Locked-in or ready for climate change mitigation? Agri-food networks as structures for dairy-beef farming

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Abstract

Many countries have included agriculture as one of the sectors where they intend to obtain significant greenhouse gas emission reductions. In Norway, the dairy-beef sector, in particular, has been targeted for considerable emission cuts. Despite publicly expressed interest within the agricultural sector for reducing emissions, significant measures have yet to be implemented. In this paper, we draw on qualitative data from Norway when examining the extent the wider agri-food network around farmers promotes or restrains the transition toward low-emission agricultural production. A qualitative analysis based on interviews with key stakeholders from various parts of the agri-food network of dairy-beef indicates that, if it is up to the dairy-beef system itself, it will develop in the direction of continued increased production volumes and increased efficiency in production, combined with moderate measures to reduce emissions. There is an obvious reluctance to stimulate the consumer demand toward other products or meat products with reduced emissions because such a solution would complicate full exploitation of existing agricultural resources and hence could bring considerable negative economic consequences. Another factor limiting the scope and drive towards a low-carbon production is that the effects of various potential climate measures do not appear as unambiguous. Our study indicates that the dairy-beef sector will likely not reach the goal of reduced emissions from its own initiatives. Rather, significant changes would probably require both push and pull support from forces outside the agricultural system.

Introduction

While agriculture is highly dependent on and influenced by climate, it also represents a significant share of global greenhouse gas (GHG) emissions. The amount is estimated to 12-14 percent in total, where this share covers as much as 47 and 58 percent of global methane (CH_4) and nitrous oxide (N_20) emissions respectively—both gases with particularly high global warming potentials (Foresight 2011). Thus, regarding the need to stabilize the climate by reducing emissions over the long term, many countries, including the EU in its entirety, mention agriculture as one of the sectors where emission reductions are intended (Fellmann et al. 2018).

Adjustments to production at the farm level are decisive to the total emissions of GHG from agriculture. Thus, farmers seem to have a key role in overcoming the problem. Flemsæter et al. (2017) suggested that, ideally, each farmer should become a climate citizen who "acts on an individual moral obligation to take personal and non-reciprocal responsibility for a global whole" (Flemsæter et al. 2017, p. 14). However, many farmers manage quite small and vulnerable firms, and they primarily have to work out a pathway that strengthens their attempts to maintain the business' existence (Wilson 2008; Marsden 2003). Fleming et al. (2015, p. 34) pointed out that farmers prioritized financial viability before climate change: "financial stresses increase the likelihood that climate change is constructed as an issue to be denied or for action to be delayed". Flemsæter et al. (2017) also concluded that farmers' current response to climate change is weak, and this conclusion is also supported by Brobakk's (2018) study from Norway.

However, emission reductions do not necessarily depend on farmers' motivations for mitigating climate change as such. Practical, everyday farm management is shaped by a range of farm-internal but also farm-external conditions such as economic frameworks and social norms (Darnhofer et al. 2010). In relation to this, the wider system around farming becomes relevant. The present paper recognizes and emphasizes that farmers constitute one of several actor groups in a wider agricultural food system (Wilson 2008) —an agri-food network, including food production, processing, and supply (Lockie and Kitto 2000), as well as various support functions. Such networks constitute an important part of the social structure of farmers and their production. This paper explores the sort of influence that the farmers, as primary producers, are exposed to from the remaining agri-food network when it comes to meeting the governmentally

stated goal of lowering agricultural emissions. Hence, our focus in this paper is on the wider system of food production, including suppliers, processing firms, farmer unions, agricultural advisory services, education, and consumption, instead of on the farmers themselves. We draw on qualitative data from Norway when examining the following research question: To what extent does the wider agri-food network around farmers promote or restrain the transition to a low-carbon agricultural production? Despite our Norwegian focus in this case, we believe the findings are relevant and transferrable to agricultural systems elsewhere. Not least, our study demonstrates challenging aspects of sustainable transitions even in cases where progressive political goals and commitment are established at the governmental level.

We limit our focus to the agri-food network around *dairy-beef*. In Norway, dairy production and beef production constitute one system (rather than separate beef and dairy systems). More than 95 percent of dairy cows are of the breed Norwegian Red Cattle (NRF), which combines both beef and dairy into one breed (Bonesmo et al. 2013). Norwegian dairy farms are generally quite small-scale[1] and combine milk production and bull finishing. This implies that beef production is often a co-product of the dairy industry where culled dairy cows and young dairy bulls constitute the major beef sources (Bonesmo et al. 2013). In addition to combined production, to further meet the domestic demand for beef, beef production based on suckler cows is available and economically encouraged by the government, as well.

The dairy-beef production is particularly relevant for a number of reasons. First, several Norwegian reports and political documents, among them white papers on climate change in agriculture (Ministry of Agriculture and Food 2008-2009; Ministry of Climate and Environment 2011-2012), have underlined the need to cut emissions from this production. Secondly, in light of the agricultural sector's significance to the continuation of rural communities in Norway, the beef and dairy value chain is particularly important for the vitality of many communities (Almås 2004). Thirdly, Norway already imports a significant share of domestically consumed beef and, in relation to the stated policy goal of strengthening domestic production (Ministry of Agriculture and Food 2016-2017), this means there is also potential for an increase in GHG emissions from the sector.

[1] At the beginning of 2017, the average dairy farm had 26.3 cows (Norsk Landbruk 2017).

This paper is structured as follows. First, we provide a description of the climate policy for agriculture in Norway and, subsequently, a description of the Norwegian agri-food network for dairy-beef. Next, we present relevant theory on barriers for change toward a low-carbon transition. After presenting our data and methodology, we continue with our analysis of prospects for change encouraged by the dairy-beef production's agri-food network. Finally, we discuss how and to what extent the wider agri-food network of dairy-beef is locked into resisting change toward low-carbon agricultural production.

Agriculture and climate policy in Norway

The emission situation for Norwegian agriculture is quite similar to the global: Norwegian agriculture is estimated to be responsible for about nine percent of the country's GHG emissions (Miljødirektoratet 2018), while the sector's share of national CH_4 emissions is as high as 48 percent (Bonesmo and Harstad 2013). Like in many other countries, there is a stated focus on reducing national GHG emissions, including emissions from agriculture. In 2010, a requested report by the Ministry of Environment, "Klimakur [Climate Cure] 2020" (Klima- og forurensningsdirektoratet[2] 2010), included a separate section on agriculture, where numerous possible emission-reducing measures were suggested. Subsequently, a scientific assessment of some of the measures, ordered by the Agricultural Ministry, identified great uncertainties with the estimations (Aalerud and Kvakkestad 2011). Since then, considerable national resources have been invested in various climate mitigation research, and more reports on relevant measures and effects have been produced in recent years (e.g., Hohle et al. 2016; Aass and Åby 2018; Bardalen et al. 2018).

Lately, the emission situation for agriculture has become more urgent: The EU has bound itself to also making considerable reductions of GHG emissions also within non-ETS (EU emissions trading system) sectors, and through a joint fulfillment with the EU, Norway will receive a concrete national emissions goal for its non-ETS sectors. The preliminary assigned reduction

[2] The Norwegian Climate and Pollution Agency, which was merged into the Norwegian Environment agency in 2013.

goal for these sectors in Norway is 40 percent within the period of 1990-2030. Even though parts of the reduction goal may be obtained by purchasing reductions from other EU countries and/or making limited one-time purchases of quotas for emissions within these sectors (Ministry of Agriculture and Food 2016-2017), the Norwegian prime minister has stated that most of the 40 percent emission reductions within non-ETS sectors must be carried out in Norway as such (Solberg 2017). Despite these politically expressed objectives, little change and reduction have been observed. In 2018, the Norwegian Government demanded the agricultural sector to reduce its GHG emissions by five million tons of CO2 equivalents within the period 2021-2030 (Aase 2018). The following year, the government managed to establish a sort of a voluntary agreement with the farmer unions; a letter of intent was signed by the parties on June 21st, 2019, where the goal is to work toward reduced GHG emissions as well as increased carbon capture and storage in agriculture (Regjeringen 2019).

While the Norwegian Parliament has defined overall goals for emission reductions, national climate and environmental policies are still based on sectoral responsibility, which means that "every social sector has an independent responsibility to (…) contribute to the realization of national climate and environmental policy goals" (Ministry of Climate and Environment 2015, p. 19, our translation). This implies that the various social sectors are responsible for accomplishing necessary measures within their own fields to reach the goals concerning climate and environmental policies (Ministry of Climate and Environment 2015; Norwegian Agriculture Agency 2018).

So far, no juridical instruments have been adopted by national governments, except for a recent national ban on peatland cultivation—which includes possibilities for local allocation of exemptions. Some economic instruments have been introduced related to manure spreading, such as subsidies for the purchase of band spreading equipment (which has been recognized as more beneficial to the climate than using broadcast spreading (e.g., Stoate et al. 2009)), but these are arranged at a more local level and are only temporary, in addition to not being available everywhere. Thus, a range of possible solutions has been suggested, but little has actually been carried through. In this matter, it is relevant to have a closer look at the influential agri-food network around dairy-beef production.

The Norwegian agri-food network's influence on dairy-beef production

Central parts of the agri-food network of dairy and beef have been established as cooperatives and later organized under the same cooperative umbrella organization: Norwegian Agricultural Co-operatives (Norsk Landbrukssamvirke). These parts of the network include both supplier companies and processing companies. The cooperatives are owned and governed by the farmers themselves, who are customers, suppliers and members of the system. There are various categories of cooperatives, where the dominating category is the marketing cooperative (Verås 2012), which involves organizations that process agricultural raw materials into finished goods for consumption. Norwegian Agricultural Co-operatives works to meet demands and expectations on three different fields: the market field, the political field, and the field of its members. This also implies that the organization has to balance three different roles: an effective competitor on the commodity market, an effective executor of agricultural policies, as well as the role of an effective guard of the members' interests (Borgen et al. 2006). In addition to the agriculture-based cooperatives, there are several other capital-owned competing companies within the various links of the supply chain.

Together, the various parts of agri-food networks are influential actors within the Norwegian food system and, thus, they also directly or indirectly concern the climate issue and GHG emissions. According to Schilpzand et al. (2010), the increasing importance of non-governmental actors in governance is generally one of the most significant trends in both food systems and the environmental field. First, the farmers themselves—even though they depend heavily on external forces at the farm level—are important at an aggregated level, both through every single decision and innovation that, at large, affects consumers and the environment and through the active engagement in cooperatives and networks in order to gain power to negotiate with government and business entities. In relation to this, farmers' unions are other influential actors. The roles of retailers and consumer organizations, as well as consumers' choices at an aggregated level, are also correspondingly important, to mention a few.

The agri-food network is, directly or indirectly, of significance to the dairy-beef production in several ways: First, cooperatives and farmers' unions are important actors in national agricultural policy making. Both parties contribute to knowledge on the situation within agriculture, among other places, in a market advisory board—a public, independent organ that manages market regulating measures for agricultural products as its main task (Norwegian Agriculture Agency 2017). Currently, agriculture constitutes the majority of this advisory board, due to its economic responsibility for excessive production (Norwegian Agriculture Agency 2017). Moreover, farmer unions have an essential role as negotiating partners in the annual Agricultural Settlement, where the government and the farmer unions negotiate to make an agreement on the financial framework for agriculture and Norwegian farmers in the coming year. Secondly, the wider supply chain (as a central part of the agri-food network) is of significance to the dairy-beef production simply due to the fact that farmers and the remaining actors are naturally and mutually dependent on each other as different actors within the same supply chain. Thirdly, many of the actors within the agri-food network provide *advisory service*s for dairy-beef farmers. Based on their functions in the network (supply, processing, knowledge communication, and general support), the various organizations' advisory services focus either on how farmers should pick the input factors that serve them the best, and/or on how farmers should produce to get the most out of the resources available on their farms. In this way, the agri-food network around farmers may have a great and direct influence on how dairy and beef are produced.

Research has pointed to the fact that various non-state actors have an emerging and important role in governing environmental change action (Schilpzand et al. 2010). In this matter, Schilpzand et al. (2010) highlighted private sector firms whose activities have a direct impact on the environment, including farmers with their land use and their significant implications for GHG emissions. Furthermore, the other parts of agri-food supply chains also play important roles in environmental governance (Schilpzand et al. 2010). Various actors within the food system engage with civil society to safeguard their supplies in the face of increasing scarcity of raw materials and potential price fluctuations and/or as a strategy to distinguish themselves to ensure competitive advantages, proposing to new consumer values such as food origin or low-carbon impact (Schilpzand et al. 2010). As Schilpzand et al. (2010, p. 286) exemplified, the retail

sector often highlights its engagement in environmental governance, among other ways, by promoting products within categories such as Fairtrade and locally produced foods.

Theory on complicating conditions for comprehensive change

Wilson (2008), focusing on possibilities for change and transitions within the agricultural sphere, highlighted how farms, to a large extent, depend on the wider system of which they are a part. Thus, system changes are needed to reduce GHG emissions from dairy-beef production. In this regard, central parts of the agricultural system, such as farmer unions, Norwegian Agriculture Cooperatives and various single links of the agricultural supply chain, have expressed that mitigation of GHG emissions from agriculture is important and something they take seriously. However, many systems, among them the agricultural system, are characterized by lock-in and lack abilities to change due to technological, institutional, and social path dependencies (Unruh 2000; Sherrington et al. 2008). The terms, - path dependency and lock-in, originating from economics, are increasingly being used as analytical tools to understand change- and transition processes within farming and agriculture (Sutherland et al. 2012), as they efficiently explain the maintenance of existing development paths.

According to Wilson (2008, p. 376), potential changes are carried out within boundaries defined by path dependency, which refers to specified, perceived limits of what is *likely* or *possible* to be done or achieved. This implies that path dependency represents a certain decision-making corridor (Wilson 2008), i.e., limited leeway for likely decisions. Sutherland et al. (2012) highlighted how any business, due to the capital investment involved, can be expected to demonstrate a certain degree of path dependency. Importantly, path dependency of individual firms or organizations is contingent on path dependency characteristics of the overarching agricultural system as such (Wilson 2008).

Furthermore, path dependency depends both on the history and geography of a system, as well as on the system's "starting position" (before a change is initiated) (Wilson 2008, p. 376). The starting position is significant to possible adjustments, as it is difficult to rapidly move far away from its current position (Wilson 2008, p. 376), i.e., to make radical changes. The memory of

previous decision-making trajectories will often influence current decision-making pathways. The shape and size of the perceived possibilities for change are also closely linked to actors' risk perceptions and venturousness (Wilson 2008).

Wilson (2008) juxtaposed the path dependency concept with the concept of *lock-in effects,* i.e., that path dependency is created by various lock-ins. According to Popp and Wilson (2007, p. 2976), lock-in can be understood as a state of constrained choice, which influences how actors strategize in a purposeful fashion. Thus, the concept of lock-in can be applied when it comes to explaining the irreversibility of agricultural systems (as well as various irreversible elements within agricultural systems) and the conditions that allow for alternatives (see Brédart and Stassart 2017). Popp and Wilson (2007, p. 2977) stressed that lock-in, as a phenomenon, does not always represent something negative, as lock-ins may maintain both virtuous and vicious development patterns.

Previous research has identified lock-ins of numerous types and at various levels within agriculture, e.g., technological lock-in, economic lock-in, cultural lock-in, political lock-in, knowledge lock-in, and institutional lock-in (Sutherland et al. 2012; Nettle et al. 2013; Burton and Peoples 2014; Magrini et al. 2016; Beudou et al. 2017). With regard to the many various conditions that may create lock-ins, Sahakian (2018) suggested the application of the broad concepts of social and material lock-ins to understand steady patterns of interactions between people and social norms and the material dimension.

Based on his industry studies, Grabher (1993) identified, among other kinds, *political* lock-ins, described as "thick institutional tissues of resistance aimed at preserving existing industrial structures" (Hassink 2007, p. 1147). Such institutional tissues consist of various organizations (e.g., political administrations, trade unions, large enterprises) and other forces that structure behavior, such as norms, rules, and laws (Edquist 1997 in Hassink 2007). Related to such political lock-ins, Darnhofer (2015, p. 26), underlined how initiated transitions are the result of political processes, where different actors are involved in debating and deciding what issues should be seen as problematic, and how they should be addressed. The various actors within the agri-food network around farmers are certainly important actors in this matter. Organizations that

have vested interests in maintaining the status quo are likely to work to resist policy reforms that change existing institutional and production patterns (Barbier 2011 in Darnhofer 2015). Here, Darnhofer (2015, p. 26) referred to Vanloqueren and Baret (2009) and Levidow (2011) and pointed out that the formal organizations in the agricultural sector often have vested interests in the productivist-modernization approach to agriculture, and, hence, they may be both unwilling and unable to embrace the benefits of alternative approaches. But, is this also the case when potential change concerns mitigating climate change?

Darnhofer (2015, p. 27) mentioned many approaches about where to focus the efforts to achieve a transition to sustainability (e.g., technological development, consumer behavior, institutional structures, cultural perspectives), and described how these approaches are a part of different discourses competing on which standards are suitable and which criteria reflect true sustainability. Central parts of this competition concern definitions of which problems are most important and which solutions are most beneficial (Darnhofer 2015). Emission mitigation constitutes an important part of these sustainability discussions.

In addition, Geels (2014), one of the main representatives for a multi-level perspective on transitions[3], recognized that the phenomenon of "regime stability" (i.e., keeping established systems and practices) may be the outcome of active resistance by central actors. He pointed to various ways in which such actors may use power and politics to resist fundamental transitions to new low-carbon systems. Actors may resist fundamental change by using various kinds of resources (e.g., positions of authority, money, access to media, personnel, capabilities) in immediate interactions with other actors; by using discursive strategies; and by gaining broader institutional power embedded in political cultures, ideology and/or governance structures (Geels 2014).

Significant mitigation of GHG emissions from agriculture clearly requires changes in the agricultural system, and the theory presented explains how and why this may be difficult to

[3] The multi-level perspective (MLP) on transitions highlights three conceptual levels, where the interplay between developments on each of them are of importance: Socio-technical *regimes* are established systems of practices and rules, *niches* are radical innovations that enable regime change, and an exogenous *socio-technical landscape* constitutes the third level (Geels, 2002; 2005; 2011).

obtain. Certain social and material conditions (lock-ins) often create path dependency, which means limited leeway for likely decisions on further development. As the problem (and solution) to climate mitigation often get placed at the famers, we assume that a research approach based on these theoretical concepts, and including the wider agricultural system, may contribute to the identification of other potential working forces in this matter. Beyond Darnhofer's general descriptions of how agricultural systems often work, empirical studies examining this more closely within the frames of climate mitigation seem rare. Our study responds to this gap, and the presented theory has brought up important issues to look for when analyzing the empirical material: Does the agri-food network around farmers seem to move in one direction, following a particular pathway? Is it possible to identify path dependency in this matter? And what kind of lock-ins seem to bring about path dependency? The exploration of these questions has been useful to respond to our overarching research question.

Data and method

The present study is part of a project on climate mitigation, financed by the climate program of The Research Council of Norway. The project explores how to break out of high carbon path dependencies in the dairy-beef value chain. It includes focusing on multiple agents to study lock-ins and transformations of complex systems with producers, supporting businesses, retailers, and consumers. This constitutes the background for the current paper's aim to explore whether the agri-food network around Norwegian dairy-beef farms promotes or constrains changes that can reduce the GHG emissions from agriculture.

The present paper is based on 13 semi-structured interviews with key stakeholders and various authorities in supplying and processing industries, grocery trade, agricultural advisory services and education, farmer organizations, as well as organized consumer initiatives. Originally, we wanted to interview actors at the *regional* level (through sectoral social dialogue meetings, with actors from two different regions that were involved in other parts of the current research project), as they are closer to the farmers through the concrete consultancy provided by these farm-related organizations. However, when approaching actors at this level, we noticed that many of them thought it was uncomfortable to attend and speak about climate mitigation,

seemingly because they did not find themselves sufficiently informed about the topic (more about this in the analysis section). Therefore, we decided to carry out interviews with actors mainly at the national level, using shorter, individual interviews by phone due to these actors' busy schedules.

When using empirical material from the national level, document analysis of various public documents and organizational websites could be seen as representing an alternative, equally fitted method. However, a quick overview showed that organizations' presentations of their own climate policies are often angled in different ways and are quite general and shallow. Thus, actor/representative interviews seem beneficial, in that it is easier to reveal the real proneness to change: What would be an acceptable change to them, and what would not?

The actors were informed that we wanted to interview them as representatives of their organizations. We ended up interviewing representatives from 13 organizations, broadly covering the agri-food network of dairy-beef. These organizations fill ten different and important functions in this particular agri-food network, and to delineate the population size of such organizations in Norway, none of these functions are filled by more than four organizations relevant at the national level. We ensured that no central function was missing in the material. The interviewees can be divided roughly into five actors from the supply side of the farm production (regarding both material and immaterial inputs), five actors from the demand side of the farm production, and three actors representing farmers' interests at large (10 males and three females in total). Whether the sample is representative of all the different organizations and perspectives that make up the entire agri-food network cannot be guaranteed, however, we did not notice any cases pointing in the opposite direction based on what is presented by the media. In addition, all the organizations included in our study are influential forces within their domain.

The interviews were carried out between fall 2015 and spring 2016, and each interview lasted about 20-30 minutes. The actors were all contacted by email or phone beforehand, and each of them also received an email with an interview inquiry letter and the prepared questions before the interviews were carried out. The interviews covered the following issues: the ongoing media

debate about the cow as a stated "climate sinner"[4]; conditions that may hinder reduction of GHG emissions from dairy-beef production; access to knowledge on what leads to reduced emissions; the preferred development of agriculture, and how to balance different goals; the goals of the relevant organization's consultancy services for farmers; if one's own organization's practices were locked-in in particular ways by adjacent parts of the value chain or by superior, current rules or instructions; the perceived relationship between resource utilization and emission cuts; and views on how the dairy-beef production should be further developed in the future. The interviews were recorded and thereafter transcribed in Norwegian. Interesting quotes were later translated as precisely as possible into English for use in this paper.

When it comes to the analysis of case studies (here: "the Norwegian case"), Darnhofer (2015, p. 26) pointed to the usefulness of identifying the strategies used by various actors to either instigate a societal change process or ensure stability. In the current paper, we focus on various central actors within the agri-food network and analyze whether their organizations are prone to instigating a societal change process or ensuring stability. The interviews from different parts of the agri-food network were analyzed through focusing on the content of meaning, resulting in the identification of different themes based on participant perspectives.

Proneness to change in the agri-food network of dairy-beef farming?

Due to the agri-food network's significance to and influence on production at the farm level, the proneness to allow and support change toward low-emission, dairy-beef production, among important actors in the agri-food network, is further analyzed.

Climate as an unfamiliar topic at the regional system level

First, it is an important finding that regional actors in the agri-food system appear to have limited knowledge concerning climate mitigation. Here are some of our experiences from the efforts of

[4] In Norway, related to the climate challenges, a quite heavy and critical debate on cattle and methane emissions has developed in the media over the last four years.

arranging dialogue seminars with various actors from one region: A spokesperson for one of the organizations (within processing) did not want to participate in the current study as he perceived his organization to be less relevant to climate challenges. A person from another organization wanted to discuss our invitation with her managers; after that, she never responded to our requests again. Another person from a second division of the same organization wanted an email with further information on our project; when he got it, we likewise never heard from him again. Also, more people who would have been relevant to interview (regional managers of various organizations) were negative about being interviewed themselves but suggested other potential participants at higher levels of the organizational system to be contacted instead. A regional manager of one of the organizations did not want to participate, uttering that the cattle and climate debate was "silly science" and substantiated it by pointing to the fact that grazers have existed at all times, and that the density of cattle in Norway is quite marginal. This manager's refusal to participate in a dialogue meeting indicates that he feared that his opinions on this topic could potentially hit back on himself and/or his organization. To sum up our experiences in this case, they simply reflect that the regional level, which operates quite close to, and quite directly with, the farmers, appears to work quite independently (i.e., rather uninformed and unaffected) of the important goal of climate emission mitigation.

Rejection of the scapegoat label—but willingness to change

The actual interviewees, most of whom at the national level, were happy to contribute to our study and did not seem to question their own level of knowledge on climate, in contrast to the regional actors we first contacted. However, the hot-tempered, non-participating manager mentioned in the paragraph above was partly supported by the actual interviewees, in that many disagreed with the negative focus on agriculture in public debates. None of the actors disclaimed the importance of efforts to reduce climate emissions, in general. However, many of them admitted that they thought it was "completely crazy" that agriculture, in general, and the cows more particularly have received their scapegoat position in Norway over the last couple of years. For example, one of the interviewees argued that:

> The cow as a "climate sinner" is a strange and tabloid debate, influenced by a lack of knowledge. (…) [E]missions from the Norwegian cattle are lower than international

> breeds. Thus, it is meaningless to import more milk and beef from abroad to reduce emissions. Additionally, transportation, heating, and energy for the industry have far higher emissions than the cows, but no one argues that we should quit with that. (Supply side actor 3)

Largely, the argument here is that Norwegian dairy-beef production is more climate-friendly than both international production of dairy-beef as well as other kinds of domestic sectors, and that the heavy criticism, therefore, is unfair. Another interviewee (within knowledge provision) said:

> We shake our heads. The estimates seem to focus solely on emissions and not on carbon capture. When you produce coarse fodder, carbon is captured. You recycle the methane emissions. Thus, it feels like the debate has become less about the environment and more about policies. (Supply side actor 1)

This quote also reflects a feeling of unfairness regarding important social discourses related to agriculture and climate mitigation both in Norway and elsewhere. Even though the interviewees generally refused to accept the public criticism of their sector, many of the agri-food network actors expressed that they welcome changes to reduce the emissions from agriculture. Although several pointed out that food production must involve some emissions, most seemed to agree that production with as few emissions as possible would be preferable. One of the actors (Supply side actor 4) also pointed out the importance of every sector's contribution when it comes to needed emission cuts and thought it would be nice if the agricultural sector could also contribute to making the development go in the right direction.

Another expressed reason behind agriculture contributing to emission reductions was to politically show that something is happening, demonstrating that the sector is taking responsibility. Hence, emission reductions are perceived as a means to strengthen the general legitimacy of agriculture. Furthermore, demonstrating that the sector is making an effort on its own initiative may also be an important means to prevent external forces from deciding to take action. One of the actors (Demand side actor 4) particularly highlighted the importance of this

strategy, as he was afraid of a potential governmentally introduced methane tax, similar to what had been discussed in a neighboring country.

Yet another reason for the positive attitudes toward changes to reduce emissions is the perceived accordance between efficient resource utilization and climate-friendly agriculture, among many actors. Efficient use of resources is expected to give economic benefits, and, thus, climate mitigation can as such be perceived as a great opportunity for farmers and agriculture.

The agricultural sector's proneness to contribute to reduced emissions is further reflected through a recently established project, "Climate-Smart Farming", which was initiated by the Norwegian agricultural sector itself with the aim to ensure better information and efficient tools for more climate-friendly production on Norwegian farms (Klimasmart Landbruk 2017). To achieve this, the project will develop a system to calculate the potential for reduced emissions at the (unique) single farm level (which has been missing so far), as well as arrange for more effective knowledge sharing within the sector. Many cooperative and also some non-cooperative agricultural organizations are involved in the project. According to an interviewee representing one of the involved organizations, the climate-oriented consultancy will be optional, as a service to farmers who are interested in changing to a more low-emission production. Furthermore, climate-oriented advice will be provided for free, as distinct from the remaining advisory services directed toward farmers. The project was established in 2016; the mentioned calculator and an adjacent arrangement for consultancy are still under development (Kjøllesda 2019).

In addition, a clear signal that agricultural actors take the climate challenges seriously and are prone to change is that several such organizations already have made changes to take care of *their own* GHG emissions. For example, both Felleskjøpet and Tine, which are central supply and processing organizations, respectively, now invest in new car fleets to reduce the emissions from their transport (Tine 2019; Felleskjøpet 2019). However, as we will further show, it is not entirely evident to the remaining agri-food network how the on-farm emissions can be reduced in a sufficient and efficient way.

Different opinions on what is required

The various actors were quite optimistic that the agricultural sector's requested emission reductions are solvable. However, they had different opinions on what should be done to reduce the emissions. In line with the ideas behind the mentioned project Climate-Smart Farming, many actors had faith in the positive effects of good—or improved—agronomy, involving conditions such as precise soil treatment, high coarse fodder quality, and high animal welfare. Some of the actors also strongly believed in the potential of biogas plants but recognized that this was more-or-less off the political agenda for now, assumingly based on a lack of business models pointing toward economic profit. Some actors argued that Norwegians should eat more meat from (domestic) ruminants to reduce the country's consumption of international produce when generating concentrated feed for pigs and chickens. Others also argued for a reduction of concentrated feed but then suggested that the issue be solved through an increase in coarse fodder-based dairy-beef production. Several actors mentioned the importance to reduce the so-called "wheel and diesel" agriculture, pointing to the negative effects of distanced lots and extended use of transportation.[5] Related to this, some also highlighted the necessity of reducing land fragmentation, and all the transportation extending from it, as they also thought this led to worse agronomy and, hence, excessive emissions. Yet another actor emphasized the importance of reducing the calf mortality rate as well as premature slaughtering to best utilize each animal in production. While it may be argued that transition, especially in farming, will have to come from multiple innovations (Elzen et al. 2012), the sector's suggested measures are not only different, but also partly contradictory. Hence, it is clear that there is no united agreement within the sector on how to achieve the necessary emission reductions. Assumingly, the Climate-Smart Farming project will make the various organizations more coordinated in their views on sensible mitigation measures.

A call for sufficient and reliable knowledge

As we can see, there are many different understandings of what the most important strategies should be to overcome the climate challenges within agriculture. Although they did not hesitate when expressing what should be done, many underlined the need for more certain knowledge about what measures would be most efficient regarding emission reductions from agriculture.

[5] As there currently is competition to rent land for farmers to expand production, many farmers must rent land at a distance from their own farms.

They thought that the current knowledge base is rather difficult to follow and advertised for a more systematic composition of knowledge. One of the actors (Farmers' interests actor 2) also admitted that he became more and more uncertain about each discussion on this topic. Another actor commented:

> Agriculture has a great ability to readjust under the condition that we know that the changes made will bring effects. Information must be nuanced and reliable. (Supply side actor 5)

Several of our informants described the climate field as difficult and complex and expressed a desire for certain and unified knowledge on GHG emissions from agriculture. The quote above suggests that uncertain knowledge reduces the agri-food network's proneness to make changes. As in other parts of society, the sector misses clear results showing the actual relevance and strength of potential measures. As long as there seems to be net costs involved, they do not want agriculture to take potentially unnecessary risks by acting on an uncertain basis.

No demand for changed demand

It is also relevant to notice what the interviewees did *not* mention as promising measures for emission reductions. Since the debate on the cattle as a "climate sinner" developed, there has, both nationally and internationally, been a focus on the possibility for emission reductions related to reduced consumption of red meat and, hence, a reduced number of cattle. In Norway, the environmental groups have been particularly visible representatives for this perspective. The total number of cattle is an important indicator of countries' calculations of their emissions. When it comes to total emissions of CO2 equivalents in Norwegian agriculture, 60 percent are estimated as coming from digestion, manure pits and cowsheds (Hohle et al. 2016, p. 67) and, thus, directly from the number of animals in production, where the cattle cause the highest emissions in this case.

Furthermore, the Norwegian Directorate of Health is working to reduce the consumption of red meat among Norwegians for the benefit of more fruits, vegetables, and fish. Its measures indicate that today's consumption of red meat is about 50 kilos per person per year, while, for health-

related reasons, the directorate suggests a reduction to about 26 kilos (500 grams per week) (Norwegian Directorate of Health 2018).

Even though reduced demand from consumers and, hence, reduced production would imply both a sound and significant step toward the emission reduction goal in agriculture, several actors argued for *increased* domestic production of beef. None of the supply chain actors argued for changed consumption patterns as a relevant measure, except for two ambivalent exceptions. One actor (Farmers' interests actor 2) mentioned that one might introduce a controlled reduction of beef consumption as a possible solution to high emission levels. However, at the same time, he underlined that such a suggestion was not in line with the mandate of his organization. Another interviewee (Supply side actor 1) dryly commented that eating less beef would probably be useful both for public health and the emission numbers but that was within the context of underlining that lower meat consumption is more relevant than the widespread suggestion that chicken and pork consumption should preferably replace beef consumption.

A recent consumer interest for more sustainable food production, in parallel with the more-or-less steady demand for red meat, is seen as a market potential for trade and processing actors. A representative from a grocery chain (Demand side actor 2) said that it is conceivable that grocery business will make more demands toward agriculture in the future that mirror what consumers want. However, the consumer representative (and the only one of all the interviewees in our study who mentioned this) directly introduced reduced consumption of red meat as a relevant measure and underlined the importance of direct steering:

> [Agri-food network actors] put the blame on the consumers higher up in the chain, that [the production of beef] happens because the consumers are asking for it. But why do the consumers want it? There have not been any attempts to make consumers think differently. (…) If it is up to the consumer to decide, we will never solve the emission challenges. That would be equal to suggesting that the market could save the environment. Consumers need help to make eco-friendly choices. Clear advice must be provided. As well as regulations in terms of price. (Demand side actor 5)

There are many different perspectives and arguments in the debates. However, the most efficient change toward a more climate-friendly agriculture seems to be encouraging changed demand and decreasing the number of cattle due to the significant levels of methane gas emitted (Hohle et al. 2016; O'Mara 2011). The agricultural system, as it is today, appears to work more-or-less against this solution, based on the conviction of following the consumers' behavior. Indeed, this conviction corresponds to the government's expressed policies (Ministry of Agriculture and Food 2016-2017, p. 19, our translation):

> The government rests on the consumers' interests when shaping agricultural and food policies. The most important task for agriculture is to produce food, and the Norwegian agriculture and food industry has to produce goods that correspond to Norwegian consumers' demands.

The legitimacy of this perspective is further strengthened by the mentioned public subsidies given to suckler cow producers. Meeting the consumers' needs is certainly a core principle within any market approach. However, the lack of proneness to make an effort to change the demand seems to be due to the conviction that production of red meat is an important way to utilize Norwegian agricultural resources in the best possible way, here formulated by one of the knowledge provider actors in the agri-food network:

> Large areas of Norway are coarse fodder land, where producing carrots or potatoes is not an alternative. If we stop producing coarse fodder, the only alternative is to let the land lie fallow. (Supply side actor 1)

Due to the topography, a large share of Norway's arable land is considered suitable only for grass production, which pragmatically means fodder for cattle. Hence, for large parts of the farmland, the actors do not see any realistic alternatives to dairy-beef production. If the particular land was not to be utilized for this production, that would not only be a problem regarding the goal of efficient utilization of domestic natural resources, but it would also imply a significant loss of income for many farmers, as well as for the sector as such. The same is the case regarding the considered ban on cultivation of peatland, since many farmers have kept such land as their

spare areas and will need it to maintain the sustainability of their business in the future. When commenting on the recent, ongoing negotiations of a mitigation agreement with the government in the media, the executives of the farmer unions rejected both suggestions on reduced beef consumption and a ban on cultivation of peatland (Aase 2019).

Transitioning into a low-carbon agriculture may imply changes in several institutions, arenas, networks, and practices at once. Many different potential measures have been suggested, both among the interviewees and in general. As this appears as promising for change, the large numbers of options can also make a real transition difficult; it is possible that only the least important factors may be followed, leaving more significant change potentials untouched. Adjustments within current production at the farm level is one pathway toward lowering emissions. This may imply reduction in tractor driving and other machinery use, reduction in fertilizer usage, and improved drainage. Changes in farm structure and/or production types are changes that seem far more unattainable.

Discussion

The analysis indicates that the agri-food network around farmers wants change toward a production with the lowest emissions possible due to several reasons, but there are also clear limits for how prone they are to support relevant change. Hence, our findings correspond well to Darnhofer's (2015) observation that there often are broad rhetorical consensus on overall goals for sustainability, while more specific suggestions on how to meet these goals tend to be highly contested due to potentially profound implications of certain pathways. The lack of suggestions on changing the demand for red meat indicates that if it is up to the dairy-beef system itself, it will continue in the direction of increased production volumes and increased efficiency in production, combined with moderate measures to reduce emissions. This is in line with the general tendency that formal organizations in the agricultural sector often have vested interests in agriculture following a productivist-modernization pathway (Darnhofer 2015; Levidow 2011; Vanloqueren and Baret 2009).

The limited proneness to support relevant change seems mainly to be due to a shared conviction throughout the system that the volume production of red meat should follow (from a health perspective, the unnecessary high) domestic demand. There is an obvious lack of requests for efforts to change the consumer demand toward other products or meat products with reduced emissions, seemingly because such a solution would complicate full exploitation of existing agricultural resources and, hence, the full potential for profit and employment. As parts of the same network, each organization's fortune depends on the others, to some extent. Hence, it is reasonable that they are united in their considerations of which measures are acceptable and which are not.

In addition, within the agri-food network, there are many different and partly contradictory perspectives on what should be done to achieve necessary emission reductions, together with significant uncertainties concerning the actual effects of various measures. These uncertainties further reduce the proneness to support great changes within the existing agricultural system.

The joint avoidance of promoting change in demand toward reduced consumption and production of beef reflects a political lock-in, described as thick institutional tissues of resistance (Hassink 2007; Grabher 1993). However, it is important to know the reasons for this resistance. At a more detailed level, there are mainly two kinds of lock-ins that seem to ensure "regime stability" (Geels 2014) and, hence, prevent the agri-food network's full support to an efficient green transition of dairy-beef production. First, we find a lock-in that can be mentioned as a *mandate lock-in,* where the actors within the agri-food network refuse to consider implementation of certain relevant climate measures, including less beef production (as well as a ban on cultivation of peatland), since implications of these evidently collide with their organizations' main mandates. Their primary mission is to support effective utilization of Norwegian farm resources, which includes a sound economic basis for the individual farms and for the sector. Secondly, we find a knowledge-related lock-in. While Sutherland et al. (2012) previously identified a knowledge lock-in among farmers, which makes them stuck to certain learned practices, our study reflects an *insufficient knowledge lock-in* that contributes to prohibiting clear directions for mitigation policies within the agri-food network. This lock-in cannot be easily overcome by improving information flows, since they are caused by uncertain

and sometimes even contradictory scientific research results and perspectives concerning the estimated effects of various mitigation measures. Following Sahakian's (2018) terms, while both mandates and knowledge needs may be labeled as social lock-ins, they are certainly based on material concerns in the form of resource utilization, self-sufficiency, and economic sustainability.

Achieving significant emission reductions within the Norwegian dairy-beef sector assumingly requires reduced compliance with the remaining political goals for agriculture, such as resource utilization and high self-sufficiency rate. Most probably, these will also hit the agricultural economy in a negative way. If such decisions have to be made, it seems, based on our analysis, unrealistic to expect that agriculture itself will initiate them. The sector simply lacks dedicated climate mitigation *drivers*, as their main mandates concerning agricultural production cannot be fully combined with whole-hearted climate mitigation efforts.

Whether there are other (non-governmental) forces that may bring about the necessary change toward a law-carbon agriculture is rather unsure. "Plane shame" has developed as a climate-related concept, among other places in Sweden (Stærk 2019), and a corresponding "meat shame" could be assumed to develop just around the corner. However, ethical food choices usually involve only a limited part of the population (Neilson and Paxton 2014). Thus, as long as the agricultural system as such does not actively contribute to make consumption of other products more attractive and easier at the sacrifice of beef, consumer demand will likely not be strong enough to force through a significant change in production. Another potential way to more effective emission reductions is scientific innovations, e.g., breeding cows with particularly good digestive qualities (Øvrelid and Langfjord 2019). However, while the ambitions are high, the potential results seem both long-term and uncertain. In other words, unless the demand changes dramatically by itself or groundbreaking innovations suddenly develop, some sort of governmental regulations seem necessary to achieve considerable emission reductions.

How transferrable our findings are to other countries depends on how the power is distributed and where the prime mover is located, within and outside other agricultural systems, regarding climate mitigation. In any case, agriculture often has several functions to fill and, thus, various

goals are at play. Climate mitigation represents yet another goal to reach and fit in with the rest. It may be a unique problem in Norway that a large share of the arable land is considered suitable only for grass production, leaving limited options for new types of production based on these land resources. Despite this, it is reasonable to believe that each farm has engineered an established production to utilize its resources in the best possible way and, hence, potential changes into new ways of production would not be preferable.

Conclusion

This study illustrates challenging aspects of sustainable transitions, even in cases marked by progressive political goals and commitment at the governmental level. We have examined, based on data from Norway, the extent that the agri-food network around dairy-beef farmers promotes or restrains the transition to a low-carbon agricultural production. Our findings show that the involved actors are generally positive to make agriculture more climate-friendly, but the measures they seem likely to encourage and support may not be sufficient when it comes to needed emission reductions. The will to change seems extensible up to the point where it is no longer possible to combine climate gains with economic gains. Due to a seeming lack of economically sound production replacements, change toward reduced demand and production of beef (given that the most important element to GHG emissions from dairy-beef production is the number of cattle) does not seem feasible if dependent on initiatives from the agricultural sector. To expect something else from the agri-food network would more-or-less be like expecting the sector to saw off the bough on which they are sitting.

Thus, the purpose of this paper is *not* to argue for a radical change in values or attitudes within the agricultural system. Rather, we have pointed out how the so-called decision-making corridor within the agri-food network is narrowed by these actors' main mandates and missions. What this paper indicates is that the dairy-beef sector cannot be expected to reach the goal of reduced climate emissions on its own initiative. Voluntary treaties and pointed sector responsibility will not suffice. It is estimated that Norwegian farms potentially, at their very best, could reduce the GHG emissions with up to 20 percent while maintaining current types of production and production levels (Hohle et al. 2016). Further reduction requires stronger and more dramatic

efforts. More radical changes, such as successful attempts to reduce the demand for—and hence production of—beef, or a total relinquishment of further cultivation of peatland, seem to depend upon both push and pull actions from forces outside the agricultural system. At the same time, we want to mention that lock-ins within the agri-food network do not solely contribute to vicious development patterns. Rather, these barriers require and ensure more thorough processes and careful considerations before consequential decisions are finally made at a higher level.

For future research, more reliable and precise emission registrations and improved knowledge on the actual effects of various mitigation measures are needed. Furthermore, if agricultural systems elsewhere have succeeded with transitioning to low-carbon production, it would be of high interest to learn how lock-ins such as those identified in the current study have been avoided or handled, and what measures or tools that have been involved. In addition, the social and material atmosphere around reducing agricultural GHG emissions is dynamic. As such, there is a need for new research to follow the development and to understand what actions could be effective in the coming years.

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