 2016; Dzebo and Nykvist, 2017; Van Welie et al., 2018). Two main research approaches can be identified that have stood out in this regard. On the one hand, there is a focus on understanding the destabilisation of regimes by highlighting ongoing decline processes in established industries and reflecting on incumbent actors' responses to various pressures (Turnheim and Geels, 2012 and 2013). This perspective highlights the processes going on within the regime that are triggered from a range of internal and external pressures, e.g. technological performance problems or economic and socio-political pressures. As such, it analyses the role of various incumbencies within systems for maintenance or decline. On the other hand, there are contributions that aim to improve our understanding of the structural preconditions of regimes and their transformative capacity (Fuenfschilling and Truffer, 2014; Fuenfschilling, 2019). These contributions are geared towards a better understanding of the nature of the regime as such and they try to conceptualise the characteristics of different regimes and their potential for maintenance or change. These studies usually put forward an institutional conceptualisation of regimes that allows for a more nuanced understanding of the 'dominant rules of the game' within a system. Fuenfschilling and Truffer (2014), for instance, strengthen the institutional character of the regimes by describing the 'rules of the game' as 'institutional logics'. They argue that a promising starting point to understand endogenous regime change is to conceptualise regimes as 'semi-coherent' entities that entail endogenous sources for change. Semi-coherence refers to the co-existence of multiple institutional logics within a regime that offer different behavioural rationalities. Studying the Australian urban water sector, the authors show that the diffusion of a specific technology (seawater desalination) has been dependent on the availability of different institutional logics in the regime. However, this is only one case study and more empirical evidence is needed to understand the effect of different types of semi-coherence on regime change and on transition pathways.

Against this backdrop, this paper analyses the transformations in the Dutch dairy farming sector over the last two decades. We raise the question: What is the role of semi-coherence within socio-technical regimes in sustainability transitions, learning from dairy farming transitions in the Netherlands? Practices in this agricultural subsector have become increasingly market-driven and 'productivist' (CBS, 2017a). We show how this once dominant productivist logic in the Dutch agri-food sector was challenged by new institutional logics centring around cultural identity and sustainability values. Tensions between the logics became particularly manifest because of a specific practice following from the market logic: the increased indoor housing of cows at the expense of grazing. The resulting dynamic between the logics subsequently enabled regime change and opportunities for changes towards more sustainability.

2. Theoretical framework

In the past years, several scholars have contributed to a better understanding of socio-technical regimes by drawing on different strands of institutional theory (Smink et al., 2015; Brodnik and Brown, 2017; Fuenfschilling and Binz, 2018; Ghosh, 2019), which has provided valuable insights into how regimes can provide openings for change and sustainability transitions. An important insight from institutional literature is that regimes are semi-coherent sets of rules rather than monolithic and homogenous incumbent structures, which is often the assumption in many empirical studies in transition research (Geels, 2011). This semi-coherence is argued to have implications for agency, innovation and regime change and ultimately for transitions in terms of the large-scale adoption of cleaner or otherwise more sustainable technologies or practices (Fuenfschilling, 2019). The lens of semi-coherent regimes may also help to shed light on why certain regimes seem to transform more easily than others and why the same landscape pressures have different effects on regimes and lead to diverse transition pathways.

In this paper, we follow Fuenfschilling and Truffer (2014) and use 'institutional logics' to conceptualise the semi-coherence of regimes. Institutional logics represent different rules of the game of a regime and specific rationalities that guide behaviour. They are the *"organizing principles that govern the selection of technologies, define what kinds of actors are authorized to make claims, shape and constrain the behavioral possibilities of actors, and specify criteria of effectiveness and efficiency"* (Lounsbury, 2002, p. 255). The original concept of institutional logics (Friedland and Alford, 1991; Thornton and Ocasio, 2008) is closely related to the idea of' economies of worth' by Boltanski and Thévenot (2006; original 1991). In essence, both approaches argue that there are a limited number of ideal-typical rationalities that actors can draw from to justify and legitimate their actions. Each logic or order of worth is rooted in different societal institutions and philosophical strands that often compete for legitimacy and that can be in conflict with one another. Applying these insights to the study of socio-technical transitions means understanding the set-up of regimes with regard to the relevance and impact of different logics. Two characteristics of institutional logics are important indicators for the nature of the semi-coherence of a regime:

1 Their *institutionalisation*. Regimes and their corresponding logics usually develop over a long period of time. It often starts with a few random and unstable relationships between system elements (actors, institutions, technologies) which, over time and with lots of effort by a range of different actors, consolidate into stable patterns of interaction. Fuenfschilling and Truffer (2014) describe that process as increase in impact of an institutional logic on the behaviour of actors and the diffusion of practices. The larger the institutionalisation, the bigger its impact and the harder it is to deviate from it (Tolbert and Zucker, 1999). There are different indications how to spot the degree of institutionalisation of an institutional logic: the scale and scope of diffusion (e.g. across different sectors and industries), duration of existence (e.g. how long a system has been guided by the same rules), invulnerability to social intervention (e.g. resistance to change) or starkness (e.g. low dissent and controversy) (Scott, 1987). But institutionalisation can also be seen in the translation of rules into practice matters, for instance in the form of corresponding laws, technologies, material infrastructure, financial investments or routinised practices (Hajer, 1995).
2 Their *degree of coherence*. Regimes may differ in the number of different institutional logics as well as whether or not they are aligning, competing or just co-existing. In institutional theory, this has been discussed under the label of 'institutional complexity' (Greenwood et al., 2011; Raynard, 2016; Zietsma et al., 2017). One hypothesis is that systems with more logics allow for deviating actions (i.e. more agency), which in turn can increase chances of structural change in the ways in which sectors operate (i.e. transitions). A broader range of institutional rationalities in a system increases the scope of legitimate actions and practices, because actors can draw from different logics to justify their behaviour. The degree of competition and alignment between logics varies from case to case. Regimes can be assumed to evolve on a spectrum from rather unitary (one coherent institutional logic or reinforcing alignment between logics) to highly contested (conflicting logics) as well as fragmented (different logics co-exist for different tasks in the system).

Thus, depending on the type of semi-coherence in terms of degree of institutionalisation of individual institutional logics and the degree of coherence between different co-existing logics, different opportunities for regime change and for transition pathways are to be expected (Fuenfschilling, 2019).

3. Methodology

3.1. Justification of the case study

We chose for a single case study to explore in more detail internal regime dynamics and how they relate to sustainability transitions. Case study research, and particularly the in-depth study of single cases, can play an important role in generating new hypotheses and critically testing existing theories (Flyvbjerg, 2006).

The case central to this paper attracted the attention of the first author of the paper, whose research focuses on transitions towards agricultural sustainability. He observed that the efforts to promote grazing were both inconsistent with the ongoing intensification paradigm in Dutch dairy farming *and* largely made by regime actors. Discussions with the now co-authors who are experts in transition studies and innovation theory made clear that this case could contribute to a better understanding of endogenous regime change in relation to sustainability transitions.

3.2. Data collection

The primary data collection methods employed in our in-depth case study of Dutch dairy farming include desk research and interviews. Desk research contained a general survey of Dutch newspaper articles published in Nexis Uni, a database of newspaper articles, and a complementary search on the internet (employing 'weidegang' and 'beweiding' – i.e. grazing – as key search terms because these terms were most often employed in the debate) in order to (1) develop a timeline of events related to the increased contestation of the practice of increased indoor housing of dairy cows and (2) to identify the actors involved, characterise the regime and explore its logics. After desk research, a total of 20 interviews were conducted with key players representing the different logics within the Dutch dairy farming regime as well as with people who were not actively representing (or advocating) a particular logic but had a thorough overview of the dairy farming sector (being for instance researchers). The 20 interviewees represent the main actors in the dairy farming regime: farmers, their interest groups, dairy processors, retailers and their interest group, banks, NGOs, the Ministry of Agriculture, researchers, and the 'Grazing Foundation' which was established as part of the efforts to promote grazing (see Annex 1). The interviews were based on a semi-structured questionnaire (see Annex 2). They served to complement the reconstructed timeline of events (see Annex 3) and aimed at exploring explanations for the dynamics related to the contestation of indoor housing of cows, expectations regarding indoor housing and grazing in the future and wider implications of the dynamics around indoor housing for Dutch dairy farming. The 20 interviews were summarised in brief documents in which the responses were organised round the questions from the questionnaire. These summaries were sent back to the interviewees for a factual check. 13 interviewees responded with some revisions or additional information or agreed with the interview reports. We included some quotes in the timeline in Section 4 to illustrate how respondents perceived particular events, in their own words in order to avoid bias from the part of the researchers.

3.3. Data analysis

We analysed the regime dynamics by means of an event analysis (cf. for instance Chappin et al., 2008 and Van Herten and Runhaar, 2013). We first reconstructed a timeline of events as a starting point for our analysis. The timeline was based on desk research, supplemented with data from the interviews (see below). We only included 'main' events. Events were considered 'main' if they directly revealed or contributed to the contestation of indoor housing in terms of conflicting logics or if they led to substantial action aimed at promoting grazing (in this context an action such as commissioning research was not considered a 'main event').

We analysed the interviews as follows. First, we used the responses to verify our observation that the efforts to promote grazing did not fit into the increasingly market-driven and 'productivist' way of working in dairy farming. Second, the interviews were used to validate and complement the timeline of events, not only in terms of *what* had happened but also *why*, in order to help articulating the institutional logics and to identify other factors that had contributed to the regime change at issue. Third, we analysed the responses to our question about the expected durability of the regime change in Dutch dairy farming, to verify whether or not it really represents a transition.

After having reconstructed the timeline of events, we interpreted the dynamics in terms of our analytical framework during several discussions in the author team. The identification of logics was partly based on previous research (i.e. the 'market logic' from Fuenfschilling and Truffer, 2014) and partly labelled by us (the 'cultural identity' and 'sustainability' logics). Document analysis and the interviews facilitated the identification of arguments employed in favour of and against indoor housing of dairy cows and grazing. This in turn allowed us to refine and characterise the logics present. The degrees of institutionalisation and coherence of the logics at issue, as well as how they were connected to the regime dynamics shown in the timeline of events were determined by the author team during several discussions.

4. Results

4.1. Contextualisation

4.1.1. An overall picture of the dairy farming sector

Dairy farming is a major land use in the Netherlands, encompassing about half of the total area in use by the agricultural sector and about 30% of the Dutch land surface (CLO, 2016; Van Schooten et al., 2018). In 2019, the subsector existed of approximately 16,000 dairy farms with about 1.6 million cows (excl. calves) (Agrimatie, 2020).

Because of the commodity character of milk, the large export orientation and the concentrated Dutch retail sector, most dairy farmers are price-takers and therefore aim at maximising production per hectare and per animal (Erisman et al., 2016; see also Bouma et al., 2019). For this purpose, there is a strong reliance on grassland monocultures (perennial ryegrass) and feed grain and on external inputs such as fertiliser to overcome local environmental limits. Grassland productivity is further enhanced by lowering water tables, facilitating mowing and managing the land, and the removal of landscape elements such as hedges and hedgerows (Van den Noort, 1987; Erisman et al., 2016). This all fits in what is called the 'productivist' agricultural paradigm (Duru et al., 2015). Prices on the international level have been highly volatile (Agrimatie, 2019), which provides an incentive to further increase productivity and agricultural intensification (Brouwer et al., 2017). As a result, productivity is high and has been steadily increasing (CBS, 2017a). For instance, between 1980 and 2016, average milk production per cow increased from almost 5000 litres a year to 8200 litres a year (CBS, 2017b) and even more than doubled since 1950 (CBS, 2017a).

There is an ongoing trend of scale enlargement (see Fig. 1). Keizer and Emvalomatis (2014: 38) state *"(…) larger farms are more likely to prosper in the Dutch dairy sector. This is because they appear to be experiencing faster productivity growth over time and, therefore, any productivity gap between large and small farms is widening"*.

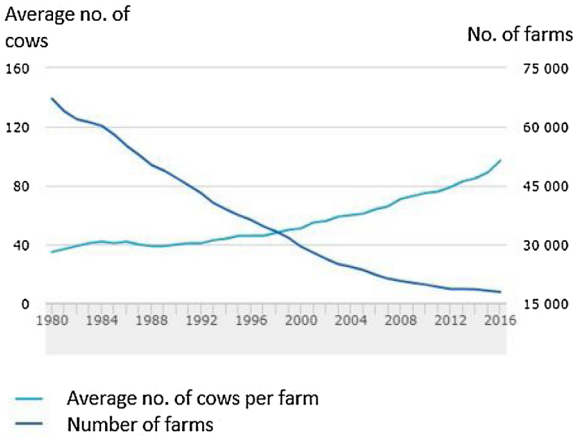


Fig. 1. Trends in number of dairy farms and farm size.
Source: CBS (2017b).

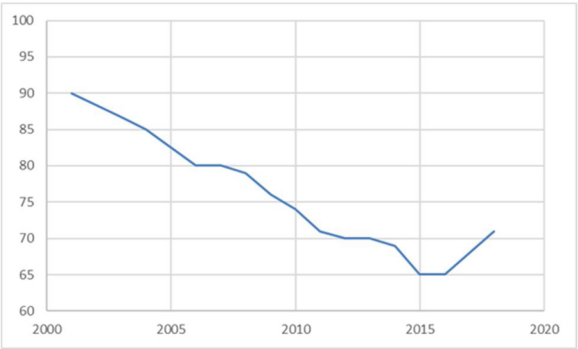


Fig. 2. Trends in grazing instead of indoor housing of dairy cows in the Netherlands (in % of all cows).
Source: CBS (n.d.).

National and European legislation aims at keeping the sector within environmental limits and limits the growth of the livestock as well as intensity of farms by requirements regarding the amount of farmland vis-à-vis herd sizes (Keessen et al., 2011; Groeneveld et al., 2016). Legislation is not always effective though, largely because of the large livestock size and a constant pressure to increase production (Keessen et al., 2011). Ongoing intensification also negatively affects biodiversity and limits possibilities for farmers to positively contribute to biodiversity (Runhaar et al., 2018).

4.1.2. The turn in grazing practices

The trend towards increased indoor housing of cows at the expense of grazing fitted the 'productivist' agricultural paradigm. Already from the early 1990s but especially since the 2000s an increasing number of dairy farmers started to stop grazing their cattle and to adopt indoor housing practices (see Fig. 2). Increased indoor housing particularly was observed among large farms (Van Bruggen and Faqiri, 2015). Among dairy farmers who continued grazing, a decline in 'unrestricted' (i.e. day-and-night) grazing was observed (CBS, 2020). The trend of increased indoor housing of dairy cows is not unique to the Netherlands but has been observed in North-West Europe in general (Gassler et al., 2018; Van den Pol-van Dasselaar et al., 2020).

There were several reasons why dairy farmers started to adopt indoor housing practices. One, it contributed to maximising milk production by optimising feeding (interviewee 7). Two, it allowed controlling manure processing, in view of legislation (Van Bruggen and Faqiri, 2015). Three, it required less labour for fetching the cows for milking (Gassler et al., 2018). Four, the increased adoption of Automatic Milking Systems favoured indoor housed systems (Van Bruggen and Faqiri, 2015; interviewee 7; 16)[1] . Five, it was stated that grazing leads to a poorer utilisation of the production capacity of grasslands as opposed to indoor housing in combination with grass mowing (Van den Pol-Van Dasselaar et al., 2002). Six, an increase in indoor housing of cows has also been related to the ongoing scale enlargement. As farms grow in herd size, so does the need for extra grasslands in the direct vicinity of the farm. If extra land is not available, grazing will be reduced or stopped (interviewee 16; Van den Pol-Van Dasselaar et al., 2015).

Several studies foresaw a substantial decline in grazing, in the Netherlands and elsewhere in North-West Europe, because of reasons mentioned above and further intensification (e.g. Gies et al., 2013; Reijs et al., 2013). In fact, the trend towards increased indoor housing is still continuing in the majority of European countries (Van den Pol-van Dasselaar et al., 2020). The promotion of grazing went against the trend towards more indoor housing, as was confirmed by all our interviewees. As one of them stated, promoting grazing *"was rowing against the current"* (interviewee 6). The resulting increase in grazing (see Fig. 2) therefore can be considered as a trend reversal. We consider it a *sustainability transition* as it represents the adoption of practices that overall are more sustainable than the indoor housing of cows. An important aspect is animal welfare – grazing allows cows to express their natural behaviour (Charlton and Rutter, 2017). Grazing also leads to lower levels of mastitis and a lower risk of claw problems (Arnott et al., 2017). However, grazing does increase the risk of disease introduction due to infections with specific pathogens like worms (Borgsteede and van der Burg, 1982). Grazing results in large fluctuations in the composition of the diet due to continuous change of supply and quality of grass as a result of factors such as weather conditions, stage of growth, species composition and sward nutrition. Large fluctuations in the composition of the diet negatively influence animal welfare, especially if the cows are very productive (Huyghe et al., 2014). From an environmental perspective, grazing has positive and negative sustainability effects. On the one hand, grazing leads to lower ammonia emissions, lower energy consumption, lower CO_2 emissions and lower methane emissions. On the other hand, grazing leads to more nitrate leaching, more denitrification, higher nitrous oxide emissions and more nitrogen losses (Thomet et al., 2011; Meul et al., 2012; Van den Pol-van Dasselaar et al., 2020). Finally, grazing has a positive influence on biodiversity (Klimek et al., 2007; Metera et al., 2010). Whereas the above shows there are both positive and negative sustainability effects associated with grazing, Dutch citizens seem less nuanced and simply consider grazing as sustainable (Gies et al., 2013).

[1] Automatic Milking Systems are the second most popular milking system, applied by some 24% of all dairy farmers (www.stichtingkom.nl/index.php/stichting_kom/category/statistiek).

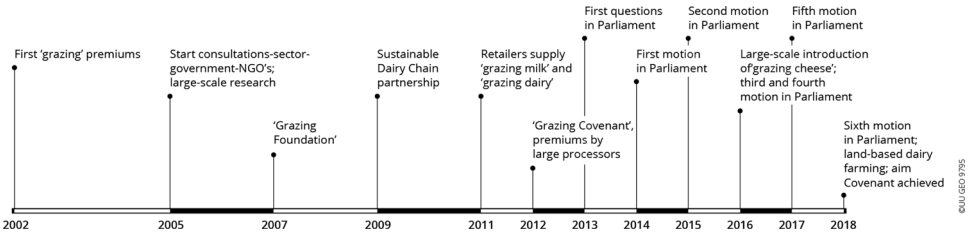


Fig. 3. Timeline of main events in the grazing debate.
Source: authors.

4.2. Timeline of events

Fig. 3 visualises the timeline of the main events related to the increased contestation of the trend towards increased indoor housing of cows. See Annex 3 for a more detailed timeline including all identified events and sources. The timeline shows an increasing contestation of the trend towards outdoor grazing, a growing realisation among regime actors that action was needed to maintain legitimacy and the resulting actions that were implemented, eventually contributing to an increase in outdoor grazing.

4.2.1. 2002: First premium for grazing

A relatively small dairy processor[2], specialised in cheese production and supplied by a few hundred dairy farmers, was the first to introduce a premium for farmers who continued grazing[3] . An interviewee mentioned several motives for this premium. One motive was a growing concern about the image of the sector due to declining grazing practices and increased intensification. Another motive was that 'grazing cheese', that is, cheese made from milk from grazing cows, was also considered to be a good opportunity to brand their cheese. According to one of the interviewees, grazing namely positively contributes to the taste and quality of cheese, which started to get at risk as a consequence of declining grazing practices (interviewee 4) Next to the premiums, the dairy processor supports farmers to integrate grazing by providing advice and stimulating peer-to-peer learning about for instance how to combine Automatic Milking Systems and grazing (interviewee 4).

4.2.2. 2005: Start consultation about grazing and large-scale research

In 2005 two environmental NGOs started campaigning to stop the decline in grazing (interviewee 10). Concerns about this trend had particularly to do with a perceived decrease in animal welfare: "*in stables, cows have few opportunities to turn around, suffer from foot problems and have no possibilities to avoid each other, which complicates the hierarchies in herds*" (interviewee 10). Indoor housing was also associated with large-scale farming, mega stables and other signs of agricultural industrialisation (Groeneveld et al., 2016). There were concerns that dairy farming would follow the industrialisation path of poultry and pig farming where indoor housing had become standard (interviewee 2; 5; 8) and which not only had raised concerns about animal welfare but also about the environmental impacts due to the high input/high output character of intensive livestock farming, health risks and nuisance (interviewee 9). The negative image of industrial livestock farming was reinforced by large-scale culling of cattle after the BSE crisis and the outbreak of foot and mouth disease.

The environmental NGOs used the promotion of grazing as an icon to put pressure on the sector and politicians to stop or attenuate scale enlargement and agricultural intensification (interviewee 9). This icon was deliberately chosen because many Dutch citizens enjoy seeing cows in pastures, which they associate with typical Dutch cultural landscapes (see Driessen, 2005; Boogaard, 2010; Boogaard et al., 2011; Gies et al., 2013; Reijs et al., 2013). In a survey of Dutch citizens in 2007 for instance a large majority of the respondents stated to enjoy watching cows in pastures (Ettema, 2007).

The dairy sector was said to be well aware of the growing societal and political concerns about indoor housing and grazing (interviewee 4; 5; 6). Farmer interest groups and dairy processors realised that following the development paths of pig and poultry farming, which had completely switched to indoor housing of animals, had become very intensive and completely lost their land-based character, should be avoided (interviewee 2; 4; 5; 7; 8; 12). It was felt that retaining 'visibility' was important: *"if citizens no longer see cows in pastures, they will start asking questions"* (interviewee 5). This was also recognised by the then Minister of Agriculture: *"the visibility of the dairy farming sector has been reduced because of the decline [in grazing] and that is undesirable"* (Brouwers, 2007: 12; in the same vein see Van Wijk-Jansen, 2011). However, the gradual decline in grazing suggests that concerns about the sector's legitimacy were not always felt at the level of individual farmers.

After the two NGOs submitted a petition to farmer interest groups, an agreement was made to discuss the decline in grazing together with the government (interviewee 10). As from 2005 onwards the two environmental NGOs, the government and farmer interest groups started consultations to discuss how the decline in grazing and could be halted (interviewee 10).

In 2005, the Minister of Agriculture commissioned a project to study the effects of new manure legislation on the dairy sector. This study was requested by some Members of Parliament who feared the new legislation would promote indoor housing of cows (De Haan

[2] The company processes about 3% of all milk produced in the Netherlands (Brouwer et al., 2017).
[3] The premium initially was 0.50€ per 100 kilogrammes of milk, which was doubled in 2016 and again doubled in 2017 (Brouwer et al., 2017).

et al., 2005; interviewee 1; 16). Furthermore, a large project was launched, Koe & Wij, that focused on four farm conditions that were expected to complicate grazing, i.e. large herds, high milk production, land fragmentation and Automatic Milking Systems. The project also aimed to raise awareness among farmers about the possibilities of grazing (interviewee 18). During the project, which ran until 2008, researchers spoke with one third of all Dutch dairy farmers (interviewee 16; 17; 18).

4.2.3. 2007: The Grazing Foundation

Initiated by dairy processors, farmer interest groups, retail organisations, banks and other stakeholders (such as a nature reserve area manager), a Foundation was established with the specific aim to financially support farmers who continued applying grazing practices and supporting farmers who have stopped or reduced grazing in 2007. There was limited interference from the government (Brouwers, 2007; interviewee 8). Board members included representatives from the dairy chain, environmental NGOs, nature reserve area managers and banks. With the establishment of the Foundation also a fund was formed to which (some of the) participating actors contributed (e.g. dairy processors, retail, banks and the government) (Brouwers, 2007).

The Foundation played an important role in initiating activities that stimulated grazing, e.g. research (in majority funded by the sector and by the Ministry of Agriculture) to produce knowledge on grassland management and the development of practical guidelines (interviewee 1; 2; stichtingweidegang.nl). The Foundation also introduced so-called 'grazing advisors'; people who provided advice to farmers about how to integrate grazing in their operational management (interviewee 1; 2; 6; stichtingweidegang.nl). About 30 advisors were trained, in part paid for by the Ministry of Agriculture (Brouwers, 2007). These advisors were field service employees from dairy processors, feed suppliers, veterinarians etc. (Brouwers, 2007; interviewee 2; 6). By 2014, 400–500 dairy farmers participated in meetings organised by the advisors, thereby learning about grazing and putting this new knowledge directly into practice on their farms. In later years the number of participating farmers further increased.

The Foundation also successfully lobbied for the appointment of professors at Wageningen University and at a University of Applied Sciences. Partly due to the lack of new knowledge in the period 1985–2005, grassland management had become a minor theme in agricultural education. The renewed societal and scientific interest in grazing and in grassland management more generally over time resulted in appointments of professors (2015 and 2019) and new knowledge that was subsequently integrated in teaching programmes at Dutch agricultural universities and Universities of Applied Sciences and at vocational schools. This assisted in bringing back this subject in agricultural education programmes (interviewee 1; 2; 10; 16; 17; 19).

4.2.4. 2009: The Sustainable Dairy Chain partnership

Dairy farmers, dairy processors and their representatives started a partnership in 2009 in order to contribute to more sustainability in the dairy sector. Stimulating grazing was and still is one of the four key objectives for a more sustainable dairy farming sector (duurzamezuivelketen.nl; interviewee 6).

4.2.5. 2011: Retailers start supplying 'grazing dairy'

In 2011 two retailers announced that they would start supplying 'grazing milk'. In 2012 a large retailer followed their example. Retailers had several motivations to do so. First, because of their involvement of the development of the Grazing Covenant (see below). Second, as interviewees explained because they wanted to contribute to more sustainable dairy farming, which in their view included grazing. Third, at that time, milk prices for farmers and margins for retailers were low and the supply of 'grazing milk' was considered a commercial opportunity to set better prices. (interviewee 11; 12; 13; 15) This was supported by various surveys that showed that many Dutch citizens enjoy cows in pastures and that many citizens were willing to pay a bit extra to keep cows in pastures (e.g. Van den Pol-Van Dasselaar et al., 2002; Ettema, 2007).

4.2.6. 2012: The 'Grazing Covenant'

In 2012, representatives from a large farmers' interest group, dairy processors, feed suppliers, retailers, government, veterinarians, NGOs, research and educational institutes and other stakeholders signed a covenant in which they aimed for enhancing grazing, the 'Grazing Covenant'. The aim was to stabilise the percentage of dairy farmers that practise grazing. This translated into a formal goal of 81.2% of all dairy farms having their cows graze outdoors for minimally 120 days a year, 6 hours a day, which was the situation in 2012 (www.duurzamezuivelketen.nl/onderwerpen/convenant-weidegang/)[4] .

A broad coalition was formed because it was said that farmers, farmer interest groups and dairy processors realised they alone could not achieve a trend reversal in indoor housing of cows (interviewee 2; 8). A business model was needed in combination with commitment from the whole dairy chain, including retailers. (interviewee 8). Advisors continued to be needed to advise in favour of grazing and give specific advice about how to integrate grazing in operational management etc. (interviewee 2).

Since 2012 new participants joined the Grazing Covenant. In 2017, 73 parties had joined the covenant (DZK, 2017). In 2019 this number had increased to 83.

The Grazing Covenant has led to a variety of activities, coordinated by farmer interest groups (interviewee 6). The activities include the recruitment of new partners, organising meetings with covenant partners, collecting data about grazing for monitoring progress towards the objective agreed upon, registration and certification of farmers and finally political lobby (interviewee 6; www.duurzamezuivelketen.nl/onderwerpen/convenant-weidegang/).

[4] In Winter cows are often kept in stables because grass does not grow and the fields are often too marshy (DZK, 2017).

4.2.7. 2012: Large-scale introduction of grazing premiums

In 2012 the largest dairy processor introduced premiums for grazing, followed by other processors. The decline in grazing had been a concern for the largest processor for some time. The announcement that in 2015 the milk quota would be abolished raised extra concern. Because of the abolishment both milk production and indoor housing of cows were expected to increase, which subsequently would amplify societal concerns (interviewee 2). The company as well as other processors and farmer interest groups did not want to follow the development path of pig and poultry farming (intensification, mega stables that met a lot of critique)(interviewee 2; 4; 5). The company also realised there was a market for dairy based on grazing (interviewee 2). This was confirmed by a public opinion study conducted in 2011–2012 (interviewee 3).



www.weidemelk.nl/nl/stichting.html

The premium started with 0.5 euro/100 kilogrammes of milk (interviewee 2). The premium was increased a few times and since 2017 is €1.50 per 100 kilogrammes of milk for dairy farmers who have their cattle graze 120 days a year, 6 hours a day, and €0.46 per 100 kilogrammes of milk for part-time grazing. The premium is financed by redistributing income from dairy sales ('bonus-malus'); farmers with indoor housing receive a lower milk price. In 2017 and 2018 the largest dairy producer actively approached farmers who did not practice grazing (interviewee 16). Hundreds of them have received tailor-made advice or visited specific 'grazing seminars'. Since the introduction of the premium, the largest dairy producer observed an increase in grazing among its supplying farmers (Friesland Campina, 2018).

In 2018, all dairy processors have implemented premiums for grazing (interviewee 11; 16). Grazing has become the norm in the supply of milk to retailers (interviewee 12).

Retailers (and eventually consumers) paid a premium for grazing milk. This premium, however, was not considered to be enough to abandon the bonus-malus arrangement dairy processors had implemented, in part because a substantial part of the milk produced in the Netherlands is exported (interviewee 2; 6).

4.2.8. 2013: Parliament becomes active

As from 2013 several Members of Parliament started asking questions to the Secretary of State about grazing. Initially they asked for information and about the position of the Secretary of State regarding the subject. In 2014 several Members of Parliament submitted a proposal for new legislation aiming at a 'responsible growth in the dairy farming sector' in which they asked the Secretary of State to discuss the enhancement of grazing with the sector and either examine the possibilities for a legal requirement for grazing or even implement such a requirement. This motion got a majority in Parliament and was accepted. In response, the Secretary of State did not implement a legal requirement for grazing, but promised to start the discussion with the dairy sector, provinces and stakeholders about possibilities for enhancing grazing, as well as about how to retain the land-based character as a condition for grazing. In 2015, three Members of Parliament requested a legal requirement for grazing, which did not receive a majority in Parliament. In September 2016 three Members of Parliament submitted a proposal for a new law that would make grazing mandatory. Although it was not accepted, it increased pressure on the sector to enhance grazing and also motivated more sceptical farmers to (re)consider grazing (interviewee 2; 6; 8). The Secretary of State supplied further funding for projects to stimulate grazing and research. In December two amendments were submitted for the proposed new legislation about phosphate rights to promote grazing. In 2017 some Members of Parliament successfully submitted a motion that requested the Secretary of State to study the possibility for a legal requirement for grazing. This request was fulfilled; however the Secretary of State left it to the dairy sector to achieve its objectives before 2020, otherwise additional measures would be taken. In the dairy sector, it was felt that the political debate about a legal requirement *"had become serious by now"* (interviewee 6).

4.2.9. 2015: Extensive research on grazing completed

Since 2001 various studies have been conducted on grazing, for instance about how to combine grazing with Automatic Milking Systems. Much of this research had a practical orientation and was aimed at stimulating and developing craftmanship. It was observed that much efforts have been made to disseminate the knowledge that was produced (interviewee 16). A good example was the extensive research on the combination of automatic milking and grazing that was completed with practical guidelines and five grazing concepts, that could easily be implemented.

4.2.10. 2015: New poll among Dutch citizens about grazing

In December 2015 the results of a poll among Dutch citizens was published which showed that over 70% of them stated to be prepared to pay more for their milk in order to keep cows in pastures. This was picked up by various media, particularly in the dairy sector itself, although it was also recognised that what consumers state that they are willing to pay does not always what they actually are prepared to pay (interviewee 7; 16).

4.2.11. 2015: End of the EU milk quota regime

The milk quota regime was first introduced in 1984 to stabilise dairy production. The first discussions to end the milk quota started in 2003 in order to provide EU producers with more flexibility to respond to a growing demand, especially on the world market (EC, 2015). Interviewees explained that many farmers experienced the end of the milk quota regime as *"liberating"* (interviewee 9; 10). The general expectation was that the end of the EU milk quota would threaten grazing because it would promote further scale enlargement and because grazing was more difficult to integrate in dairy farms increasing in herd size but not in grassland area (PBL, 2015).

The expected increase in milk production, however, was only temporary. Because the increase in milk production resulted in exceedance of legal phosphate limits, new legislation was implemented that implied a reduction in herd sizes. Phosphate rights were introduced that were linked to milk production per cow (a high producing cow needs more phosphate rights than a low producing cow). A potential unintended effect however was that these rights threaten grazing. It is appealing for farmers to strive for a higher milk production per cow. High producing milking cows need balanced diets and that can be more easily achieved indoors. (interviewee 16) In addition, the phosphate legislation did not remove the pressure on farmers to further intensify and enlarge farm scale, which continued threatening grazing (interviewee 16).

4.2.12. 2015: 'Early warning'

Based on provisional data about the trend in grazing mid-2015 the Sustainable Dairy Chain partnership realised that more efforts were needed to maintain and enhance grazing (interviewee 6). As a result, the project 'New Grazers' was initiated. This project focused on farms with indoor housing. The aim of the project was to support these farms to start grazing again in order to increase the percentage of grazing farms. The farmers were supported by the Grazing Coaches via FarmWalks.

At the end of 2015, it was shown that the percentage of dairy farms that practised grazing had increased slightly after a long period of decline. However, this was mainly due to an increase of farms that practised *partial* grazing.

4.2.13. 2016: Large-scale introduction of 'grazing cheese'

In 2016, a major dairy processor introduced 'grazing cheese'. This was also considered to give a substantial financial impetus for farmers to continue, intensify or re-start grazing (interviewee 1; 2).

The small dairy producer, who introduced premiums already in 2002, had started producing 100% grazing milk-based cheese a few years before, in 2012. Nowadays all cheese from this producer is made of grazing milk (interviewee 4).

At the end of 2016, it was shown that the percentage of farms that practised *full* grazing (at least 120 days of grazing with at least 6 hours grazing per day) finally increased slightly after a long period of decline.

4.2.14. 2017: The Coalition agreement

In the Coalition agreement of the new government that was published in 2017 grazing was mentioned, which emphasised its political importance, although it also stated *"The cabinet does not want a legal requirement for grazing. The sector therefore has to ensure to achieve its ow objectives in 2020"*.

4.2.15. 2018: sixth motion in Parliament; commitment to land-based dairy farming

In 2018 a motion for a legal requirement for grazing if the sector would be unable to achieve a minimum of 80% grazing cows (120 days/6 hours a day) was rejected but with a very small majority of votes (81 out of 150 votes).

In the same year, a commission, installed by farmer interest groups and dairy processors, delivered its advice on the future of the dairy farming sector. The commission's task was to operationalise 'land-based' dairy farming and to provide some action perspectives until 2015. The sector had announced beforehand to conform to the advice of this commission. The trend of decreasing grazing was implicitly framed as part of the problem of the gradual disappearance of the land-based character of dairy farming (CG, 2018: p. 9): *"Dairy farmers have invested in new and larger stables in view of increased herd sizes but did not always invest in extra land. With that, dairy farming has become more intensive, farmers had to transport manure to other farms and buy more feed from third parties. This resulted in cycles having become longer or even disrupted, which in some cases has had negative consequences for nature, environment and landscape quality."* Retaining the land-based character of the dairy sector was considered a means to an end: societal legitimacy, environmental and landscape quality and a better economic perspective for the farmer (CG, 2018). The advice was considered important for legitimising and stimulating the efforts made to enhance grazing, because retaining the land-based character of dairy farming provides an important condition for grazing (interviewee 5).

During fall 2018 the new Minister of Agriculture presented her vision on the future of Dutch agriculture in view of the sustainability challenges the sector and Dutch society were faced with. She pleaded for a transition towards a more circular agriculture, with lower environmental pressure and an enhanced contribution to biodiversity. Retaining the land-based character of dairy farming and enhanced grazing were explicitly mentioned.

4.2.16. 2018: The aim of the Grazing Covenant achieved

December 2018 it was announced that the formal objectives of the Grazing Covenant were achieved – 82% of all Dutch dairy farmers practised grazing according to the minimum requirements. Particularly among large farms (100–200 cows and ≥ 200 cows) the increase in grazing has been relatively large, which is remarkable because the trend of increased indoor housing was particularly notable among large farms (Van Bruggen and Faqiri, 2015)[5] .

Figures from 2019 show a further increase in grazing (see Fig. 2). The question is however whether the trend reversal in indoor housing is temporal or structural. None of our 20 interviewees expected grazing would decrease again in future, for various reasons. First, grazing has become institutionalised via the Grazing Foundation, the Grazing Covenant, the dairy market, the integration of grazing in teaching programmes etc. In other words, a solid basis exists to support farmers via knowledge, money and societal recognition (interviewee 2; 6; 8; 9; 10; 18). Continued efforts to support and promote grazing by means of these institutions are considered necessary however (interviewee 2; 4; 5; 6; 15). Second, the apparent willingness-to-pay for grazing dairy and the observed norm of grazing in the supply of milk and other dairy products to retailers is considered important for the continuation of grazing practices (interviewee 1; 3; 11; 12). Third, a majority of the Dutch dairy farmers has never abandoned grazing completely and is expected to continue that practice (interviewee 15). Fourth, the sectoral commitment to preserving the land-based character of dairy farming provides an important precondition for grazing (interviewee 2; 7; 8; 10; 11; 17). Fifth and finally, there is still the threat of a legal requirement if grazing will drop again (interviewee 1; 16).

5. Discussion

5.1. Analysis of institutional logics in Dutch dairy farming

From the timeline of events we observe multiple institutional logics. A substantial part of the dairy farmers operates according to the 'productivist' (or 'industrial') paradigm which fits within what Fuenfschilling and Truffer (2014) labelled as a *market logic*. This logic is strongly export-oriented and aims at maximising production per hectare or per animal whilst minimising costs. The trend towards increased indoor housing of cows fits within this market logic (see the arguments in favour of indoor housing in Section 4).

The market logic is not the only logic at play. Sustainability concerns related to environmental impacts and animal welfare have gained traction when the trend towards increased indoor housing started, particularly as from 2005 when two NGOs started campaigning to halt the decline in grazing. From that time onwards, NGOs, government and representatives from the dairy sector started consultations to discuss the decline in grazing, which put the *sustainability logic* on the table. This sustainability logic (see also Rawles, 2010) manifests itself in different ways than the market logic. There is a close link with policy and legislation that aims at keeping the sector within environmental limits and that limits the growth of the livestock as well as intensity of farms (see Section 4.1). Section 4 shows that the sustainability logic was increasingly voiced by environmental and animal welfare NGOs and by some political parties. This logic centres round *perceived* sustainability rather than about *actual* sustainability because grazing has both positive and negative environmental impacts (see Section 4.1).

Finally, our timeline shows that a third logic came into play that is rooted in *cultural identity*. Many Dutch citizens enjoy seeing cows in pastures, which they associate with typical Dutch cultural landscapes (Driessen, 2005; Gies et al., 2013; Reijs et al., 2013). A survey of Dutch citizens in 2007, for instance, clearly showed that a large majority of the respondents stated to enjoy watching cows in pastures (Ettema, 2007). The 2015 poll again stressed this cultural importance of grazing. Because of the cultural value of grazing, the two environmental NGOs organised their 2005 campaigns to stop or attenuate scale enlargement and agricultural intensification round the decline in grazing (see Section 4).

As outlined in our theoretical framework (Section 2), the semi-coherence of a regime depends on two dimensions of the institutional logics within that regime: their degree of institutionalisation and the degree of coherence of different logics. We will therefore first discuss these two dimensions of the institutional logics and then reflect on their consequences.

When the contestation of the increasing indoor housing of cows started, the market logic was strongly *institutionalised* in practices of dairy value chains and banks, in agricultural policy and in the agricultural educational and knowledge system and considered the dominant logic (see Schuurbiers et al., 2019 for an explanation how the institutionalised market logic poses barriers to change). The sustainability logic was institutionalised in part in environmental and animal welfare policy and legislation and voiced by NGOs and some political parties (e.g. the Members of Parliament who had become active as from 2013). The cultural identity logic was not explicitly institutionalised in the Dutch dairy sector: there is, for example, no obligation for grazing, in contrast to e.g. Scandinavian countries[6] . But it was voiced by NGOs and political parties. Recurrent surveys of Dutch citizens about dairy farming constitute a loose institutionalisation of the sustainability and cultural identity logics. These surveys show that many citizens subscribe to the two logics. Dutch citizens generally appreciate dairy farmers but they are also concerned about sustainability and animal welfare (e.g. Ettema, 2007; TNS, 2014, 2017). For a part of Dutch dairy farmers, a combination of the three logics (i.e market, sustainability and cultural identity logics) manifests itself at farm-level (see Section 4.1). Many farmers are aware of concerns related to the sustainability and cultural identify logics (and/or subscribe to these logics themselves; see Trouw, 2018).

The increased contestation implied a clash between the market logic on the one hand and the cultural identity and sustainability logic on

[5] It should be noted that increased grazing among large farms mainly relates to grazing during the day (also among large farms a further reduction in day and night grazing has been occurring) (CBS, n.d.).

[6] In Sweden, Finland and Norway grazing is legally required, while in Germany soft law is applied (www.nieuweoogst.nl/nieuws/2017/02/08/verplichte-weidegang-scandinavische-boeren).

the other hand. The contestation made clear that the three logics had become competitive rather than co-existing. This growing *incoherence* of the three institutional logics in Dutch dairy farming illustrates how the specific semi-coherence of a regime shapes the transition pathway of a sector. Initially, these logics co-existed with different degrees of institutionalisation. However, the increasingly dominant market logic led to the practice of a proliferation of indoor housing of cows at the expense of outdoor grazing. This shift triggered a growing incoherence in the regime that sparked tensions and even conflicts. The practice of outdoor grazing had become a boundary object (Star and Griesemer, 1989) for actors advocating a sustainability logic as well as a cultural identity logic. While the latter wanted to keep outdoor grazing because it was conceived as part of the Dutch cultural identity, the former were arguing for outdoor grazing because of animal welfare and environmental reasons. This very specific *alignment of different interests* in favour of the same grazing practice allowed actors to collectively engage in a specific form of agency: the development of new institutions, such as the 'Grazing Foundation', the 'Grazing Convention', the premiums, certification and supply of 'grazing dairy', the appointment of professors, the integration of practical knowledge about grazing and grassland management in agricultural educational programmes and the advisors. These institutions contributed to a realignment of the three logics. The result was a novel semi-coherent regime in which a new balance was found between the market logic, the sustainability logic and the cultural identity logic. The market logic was weakened as well as re-defined as a limit was set to intensification (indoor housing, retaining the land-based character of dairy farming) and although one of the main 'solutions' was market-based (the commercialisation of grazing dairy), it can be argued that it was marketing sustainable products rather than productivist practices. The sustainability and cultural identity logic gained more importance: through the mentioned new institutions, the respective logics have been institutionalised to a higher degree. The end result was a sustainability transition in the sense of the large-scale (re)adoption of grazing practices. The outcome of the growing incoherence within the dairy regime is quite different compared to pathways taken in the two other livestock sectors (pig and poultry farming), where indoor housing has prevailed[7] .

5.2. Reflection on the case study: lessons for sustainability transitions

Our case study illustrates the importance of the semi-coherence of a regime for transition pathways. Fuenfschilling and Truffer (2014) described a type of semi-coherence that favoured the diffusion of a technology (seawater desalination) that can be interpreted as entrenching the dominant logic of the system and thereby *preventing* a transition to more sustainable solutions. Our results present a case where the semi-coherence *enabled* the adoption of a practice (grazing) that can be considered to be more sustainable.

We argue that the main difference lies in the particular type of semi-coherence of a regime, i.e. the degree of alignment of institutional logics in a sector. This becomes particularly evident when looking at the alignment of logics with regard to specific practices. In the dairy farming sector, the practice of grazing served as a boundary object to reconcile the different logics. Actors were advocating for the same practice despite following very different rationales. The practice of grazing promotes ideas of the sustainability as well as the cultural identity logic, and it is not entirely incompatible with the dominant productivist logic – rather, it serves to legitimise it. In the case of the Australian water sector, in contrary, the presence of different institutional logics led to the availability of very different practices, ranging from de-centralised on-site water treatment to large-scale desalination plants. All of these technologies embodied very distinct institutional logics and were incompatible with the other logics. Picking a winner is thus directly related to the institutionalisation of a particular logic over another. In the Australian water case, no practice could serve as a boundary object to align logics in a fruitful way. As a result, there was a fierce competition over legitimate practices that was ultimately won by the technology associated with the dominant regime logic. The consequence thereof was the overall *weakening* of the sustainability logic.

The reconciliation of different institutional logics around the practice of grazing also allowed for the building of new institutions that were essential for the institutionalisation of the less dominant logics in the sector. The particular semi-coherence of the regime shaped the opportunity space for actions to engage in institutional work and exploit the 'crack' in the regime to establish a new socio-technical configuration. This change in relative importance of logics has the potential to enable further changes along this pathway. Understanding the role of practices in taking advantage of the semi-coherence of regimes by fostering alignment and reconciliation of different institutional logics is therefore important to understand the diffusion of sustainable practices, or, put in MLP terms, niche-regime interaction. More research is needed about the particular features of emerging practices that can act as such boundary objects.

Furthermore, assessing the semi-coherence of regimes helps to characterise the impact of landscape factors. It explains why certain landscape pressures are addressed in some sectors while neglected in others. We observe that the practice of indoor housing was not equally contested in other livestock sectors, such as pig and poultry farming. This can be interpreted as a direct consequence of the missing relevance of the cultural identity logic in these sectors compared to dairy farming.

5.3. Reflection on the case study: lessons for agricultural sustainability transitions

The dominance of the market logic in Dutch dairy farming, expressed in productivist farming styles, has contributed to an enormous productivity increase but has also come at a substantial cost in terms of environmental degradation, biodiversity loss, reduced landscape quality and insecure income for many farmers (Erisman et al., 2016; Runhaar, 2017). Against this background, the regime change in Dutch dairy farming can be considered as an incremental change towards sustainability: the trend reversal in indoor housing has some positive sustainability effects (see Section 4.1) and posed some limits to productivist agriculture but did not imply a

[7] The case study also showed how the dynamics in the dairy sector could not been seen in isolation of dynamics in two other livestock sectors (pig and poultry farming). This stresses the importance of the study of interactions between different types of regimes within sectors for sustainability transitions (see also Van Welie et al., 2018).

radically new, more sustainable way of dairy farming. The commitment to promoting grazing but also to preserving the land-based character of dairy farming however did mean a limit to *further* intensification and in that way prevented further biodiversity loss and other sustainability problems to some extent. At the same time, the regime change in favour of grazing may impede more substantial transitions that target the fundamental features of agri-food systems that underlie its unsustainability (Feola, 2019).

It is questionable to what extent the regime dynamics analysed in this paper could contribute to other forms of agricultural sustainability in Dutch dairy farming. The commercialisation of grazing dairy offered a way out to reconcile the three logics at play but there are serious doubts as to the question whether Dutch (and foreign) consumers are also prepared to pay for practices that for instance benefit biodiversity, such as herb-rich pastures or conservation of meadow birds (this was also confirmed by interviewee 8; 9; 11; 12; 13; 15; 16; 17; 19). Promoting other forms of agricultural sustainability therefore probably requires different transition pathways, for instance with a more prominent role for governments to initiate and direct regime change. For instance, for promoting the large-scale adoption of herb-rich pastures that potentially provide multiple services next to biodiversity (Bengtsson et al., 2019), the Ministry of Agriculture could play an active role to mobilise beneficiaries and initiate the development of new institutions to facilitate such a transition (including a payment scheme for public services such as biodiversity and landscape values).

6. Conclusion

Theoretical work on regime change thus far has only paid limited attention to understanding regime change 'from within'. We argued that the analysis of empirical manifestations of regime change helps to understand and theorise endogenous regime change. Our research question therefore was: *What is the role of semi-coherence within socio-technical regimes in sustainability transitions, learning from dairy farming transitions in the Netherlands?* We theorised that regimes that are very fragmented and conflicting provide more opportunities for agency and change because actors can draw from different logics and thus engage in more path-breaking activities. In our case study, these mechanisms were indeed found. By analysing the degree of institutionalisation and coherence of institutional logics in a sector, we have shown how a regime enables the diffusion of a practice or starts to destabilise it. While the degree of institutionalisation of a logic is an indicator for the general legitimacy of certain practices, the coherence between logics can explain the dynamics involved in their diffusion (or lack thereof). It thus provides a more nuanced account on how regimes are functioning internally, but also how they process niche development and landscape pressures.

Our analysis not only shows how a growing incoherence can destabilise regimes, but also points to the importance of finding an alignment between alternative logics to promote more sustainable solutions. Stated differently: the presence of alternative institutional logics is necessary to *crack* the regime, but opportunities to *patch it back together* are similarly crucial to enable transitions.

Future research should thus focus on how semi-coherence within a regime is introduced, managed or reconciled by actors and what type of semi-coherence is most conducive for sustainability transitions. The development of a typology of regimes with varying degree of institutionalisation and coherence could be helpful to understand the transformative capacity of various industries and explain why certain industries renew themselves more easily than others. Understanding the state and nature of a regime is also important when designing and introducing transition policy measures. Regimes that are highly institutionalised and coherent are most likely responding differently than regimes that are contested or very fragmented. Assessing the semi-coherence of regimes might thus guide policy making in order to achieve industry-specific incentives for sustainability transitions.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.eist.2020.06.001.

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