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## Abstract

Climate change will continue to be a major issue to achieve sustainability in agriculture, which makes adaptations of resilient climate policies and technology to be necessary in reducing greenhouse gas emissions. Discourse analysis is used to understand how farmers perceive climate change and how their behaviour is understood. Discourses are particularly how language is used in different situations. Interviews were conducted in April 2021 with 3 subjects in dairy farming. Five discourses were identified as important for this study to how the selected farmers perceived climate change policies and adaptation of technology to mitigate emissions: Money, Technology, Human Responsibility, Environmental Citizenship and Questioning. Each discourse contributes to understanding how future adaptation behaviour can be in approaching climate change.

## Content

|                                                                           |           |
|---------------------------------------------------------------------------|-----------|
| ACKNOWLEDGEMENTS .....                                                    | 2         |
| ABSTRACT.....                                                             | 3         |
| <b>1. INTRODUCTION .....</b>                                              | <b>6</b>  |
| 1.1 AGRICULTURAL CLIMATE POLICY DEVELOPMENT AND CLIMATE CHANGE .....      | 6         |
| 1.2 THE PARIS AGREEMENT IN RELATION TO AGRICULTURE .....                  | 7         |
| 1.3 NORWEGIAN POLICIES AND THE NORWEGIAN FARMERS ASSOCIATION .....        | 8         |
| 1.4 AGRICULTURAL ADAPTATION TO CLIMATE CHANGE .....                       | 11        |
| 1.4.1 <i>Farmer's perception</i> .....                                    | 12        |
| 1.5 PROBLEM STATEMENT AND RESEARCH QUESTIONS .....                        | 14        |
| 1.6 ADDRESSING THE PROBLEM STATEMENT .....                                | 15        |
| 1.7 THESIS ORGANIZATION FOLLOWING THIS INTRODUCTION .....                 | 16        |
| <b>2. ANALYTICAL FRAMEWORK.....</b>                                       | <b>17</b> |
| 2.1 CONSIDERATION OF OTHER APPLICABLE THEORIES .....                      | 17        |
| 2.2 DISCOURSE ANALYSIS .....                                              | 17        |
| 2.3 ESTABLISHING THE DISCOURSES.....                                      | 19        |
| 2.4 THE ARGUMENTATIVE APPROACH .....                                      | 20        |
| 2.5 DISCOURSE ANALYSIS AS METHOD .....                                    | 23        |
| 2.6 FARMERS RESPONDS TO CLIMATE CHANGE AND DISCOURSES .....               | 26        |
| 1.7 AIM AND SIGNIFICANCE .....                                            | 30        |
| <b>3. METHODOLOGY.....</b>                                                | <b>31</b> |
| 3.1 CASE STUDIES .....                                                    | 31        |
| 3.1.1 <i>Qualitative methodology</i> .....                                | 32        |
| 3.1.2 <i>Abductive research strategy</i> .....                            | 32        |
| 3.2 DATA SELECTION .....                                                  | 33        |
| 3.2.1 <i>Interview strategy</i> .....                                     | 34        |
| 3.2.2 <i>Research ethics, privacy and confidentiality</i> .....           | 34        |
| 3.2.3 <i>Selection of interviewees</i> .....                              | 35        |
| 3.2.4 <i>Interview procedure and timeline</i> .....                       | 36        |
| 3.2.5 <i>Operationalization of the measures</i> .....                     | 36        |
| 3.3 LIMITATIONS OF THE RESEARCH METHODOLOGY.....                          | 37        |
| 3.3.1 <i>Validity and Reliability of Measurement</i> .....                | 37        |
| 3.4 METHODOLOGY FOR ANALYSING QUALITATIVE INTERVIEW RESULT .....          | 38        |
| <b>4. DATA AND ANALYSIS .....</b>                                         | <b>39</b> |
| 4.1 FARMERS' THOUGHTS ON AGRICULTURE, CLIMATE CHANGE AND TECHNOLOGY ..... | 40        |
| 4.1.1 <i>The discourse of money</i> .....                                 | 42        |
| 4.1.2 <i>The discourse of technology</i> .....                            | 46        |
| 4.1.3 <i>The discourse of human responsibility</i> .....                  | 48        |
| 4.1.4 <i>The discourse of environmental citizenship</i> .....             | 50        |
| 4.1.5 <i>The discourse of questioning</i> .....                           | 52        |
| 4.2 STORYLINES AND DISCOURSE-COALITIONS .....                             | 54        |
| <b>5. DISCUSSION.....</b>                                                 | <b>55</b> |
| 5.1 RELATION BETWEEN THE DISCOURSES.....                                  | 55        |
| 5.1.2 <i>Perception of climate change</i> .....                           | 56        |
| 5.1.3 <i>Relation to climate change policies</i> .....                    | 57        |
| 4.3.3 <i>Perspective of technological innovation</i> .....                | 59        |
| 4.3.4 <i>Relations between the farmers' perspectives</i> .....            | 60        |
| <b>CONCLUDING REMARKS .....</b>                                           | <b>63</b> |
| FUTURE RESEARCH.....                                                      | 64        |

|                                                                |           |
|----------------------------------------------------------------|-----------|
| <b>REFERENCES .....</b>                                        | <b>65</b> |
| <b>APPENDIX.....</b>                                           | <b>72</b> |
| <b>APPENDIX 1: METHANE CAPTURE DEVELOPMENT TECHNOLOGY.....</b> | <b>72</b> |
| <b>APPENDIX 2: INTERVIEW GUIDE .....</b>                       | <b>76</b> |

# 1. Introduction

## 1.1 Agricultural climate policy development and climate change

The United Nations Framework Convention on Climate Change (UNFCCC) emphasizes the importance of acting now consequently to global concern of greenhouse gas emissions. The Paris Agreement is a succession of the Convention where 160 countries have the common cause to combat climate change with one of the main goals of “increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production” (UNFCCC, 2016: 22). Along the same lines, the European Commission highlighted the future challenges of climate change by presenting a legislative proposal on the Common Agriculture Policy (CAP). The aim of the proposal is to tackle current and future challenges to support farmers to have a sustainable and competitive agricultural sector. Moreover, the CAP points out the necessity of increasing investments in research and innovation to boost knowledge and development, and to make the agriculture sector resilient and sustainable (European Commission, 2020).

Changes in climate results in more extreme weather, periods of droughts and consequently rapid wildfires. Predictions of potential consequences of climate change shows how parts of the world might be affected differently (Wheeler & Von Braun, 2013). The main climate change impacts of the Norwegian sector in relation to bio-geographical region is determined by it being both Atlantic and Mountain regions. Accordingly, potential climate impacts can contribute to increased precipitation, flooding, and rise in temperatures (*Klimagassutslipp fra jordbruk*,).

With the climate change impacts affecting areas differently, the importance of resilient strategies and a contingency plan, will be necessary to tackle a potential climate crisis. Furthermore, the negative effects to agriculture have the potential to affect a country's stability due to loss of electricity, food supply, and security. Although this has not affected Norway until now. Regardless, climate change advancing and the need for adaptation strategies will increase. Farmers are therefore particularly at risk and will consequently be in need to adapt to potential changes to secure food production, livelihood, and societal necessities. With this in mind, it will interesting to investigate how farmers can be of value for mitigation of emissions. Policies

and technologies will change continue to change; however, the interesting factor is thus how farmers will adapt accordingly.

Greenhouse gas emissions are increasing and have the potential to severely damage to the planet. The process of climate change is a global trend, which is due to a combination of natural climatic fluctuations and man-made changes in the coordination of the atmosphere (Skarbø & Vinge, 2017: 11). Projections for Western Norway, based on a global climate model highlights that this negative trend is increasing. Regardless, by illustrating climate change through expectations of shorter winter seasons, more extreme weather, and heavy rainfall with increased risk of flood, Norway has previously not perceived climate change as an immediate threat (Skarbø & Vinge, 2017: 52; Brobakk, 2018). However, the Norwegian Environment Agency among others, have with their report “Klimakur 2030” analysed the potential to reduce non-quota obligated greenhouse gas emissions regarding forest and land use pollution (Klimakur 2030, 2020). The report can potentially influence the government in how Norway will achieve their targets, and contribute an implementation of strategies, policies, and new technology development. Until now, research on development of methane capture technology has been low. Agriculture is responsible for 8.8 % of Norway’s emissions, and methane emissions through animal digestion is responsible for a massive part of the total amount (*Klimagassutslipp fra jordbruk.*)

## **1.2 The Paris Agreement in relation to Agriculture**

The Paris Agreement states that “Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions” (UNFCCC, 2017: 104). Changes in climate have potential implications on agricultural development, as the sector is dependent on a specific and stable climate. The changes will depend on technology development to reduce GHG emissions. As much as the Paris Agreement is a step forward and contributes to future strategies to combat pollution, adaptation strategies for new technology development must be processed and evaluated by extension of the field of work. The development and execution of new technology can include several actors (e.g., government, engineers, and farmers) and aspects (e.g., technology, infrastructure, and economy), who all will influence the development of necessary future projects.

### **1.3 Norwegian Policies and The Norwegian Farmers Association**

Norwegian climate policy is mainly influenced by industries related to the oil and electrochemical sectors. Ultimately, the country's climate policy is conducted and presented by emission-intensive industries with a corporate approach by large companies with economist and policymakers (Flemsæter et al., 2018). The Norwegian government submitted a report in 2008 titled "Climate change – agriculture as a part of the solution" (report no. 39), which points out the importance of the agricultural sector in fulfilling climate policy commitments. Accordingly, the farm structure of operations and production on a farm would require change, which made the farmer essential to implement mitigation measures (Brobakk, 2018). To be in line with the Paris Agreement, Klimakur 2030 (2020) was published to the Norwegian government. It highlights the need to cut emissions to limit the global temperature rise. According to them, there are 60 different measures to reduce emissions by 50 % by 2030. Also, several of them will require development of new and existing technologies (Klimakur 2030, 2020). Their focus in the report is non-quota obligated emissions related to transport, agriculture, heating, waste, fluorinated gases and sections from the oil and gas industry.

Development of the agriculture sector is necessary, and the first collaborating agreement to adapt agriculture in the Norwegian business society was established in 1950. It was a political negotiation between the government and The Norwegian Farmers Association (NFA). This was a result of price settlement from the 1930's, and the authorities negotiated with business policy organizations on price and regulatory provisions. The NFA is the largest trade union for Norwegian farmers and the aim is to gather everyone who is or feels connected to the farmers' profession (*Om Norges Bondelag - Norges Bondelag*, 2016). The NFA promote common causes, secure agriculture, and the economic, social, and cultural interest of farmers and is financially and politically independent. Moreover, there is a yearly negotiation of financial opportunities and how the budget will be distributed in the agriculture sector. The agreement will ensure that e.g., food production goals set by the government are met. Foremost, more crucial is that the agreement determines what price the farmer will receive when they sell their products. The agreement guarantees public insight and opportunities to gain knowledge, debate and engage in how the State and agriculture prioritize the budgetary framework in the negotiations. Negotiations, both requirements and offers, are public (Bunger, A. Tufte, T, 2016). It follows then, debate about agricultural policy in the public sphere, and the authorities are in need to formulate the proceeding steps of their negotiations



The NFA has in recent years developed its own climate strategy. It is a contingency of the agreement from June 2019 between NFA, NFSA and the Norwegian government. The four main goals in the agreement consist of food security and contingency, agriculture throughout the country, and increased value creation and sustainable agriculture with low greenhouse gas emissions, which according to the NFA can be supported through sufficient income, enhanced investment funds, and improved infrastructure. It also emphasises the possibility to achieve the commitment without reducing topsoil, weakening district settlement and the number of grazing animals (*Om Norges Bondelag - Norges Bondelag*, 2016). However, in the 2021 negotiation, the government implemented a requirement of *loose-housing-barns*. Such barn implementation will enable free movement for livestock to ensure increased animal welfare, which further can reduce greenhouse gas emissions.

The twelfth Sustainable Development Goal (SDG 12) emphasises the work on sustainable consumption and production to accelerate the environmental changes (*Sustainable Consumption and Production | Department of Economic and Social Affairs.*). While animal welfare is not specifically mentioned in the SDGs, the work to achieve them is considered compatible to improve animal welfare and thus reduce greenhouse gas emissions. The World Society for the Protection of Animals (WSPA) work on international recognition of animal welfare as an essential feature to mitigate emissions. The WSPA highlights that low-welfare intensive livestock production leads to an un-sustainable agricultural sector. Challenges in global food security, greenhouse gas emissions and biodiversity are emphasised as critical consequences of such production. Adaptation strategies involve less intensive farming and good animal welfare which leads to lower environmental footprint: “high-yield, but health-compromised livestock have been shown to produce higher greenhouse gas emissions” (WSPA, 2013, *Farm Animal Welfare | World Animal Protection*, 2021). In other words, livestock in loose-house barns can complement the SDGs in working to reduce emissions in agriculture and the Norwegian policies as such.

As a result, the negotiation agreement work as an institutional framework on how agriculture is part of and contributes to society. The negotiations have potential to influence existing infrastructure and future investments in agriculture to mitigate environmental challenges. In the WSPA perspective, will the loose-house-barn strategy will mitigate livestock emissions in agriculture. The strategy will consequently trigger an investment need according to the NFA, and if farmers are unable to invest in new barns it will develop consequences for district

agriculture. The NFA are optimistic in regard to the positive effects of such adaptations, however, they express both frustration and an increased need to collaborate with the government in order to achieve this reorganisation (Norges bondelag, 2021).

At this point there are 2900 loose-housing-barns operating in Norwegian milk production, while there are 4900 original barns responsible for 37 % of the production. An analysis done by Maria Mainitz Fossum and Hanne Kristine Teigland indicate that farms livestock amount is fundamental when investing in loose-housing-barns (Fossum & Teigland, 2020). To achieve a positive net present value of the daily operations according to the collected data, farms will have to maintain 29-38 cattle on an average to receive financial support to adapt, which makes incentives essential for any kind of adaptation (Fossum & Teigland, 2020). In comparison, the average number of cows for dairy farming in Western Norway is about 21, which is the lowest in the country. The loose-housing-barns requirement can thus result in many farm closures in the country, especially among small and medium-sized farms. It is precisely these two groups, small and medium-sized farms, that politicians have chosen to prioritize and develop. Despite national guidelines that barns with 15–30 cows should be given priority when allocating investment grants, this may have little effect if the grant is not increased. Especially since increased subsidies are crucial to get the finances to be adequate for developing farms.

In order to avoid reduction of livestock farming, among other things, the NFA demanded an extraordinary, multi-year investment package of 450 million NOK in addition to the established funds, nevertheless, this was not approved in the government's offer (Bondeopprøret, 2021). On the same lines, the NFA demanded increased income opportunities to reduce the income gap between farmers and other parts of society, which has not been taken into consideration. The government's offer consisted of 962 million NOK, while the NFA demanded 2.1 billion NOK. Lars Petter Bartnes, leader of the NFA commented this in an article on their websites:

In the requirements, we ask for a severe increase in income, and it is not accommodated. The offer does not reflect the economic severity, it does not reduce the income inequality to other groups, and the offer is too weak to create change for the future of agriculture. Translated from Norwegian in best means (Stor acstand til Bønder - Norges Bondelag).

It is further stressed that the requirement without sufficient funding will consequently mean reduction of small and medium farms. The variety will decrease, and the larger farms will be

the only ones left which will be a consequence of valuable recourses for food production in the smaller county areas in Norway. Nevertheless, the agricultural sector is resilient and will, in light of this chapter, continue to seek solutions to develop further and adapt to future challenges.

#### **1.4 Agricultural adaptation to climate change**

The necessities of adaptation to climate change are addressed in the literature on agricultural adaptation, but the focus is on unspecific global terms in addition to adaptations for food security (Bruinsma, 2003; Howden et al., 2007; Kurukulasuriya & Rosenthal, 2003; Lobell et al. 2008; Wreford, Moran & Adger, 2010). Other prominent researchers look deeper into specific regions such as Europe (Iglesias et al. 2007).

While narrowing the search to Norwegian studies, many of the same authors occur. However, the research primarily concern issues in vulnerability assessments (Aaheim, 2009; Kvalvik et al., 2011; O'Brien, Eriksen, Synga & Ness, 2006) to how Norway can be affected by climate change. By extension, researchers investigate both economic (Aaheim, 2003; Vennemo & Raasmussen, 2010) and political (Næss, Bang, Eriksen & Vevatne, 2004) aspects of climate change impacts and adaptation. Technological development and innovation often occur as a means to the mentioned categories. Relevant literature to the agriculture sector often limits the focus on the development of fertiliser and soil to optimise farmers production, both in Norway and in other parts of the world (Rossel & Bouma, 2016; Myhr & Traavik, 2003; Eltun, Korsæth & Nordheim, 2002; Raut & Sitaula, 2012). The productivity of technology adaptation usually improves, and as it is implemented and evolves, this productivity increases further. It can, by extension, provide safe and better food and household production (Chavas & Nauges, 2020).

There is little research on reducing methane emissions within Norwegian agriculture and how technology can mitigate these emissions. Some of the research is conducted by The Center for International Climate Research (CICERO) and Sintef (independent Norwegian research facility), while a local farmer in collaboration with the Norwegian Research Centre (NORCE) has an on-going project in Stavanger.

Methane (CH<sub>4</sub>) is a greenhouse gas which breaks down slowly. Research done by CICERO estimates that the heating effect of methane will exceed the CO<sub>2</sub>-emissions over the next ten years (Dejonckheere et al., 2019). The rise in emissions is largely due to fossilfuel

industrialization and the expansion of agriculture, and the emission in the atmosphere makes it difficult to reach the ambitious Paris Agreement goals. CICERO observes that “reducing methane emissions from agriculture, in particular from ruminant cattle, is more challenging, but scientific and technological innovations and shifting consumption patterns can play effective roles” (Dejonckheere et al., 2019). However, the Zero Emission Cowshed and NorthWesternPaths projects have ambitions to reduce greenhouse gas emissions in food and agricultural systems in Norway and other Nordic countries. The intention is to capture the belch released from cows and exploit it. The idea is to use smart ventilation to withdraw methane and air out of the barn to a mix of energy and further develop energy i.e., heat.

On the same lines, the technology development project of reducing methane in agriculture in Stavanger is done by Gjesdal Gard, NORCE, and Energy Innovation AS (See Appendix I). Their goal and motivation are to reduce emissions at farms and develop technological solutions for dairy farmers while maintaining profit by reducing environmental impact. The technology is similar to the development done by CICERO. However, Gjesdal wants to contribute to energy self-sufficiency for all, and to produce electricity individually. Further, they emphasise the possibility to have more competitive products as society is increasingly sceptic to products that may affect the climate negatively.

#### **1.4.1 Farmer’s perception**

Few researchers have taken farmers attitudes towards climate change and related issues into consideration. The majority of literature focus on farmers in developing countries (Mertz et al. 2009; Maddison 2007; Gwimbi 2009; Gbetibouo 2009) which may be a result these countries having unstable economies and resource environments. However, little attention has been given to developed countries which subsequently are the main polluters (Gerber et al. 2010). In the Norwegian context some literature highlights attitudes to climate change and climate policy (Brobakk 2018; Flemsæter et al. 2018; Mittenzwei et al. 2017) where financial incentives, support schemes and development of new technology are shown as essential means to adaptation. In the words of Brobakk (2018: 1), “Farmers seem to view adapting to new environmental policy as a greater challenge than adapting to climate itself. Farmers also seem to place production-related goals and managing the farm economy higher on the agenda than curbing emissions”. Considering this landscape, behavioural change concerning climate change is both complex and occurs slowly.

Along the same lines, studies of public perception of agriculture have been limited in number. A study done by Boogard et, al. (2010) explored how (non-farming) citizens developed opinions about modern dairy farming. The participants from Norway and the Netherlands experienced a dairy farm in real life. The study registered four topics including: the animals and their products, the rural landscape, farm practices and the farmer. Further, experiences conducted in the study showed a common perception by the citizens. The authors (2010: 1) argued that:

By taking different topics and issues into account and looking at animal farms from multiple angles, the respondents 'developed a balanced and nuanced opinion of animal farming. The image that they constructed was not dualistic (arcadia versus factory) but pluralistic, thus at the same time more complex but also more flexible than expected. We expect that the development of a pluralistic image and balanced opinion was facilitated through the direct experience of dairy farming and farm life.

Agriculture was perceived as responsible for reconciling modernity, traditional, and naturality and that was to be continued. However, the citizens were also willing to accept change. They expect that the perception and opinions can be facilitated by direct experience of farm life.

Westskog, Hovelsrud and Sundqvist (2017) emphasise that local context is not sufficiently addressed in Norwegian national climate adaptation policies, and that it currently can be characterised as top-down with standard requirements. This contributes to challenge farmers perception of adaptation to climate change, and further emphasises the need of inclusion in policymaking. Consequently, this could contribute to them implementing mitigation measures on their farms, and thus show their importance as a sector to reduce emissions. Flemsæter et, al. (2018) analyses this through a climate citizen approach.

In discussion of citizenship, the issue has been centred about individual commitments within a community. However, the concept of *environmental citizenship* has been distinguished between actor-and structure-centred perspective (Flemsæter et al., 2018; Hobson, 2013; Viherhalo, 2017) This essentially distinguishes between configuration and understanding of obligation and entitlements in an environmental perspective and two branches fold out of this by responsibility in relation to environmental citizenship. On the one hand, individual behaviour and practicing

of sustainability is a major focal point: “People’s awareness of environmental issues is strengthened through governmental programmes or environmental organisations and that people need to be disciplined into ‘good’, ‘green’ behaviours” (Flemsæter et al, 2018: 2054). Key features include teaching of sustainable values, a sense of community, and formal guidelines between individuals and institutions by polity [organisations, government].

On the other hand, a less visible focus on people’s behaviour stretching beyond the relationship between the individual and the state: “Responsibility for action is asymmetrical in the sense that privileged groups in affluent societies bear the greatest responsibility for unsustainable behaviour, whereas underprivileged groups in less affluent societies are those who are most harmed (Flemsæter et al, 2018: 2054). By extension, local context connects with the global. The essence of environmental and ecological citizenship is thus how individuals perceive themselves as part of society, in addition to embracing or distancing responsibility of sustainable actions. Environmental citizens suggest that polity are responsible in finding solutions and implementing them, whereas ecological experience is a moral obligation towards society to make individual sustainable action.

As the climate change impacts affects areas with different consequences, the importance of resilient strategies and a contingency plan to tackle potential climate crises increases. The negative effects to agriculture have the potential to affect a country’s stability e.g., food security and increased greenhouse gas emissions, which makes sufficient climate policies and technology developments essential to adapt. While existing policies support these statements, it is interesting to see how farmers perceive themselves as part of the solution to fulfil climate policy commitments.

### **1.5 Problem statement and research questions**

This study aims to investigate how farmers respond to climate change, and the adaptability to implement new technology development in Norway to reduce greenhouse gas emissions.

It also seeks to understand what influence the development and adaptations of new and climate friendly technology will have on efforts to adapt in the agricultural sector. Thus, the main research question for this thesis will run as follows:

## **How do farmers in Norway respond to climate change policy, and what role does technology adaptation play in their efforts to reduce greenhouse gas emissions?**

To answer this, it will be necessary to approach this by applying several complementary research questions in this study. Answering these will give a broader perspective of the case and help provide a clearer and more reliable interpretation of this topic. As a result, there is formulated a set of research questions to function as guiding of the analysis into answering the thesis main research question:

- 1. How do farmers perceive and situate themselves and agriculture to climate change?**
- 2. How do farmers understand and relate to climate change policies?**
- 3. What arguments can be found among the farmers advocating for innovative technology in agriculture?**
- 4. What arguments can be found among farmers arguing against technology mitigation for climate change?**

### **1.6 Addressing the problem statement**

The research questions here are interpreted to understand farmers perspectives of climate change and mitigation in relation to policymaking and technology development in Norway. Further, the farmers perceptions should be interpreted to explore to what extent mitigation can offer advantages to reduce greenhouse gas emissions. There are different aspects connected to climate change and agriculture, however, the research questions limit scope for this thesis. This thesis will not evaluate the truth of different perspectives, in other words, the analysis will focus on what the perspectives are and how they can be interpreted, not whether the responses are correct or incorrect.

Agriculture's actual effect on mitigating climate change will not be the focus in this thesis. It will not be relevant to analyse how Norwegian agriculture works in reducing greenhouse gases, while the perspective on the matter is of interest. The thesis will limit the study to Norway and do not engage in a global focus on climate change. The decision to not take the environmental

mitigation effects into account is especially due to the limited time frame. The relevance is also limited as the existing effects will not change the perception of climate change policies and technology of selected farmers in this study. However, it could be relevant for further studies with the collected data of this study.

The research question that focuses this study has limited existing research. However, there are subjects to be investigated to collect sufficient data to elaborate within the field of research.

Differences in opinions among actors involved in agriculture will contribute to explore relations of perceptions of climate change policies and technology adaptation. Coalitions (described in chapter two) can be established by elaborating the field of research, and the aim and objectives of perception can generate understanding of how decisions can be influenced. Therefore, discourse analysis will be suitable for this study due to how the framework connects and investigates different meanings from interviews, documents, statements, etc., and the researcher/analyst acquires greater insight to analyse the data as a whole. Marteen Hajer (1995) sheds light on such a framework, which analyses argumentative structures centred around of a variety of storylines, this further gives actors/participants a way to reflect and draw upon different discursive categories. This theoretical framework will be further elaborated upon in section two.

## **1.7 Thesis organization following this introduction**

This thesis will be structured as follows:

The next section will further establish the analytical framework in which the data will be analysed. As this thesis will be doing a discourse analysis, the chapter will account for what a discourse is and elaborate on the argumentative approach, which is chosen for this thesis. The theory will contribute to derive what discourses there are and what they contain. In section three the methodological approach will be established. The case selection outlines justification for the approach. Further will the collected data be described, and the main data of choice was essentially conducting interviews, with media sources, and official documents to compare. Section four includes the response and analysis. It will be a discussion of findings and relevant data connected to the research objectives, questions, literature, and theory of this thesis. In section five, an analysis will be conducted, and after the presentation of the different discourses, they will be discussed in relation to each other to understand the subjects' perceptions. Finally,



the last chapter will present the main results with reflections on the thesis. Depending on the findings, thoughts, and remarks of possibilities for future studies in this field will be stated. The reference list will follow the conclusion.

## **2. Analytical framework**

This chapter accounts for the thesis' main structure, which will help understand the phenomena and elements to interpret the discourses and findings. Depending on the aim of what is being studied, there are several theoretical approaches to be taken (Sovacool, Axsen, Sorrell, 2018: 14). Theory can be used as a tool to focus on relevant aspects of a phenomenon, thus helping give structure to obtain an answer for the study's analysis (Blaikie, 2010: 124). Moreover, it is necessary to understand what has or has not been observed, and the tool helps to interpret these observations. Reality can be addressed through a framework derived from theory, such as discourses. Ideas, arguments and meaning from the real world can be interpreted, as Dryzek points out: "A discourse is a shared way of apprehending the world" (Dryzek, 2013: 8). Hence, the theory will offer to organise observations in correlation to information that has been collected.

### **2.1 Consideration of other applicable theories**

Other theoretical approaches could be used for this study; however, the focus and aim would change. Another direction could be narrative analysis to focus on stories created in a literary point of view. This approach has however, similarities to the argumentative approach to discourse analysis, which will be elaborated later in this chapter. The argumentative approach has been chosen as the aim is to understand language used about climate change in agriculture to further understand potential adaptation to policies and technological developments to reduce greenhouse gas emissions. It is relevant to understand the structure of the arguments.

### **2.2 Discourse analysis**

Hajer (1995) describes discourse analysis within social sciences as a post-positivist tradition to understand and interpret connections, as well as meaning for various social processes (45). The analysis can be used as theory and method whereas the approach depends on the research.

An important scholar is Norman Fairclough with the critical discourse analysis. Michel Foucault was another scholar who really placed emphasis on discourse analysis through his focus on power relation with Foucauldian discourse analysis (Jørgensen & Phillips, 1999: 21). The practice of political theory was criticized by Foucault, as the attention to smaller actors (micro-powers) was fairly overlooked in the practice of chosen discourses, and primarily focused on the institution (Jørgensen & Phillips, 1999: 47). By comparison, Foucault focused on influence that had the possibility to generate change.

Everything can be interpreted as text in discourse, despite not being written down, all dialogue can be interpreted (Neumann, 2001: 23). The Hermeneutic tradition also emphasises that expression, dialogue, pictures etc. can be understood as text (Neumann 2014: 103), which as a result means that language is interpreted and understood as a tool to constitute social reality (Yin, 2011: 108).

Discourse analysis assumes that language influences how reality is understood, and how the world is viewed (Hajer, 2006: 66; Jørgensen & Phillips, 1999: 9). Discourse analysis has an epistemological focus, as discourses are in constant change and representations are reproduced for knowledge about reality (Neumann, 2001: 179). Meanings about reality are constructed through discourses that shape the narrative. Furthermore, the perception we have about the social world will be shaped through language and is thus established through discourse (Jørgensen & Phillips, 1999: 28-29; Neumann, 2001: 18). Discourse will be adopted in this thesis as a concept that incorporates conversation and text through its wider meaning. Jørgensen & Phillips (1999: 28) suggest that the discursive practice in collaboration with social practice, such as understanding of phenomena other than text has the potential to complement each other and thus constitute our reality.

In social constructivism it is suggested that discourse adopts the problematic perception which challenges the existing perspective. Depending on the actor's perspective, a problem can have various definitions (Hajer, 1995: 43). Discourse analysis is relevant in terms of analysing representations, in addition to exploring reasons to leave certain aspects out and why something, i.e., meaning, is given power (Hajer, 1995: 43). In order to achieve this, uttered stories and meanings must be examined. By following the different discourses, the task will thus be to find precise meaning in social reality, and as a result explore why specific discourses has authoritative power (Jørgensen & Phillips, 1999: 34).

### **2.3 Establishing the discourses**

Depending on the issue in a chosen discipline discourse analysis can be defined differently (Jensen, 2012: 31). When it comes to the topic of everyday speech, discourse will not be defined as the same as a discussion. Hajer (1995) reminds us that “a discourse refers to a set of concepts that structure the contributions of participants to a discussion” (67). The author further defines a discourse as “a specific ensemble of idea, concept, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities” (Hajer, 1999: 44). John Dryzeck (2013: 9) has in his definition similar ideas when stating that “A discourse is a shared way of apprehending the world. Embedded in language, it enables those who subscribe to it to interpret bits of information and put them together into coherent stories or accounts”. These definitions acknowledge the practices to give content to meaning by using language. This further ensures the interpretation of context; what, why and whom language is delivered to and used as a tool to understand the discursive practice. This is an essential matter in how the issue is framed in addition to what is framed. Further, concept of reality will be actively be created and further reframe the social world as we understand it and not only show us what it is perceived to be (Jensen, 2006: 9, Jørgensen & Phillips, 1999: 9).

While reality can be understood differently, a discourse consists of various factors such as, speech, statements, documents etc. where the language works as a contextual coherence. Language in these contexts is used to create meaning to given reality, how it is described and further establish statements to describe and interpret surroundings, and understand the world (Jensen, 2006: 13; 2012: 31). Jørgensen & Phillips (1999: 22) argues that truth and meaning is created discursively. When making this comment, the point is that the objective truth does not exist, perception is established and constituted through existing discourses. These concepts are used when establishing what discourse is, so too with categories and ideas. When retrieved the platform will emerge to study the discourses. Phenomena can be given meaning trough discursive categories. Nevertheless, it will be understood differently when the discursive categories are changed. The world will only make sense with available discourses (Hajer, 1995: 53). Discourses are unconsciously produced, not intentionally. Structures of communication in forms of written and spoken language, i.e. statements, documents, etc construct discursive categories. Different discourse subjects, such as actors, will practice the discourse theory often

and produce and reproduce it without being aware (Hajer, 1995: 53). However, the actors are aware of self-interest, but not how they contribute to the discourse. Furthermore, the discourse functions are understood when observation and interpretation is done to the discourse.

## **2.4 The Argumentative approach**

Social-interactive discourse theory was explored by Hajer, and he further constructed the discourse theory of Discourse Coalition Framework. This has an argumentative approach which fill the gaps of where the discourse analysis lacks sufficient analysis of the policy processes. This approach will suit this study as it delivers a framework which explores interactions of discoursing subjects and structures. Furthermore, it will construct understanding and context of why something is said, to whom and why a perception is as such for the discursive process (Shmidt, 2011: 56). The actors understanding of reality will contribute to context for the analyst to understand power balance, and where the struggle of dominance exists. Hajer (1995) and Billig (1996) defines this as the argumentative approach. Billig (1996) argues that:

To understand the meaning of a sentence or whole discourse in an argumentative context, one should not examine merely the words within that discourse or the images in the speaker's mind at the moment of utterance. One should also consider the positions which are being criticized, or against which a justification is being mounted. Without knowing these counter-positions, the argumentative meaning will be lost (Billig, 1996: 121).

The approach seeks to fill gaps in the discourse analysis. Hajer argues that subjects ought to be studied as both producers and accounts for transforming a discourse, essentially being involved in the construction of the discourse analysis (Hajer, 1995: 55). This highlights the necessity of investigating the real-world perception for existing actors to understand the discourses. Actors should be looked at critically in such investigations and views should be challenged to obtain better understanding of the context (Billig, 1996: 121). The study of subject positions, which is defined by Davies and Harré (1990: 49) as “the discursive process whereby selves are located in conversations as observably and subjectively coherent participants in jointly produced storylines. There can be interactive positioning in which what one person says positions another. And there can be reflexive positioning in which one positions oneself.” Subject position is the position that constitutes the subject; the phenomenon is dealt with according to

values, representations and institutions that represents one's identity, and identity is what constitutes the position (Neumann, 2001: 94). In other words, action reproduce the notion of social reality. Consequently, it becomes equally important to study the 'structure positioning' (Hajer, 1995: 56). Such positionings work as structures in variables such as institutions, values, and identity representation. These are either persistent or able to change, which means the position can be both reproduced, and transformed. A case in point is a petroleum company, that shifts focus to environmental strategies due to climate change perceptions.

In the petroleum company, actors are tied to specific positions to utter themselves as they represent it and not the individual (Hajer, 1995: 56). It is [often] not the individual under investigation when investigating the discourses, but the positioning of the actor. Nevertheless, the position will be taken to account as one reveals a discourse. Social reality will be reflected on the individual simultaneous to the actors' position (Davies & Harré, 1990: 45; Hajer, 1995: 56). Depending on the role of the actor/individual [employee, expert, friend etc] nuances will vary.

*Storylines* are influential concepts within the argumentative approach. In discourses of politics, especially environmental problems, this has become important. The variety of representation of issues evolve from various directions. Storyline is defined as:

(...) a generative sort of narrative that allows actors to draw upon various discursive categories to give meaning to specific physical or social phenomena. The key function of storylines is that they suggest unity in the bewildering variety of separate discursive component parts of a problem (...). (Hajer, 1995: 56)

The storylines conduct understanding of an actor's position, as to how choices are made available to them while not being bound to the specific position (Hajer, 1995: 56). It further presents different external elements such as categories, concepts, references etc, can be adopted to various discourses to construct arguments. The perception of reality supports the meaning of the story in the appeal for common grounds to the message receiver, which results in development of discourses. By appealing to the message receiver when telling a story with the meaning as it is, the perception of reality will have opportunity to support it. Thus the story will draw upon other discourses. By extension, meanings to stories will empower the discourse when using rhetorical means and metaphors, to appeal to decision-makers in their strategies.

The argumentative approach claims that there will never be a complete understanding of a problem, and that communication is about interpretation between actors. Reality is explained through narratives as it is seen and understood in storylines. Necessary elements are drawn outside of the discourse and create a new platform to indicate and generate common understanding of the phenomenon. This can provide simple explanations of a complex issue or phenomenon. Storylines can give the analyst understanding of incomplete problem definitions and see the continuous change of them. Ultimately, it shows that 'mutual understanding' of a story is rarely the case, i.e., the message-sender and receiver can misunderstand the meaning as the emphasis of value in the message is different (Hajer, 2006: 69). By establishing storylines, the interpretation of discourses in a fluctuating social reality will be of help.

Different tools used in storylines can contribute to the focus of this thesis of climate change discourses in agriculture. *Metaphor* is considered an important tool when investigating storylines. Hajer (2006) celebrates the fact that, "metaphors bring out the 'thisness' of that or the 'thatness' of a this" (68). In other words, it means saying something without directly saying what is such as symbolism in speech. *Analogies, historical references, clichés, and appeals* are also used as tools to trace storylines in discourses (Hajer, 1995: 63). These are important to understand the discourse, as they describe the underlying content. Thus, providing understanding of the storyline's intention to ensure all elements of a discourse are included.

In Hajer's (1995) revision of discourse analysis, he particularly emphasises the role of coalitions and their emergence. Hajer (1995) defines Discourse-coalitions as "the ensemble of (1) a set of storylines; (2) the actors who utter these storylines; and (3) the practices in which this discursive activity is based" (65). Ultimately, storylines are vital for the existence of coalitions, as they form due to common use of storylines and arguments despite mostly different interests. In addition, specific settings will be of importance in relation to which storyline is uttered. This will consequently reveal when the discourses are drawn upon (Hajer, 2006: 70). The discourse-coalition is thus formed by the context in which storylines are uttered.

Coalitions are formed when actors take use of similar discourses in discussions, however, they do not need to be involved with each other (Hovden & Lindseth, 2006: 66). These coalitions will often be more persuasive and have greater probability to achieve influence on decision makers. A new meaning of a phenomenon can occur when different discursive practices affect

each other. The interaction that occurs in storylines consequently produce discourse-coalition, and to find them the analyst needs to look for similar stories containing different arguments told differently, and thus establish the coalitions. The same outcome may be the approach for the actors; however, the motivation might vary. Language is perceived as actively used in the argumentative approach, and the tools used for storylines takes part of the interaction in discourse. Motives, meanings, and interest are shaped through use of language as a communicative device, hence being a powerful tool in discourse theory (Hajer, 1995: 59).

The argumentative approach takes no consideration to actions and perceptions due to belief systems (Hajer, 1995: 59). Actors will argue for their perception of reality, thus acquiring support, i.e., framing of the phenomenon. Hajer (1995) supports this when arguing that “The argumentative approach conceives of politics as a struggle for discursive hegemony in which actors try to secure support for their definition of reality” (59). To achieve support three dynamics will be vital in the argumentative approach: (1) Credibility – the positioning of a subject is perceived reliable despite what the discourse implies for individual meaning and positioning in a discourse. (2) Acceptability – “attractive or necessary” positionings. (3) Trust – secure trustworthy and precise discourse. Arguments may change perceptions due to development of the characteristic in argument, in other words, make it seem logical or sound right (Hajer, 1995: 59-69).

## **2.5 Discourse analysis as method**

The methodological framework for this thesis is further adopted from discourse analysis, as described in the theory section / previous chapter. The methodological assistance from discourse analysis can be derived from Hajers (2006) ten steps of doing such analysis, as far as it is reasonable to do so. These steps are paraphrased and narrowed to fit the purpose of this thesis (2006: 73).

1. *Desk research*: A general review of relevant documents on climate change, policy, and technology in agriculture: existing research, newspaper, websites, and a general overview of relevant official documents of institutions and organisations.
2. *Helicopter interviews*: In this case conversation and information gathering of informants that have an overview of new technology development, such as methane capture development contributors at NORCE in collaboration with Kjell Ivar Ueland.

3. *Document analysis*: Analysing documents for structuring concepts, ideas, and categorisations; employment of story lines, metaphors, etc. Arguments that are found in relevant documents and statements of existing research and websites etc. will be analysed to see existing arguments that complement the findings. This should result to define structures of various discourses in the discussion.
4. *Interviews with key players*: Based on the first three steps, central actors should be interviewed. These are actors from selected organisations, in this case farmers. The interviews will be used to establish a farmer's perspective on experiences, decisions, etc. The interviews should develop a deeper understanding of what was established in the first three steps.
5. *Site of argumentation*: Search for data, not for reconstruction of arguments, but to account for the argumentative exchange, e.g., debates, and especially minutes of inquiry of a certain decision (this is important for key incident, see step 7)
6. *Analyse for positioning effect*: Actors can get 'caught up' in an interlay. They might force others to take up a particular role, but as they become aware of this, they might also try to refuse this role. In other words, understand farmers position in the chosen discourses.
7. *Identification of key incidents*: Key incidents are incidents that are essential to understanding the discursive dynamic in the sector. Try to gain as much knowledge about the case as possible to gain insight in what determines potential political effects to adaptation process.
8. *Analysis of practices in particular cases of argumentation*: Instead of assuming coherence on part of actors, one should examine data to see if the meaning of what is said is related to the practices in which it was said.
9. *Interpretation*: One may find a discursive order that governed a particular domain in a particular time. It is helpful if one can account for the discursive structures in a discussion and interpret the practices and sites of production that were of importance in explaining a particular course of events.
10. *Second visit to key actors*: After the discourses are constructed, one should inquire about the discourses and ask the key actors if they recognise some of the hidden structures in the language. This is a way of verifying that the analysis makes sense This was done by e-mail correspondence due to the practical limitation of this thesis



How meanings on climate change, policy and technology development evolved to certain perceptions should be investigated by looking at different discourses and comparing them. It is crucial for this thesis to investigate the different perceptions of climate change, policy, and technology within the agriculture sector to understand behaviour. This thesis will practice the definition of Hajer and Dryzek with an emphasis on the elements of discursive understanding and progress. In the investigation of chosen actors, this thesis must focus on existing practices, which is found by exploring and understanding practices, situations, thoughts, and reasons for arguments, determining who is the messenger and the receiver (Hajer, 1995: 44). When doing so, the focus can be derived from storylines that develop from discursive practices. The approach makes it possible to identify the authoritarian discourses and understand which actors manage to gain support of their view. The phenomenon is framed in context of what practices are done, i.e., what is said and to whom it is said, and this is essential to understand the meaning of the discourse.

It is further necessary to investigate how established discursive practises can influence farmers perspective of climate change. Various sets of rules are found within these discourses. They are guides to develop understanding of phenomena's in given concepts, ideas, and categories in the discourses of choice. In other words, the discourse manufactures a type of arena to discuss a problem. The analytical framework of discourse analysis to this thesis will guide the analysis to recognise specific tools used through the language employed by different actors, particularly the use of storylines. For this thesis, the stated arguments and the story that is used to do so will be investigated to further establish potential connection to the existing content of the established discourses. It will also be related to the discourses of choice and data collection. This will eventually give supplementary information for storylines and how to determine what the discourse consists of. For the theoretical aspect, storylines are determined by what and how they are established. Discursive tools are therefore important in the formation of storylines. Hence, the guiding purpose of such tools contribute to the establishment of storylines due to noticeable factors in text, and this case statements. In other words, power and influence of the discourses can be understood through these establishments.

Discourse analysis allows the researcher to grasp the value in derived discourses retrieved from farmers' responses. The experiences were further reconstructed to understand what meaning was constantly reinterpreted. The discourse analysis gave various approaches to informant's

insights through narration. It also challenges the farmer's identity individually and as part of society which can give a clearer direction of the task at hand.

## **2.6 Farmers responds to climate change and discourses**

Other studies have focused on the problem of how farmers respond to climate change and sustainable agriculture. A study with the aim of understanding farmers attitudes, values and intentions towards climate change was conducted by Barnes & Toma (2011). The authors distinguish between six distinct types with different outlooks on climate change impacts: The Regulation Sceptic (RS) is defined through profit maximising behaviour, and scepticism towards regulation in relation to the environment. Second, the Commercial Ecologist (CE) expect negative consequences of climate change. However, the threat is not sufficient to be proactive without the necessary incentives to adapt. "Win-Win" technologies may be efficient.

Further, the Innovator (IN) nurtures and embrace new ideas. However, the IN can be motivated by enhancing efficiency and reducing cost to gain financial reward. Nevertheless, in discussions on climate change the adaptation practice to technology to reduce emissions is more likely, that is if they are profitable. The Disengaged (DG) shows low interest or opinion towards climate change, and by extension that adaptation is believed to be unnecessary as it is not of legitimate use. The Negativist (NG) understands that climate change will have a negative impact, ultimately that weather changes can affect productivity. However, despite being in line with attitudes of profit maximisation, the regulation scepticism results in difficulties in relation to innovative attitudes. Nevertheless, the acceptance of negative impact can lead to adaptation. On the other hand, The Positivist (PT) distinguishes climate change to have a positive impact and effectuating future improvements in yield. This consequently contributes to low adaptation, and the main scepticism concerns regulations over ecological improvement. The analysis found that five of the six types expressed no intention to adopt practices which would reduce emissions and that technology should focus on win-win policies to acquire engagement (Barnes & Toma, 2012: 514-516).

In the work of Fleming & Vanclay (2010) it was showed that sustainable agriculture is essential to keep up with climate change. Consequently, practises within farming will need to change in order to reduce emissions and adapt to social expectations. Consequently, four discourses were critical to shape farmers' perspectives on climate change and understanding of these discourses

can facilitate behavioural change. However, they can also contribute to resistance to change as a result. These discourses include Money, Earth, Human responsibility, and Questioning (Fleming & Vanclay, 2010). The study further discussed barriers for adaptation and practical and information barriers was categories drawn out of the discourses. The practical barriers included arguments to lack of time, money, and social infrastructure. Further, it was individual's motivation, recourses, willingness to risk and character traits essential to change behaviour and be adaptable. The information barriers included lack of information, access to information, problems targeting information, and lack of ability to understand information. The barriers further emphasised the overload of information in society which can result in challenges to narrow it and evaluate it to be of interest. The discourses can influence the language used in conversation of issues, which makes discourses fundamental in understanding behaviour. However, individual behaviour change is slow, and is not perceived as one-to-one persuasion task but a cause to be challenged in society (Tribbia, 2007: 248, retrieved from Fleming & Vanclay, 2010).

In terms of *the discourse of money* (DM) sustainability is considered something viable when the business is profitable: "Nature is understood as a resource to be monitored, controlled and maximised, and sustainability is about continuing productivity and profit" (Fleming & Vanclay, 2010: 13). In discussion on climate change adaptation is not considered crucial which can be a result of gradual environmental changes which is obscure. However, it will be overcome through necessary adaptation, in other words people, governments and international policies will be more important than how the local environment changes. Individual actions can be challenging as restrictions exist as a result of different capacities to take action, in addition to the individual experience of responsibility. Essential parts of this discourse include maximising profits, being able to maintain economic growth, support technological and financial market fixes, and to gain advantage into future opportunities. Climate change is overcome through market forces and innovation which are both a result of social structures and is perceived as a threat when decisions will affect production. Nevertheless, technology is looked upon as a primary solution which means the agriculture sector need to be in line with other industries to be competitive. However, farmers seek to obtain knowledge of other actors' decisions before taking a position themselves. Key words include, effectiveness, efficiency, and market relationships, in addition to industry positioning. The high costs and low profit of adaptation demonstrates the hesitant positions of farmers adaptability in this discourse.

*The discourse of human responsibility (HR)* sheds light on the importance of social action as society is portrayed as the problem. Working together in terms of communication, collaboration and participation is of great need to take action: “Achieving more public engagement with climate change and creating more equitable and desirable government policies and even a better world order” (Fleming & Vanclay, 2010: 15). In making this comment, the discourse highlights shared responsibility to adapt, however it is unclear what actions to take, in addition to having a vague focus due to challenging social structures. Farmers are concerned and feel responsibility in terms of producing enough food for the increasing population. The increase of output, lack of sufficient infrastructures, social systems, and norms makes adaptation and action to climate change challenging. Incorporated infrastructures must be challenged and modified to change consumption patterns, and collective values will be critical to this discourse as society is key to constructing positive environmental changes.

*The discourse of Questioning (DQ)* suggest that uncertainty or incomplete knowledge needs to be faced and developed through facts, truth, knowledge, information, and trust. The issue of exaggeration of negative environmental impacts as a result of human influence contributes to doubt: “Controversial or emotional information is likely to be distrusted and rejected (...) nothing about climate change is black and white, and everything is arguable and contested” (Fleming & Vanclay, 2010: 15). In other words, information revealed as too confusing or difficult to understand can develop distrust. By extension, further engagement to find relevant information is avoided until sufficient research is done to elaborate clear answers. Ultimately, accepted and supported information is trusted when others have acknowledged it: “the most easily adopted positions are either total rejection or sitting on the fence” (Fleming & Vanclay, 2010:15). This is interesting since not deciding is also a decision, there is rarely a neutral position. Scientific knowledge and competent application of technology is essential for farmers within this discourse. It follows that obstacles to adapt due to uncertainty of environmental effects due to either too controversial or radical information for conviction.

*The discourse of earth* includes one controversial issue, that it “is seen as one aspect of ‘the category of environmental insults deriving from industrial society’ (Fleming & Vanclay, 2010: 15). Even though problems such as degradation, pollution and extinction are considered negative, the common perception is that earth will be largely unaffected. Earth consists of creative and restorative powers described as “Mother Nature”, which is a metaphorical personification. Negative effects of climate change are not equally concerned for in the

discourse, as earth will be unaffected by them which makes adaptation less crucial: “Humans do not have dominion over the earth (...) the earth has dominion over humans” (Fleming & Vanclay, 2010: 15). As humans have no control of earth, they are not able to influence any change either. This consequently makes respect for nature essential. There is a sense of something divine, a greater purpose for change in environment and natural evolution, which means that an external force decides the potential development of humans and other species, not its residents.

Although DE can be crucial in concern of climate change in other research, it will not be a major focal point to this study. There have not been questions related to the phenomenon of “Mother Nature” in the interview guide, however, the phenomenon could contribute to interesting perceptions of nature if it was added. Nevertheless, questions about technology have been important for this study, which further establishes the discourse of technology. Technology is also mentioned through DM and DQ. Particularly interesting is how it can complement farmers mitigation to climate change, and the farmers perception of taking use of technology in relation to society, thus how it can complement adaptation behaviour.

*The discourse of technology* is intimately related to the environmental changes. In discussion of technology the economic models and mentioned discourses describe adaptation as profitable. However, important elements include risk, uncertainty, and information acquisitions through learning as there is usually little understanding of the technology in advance: “Farmers are often assumed to be Bayesian learners, and to learn from their own experience (i.e., learning by doing) and/or from others (i.e., learning through contacts with other farmers) (Chavas & Nauges, 2020: 44). Farmers are perceived to work by a “learning by doing strategy”, in addition to gathering information by interacting with other farmers and observing early adaptors. This makes access to information of potential suitability at each respective farm, as well as profitability, essential for the discourse of technology. Furthermore, social interaction and learning plays a particular interesting role for adaptation, despite difficulties to understand actual learning outcomes by the interactions (Chavas & Nauges, 2020: 45) As uncertainty can be central when dealing with innovations, farmers adaptation can consequently be challenging. Further, farmers’ specific needs will vary due to personal capital and conditions in addition to uncertainty of optimal usage, skills, and experience. Technology is more likely to be adopted by farmers with specific needs. Chavas & Nauges (2020) emphasises this in their research: “farmers who overweigh small probabilities adopt earlier” and “risk-reducing technologies are more likely to be adopted

by risk-averse farmers” (:45) such as drought-tolerant technology which contributes minimizing risks in agricultural production. The discourse of technology is particularly interesting for this research as it has been part of the productivity development in agriculture. However, at this point the focus narrows to climate change and how potential developments can mitigate behavioural change for environmental adaptation. The interesting factor is also farmers’ adaptation to these developments, and how they perceive policies as relevant for making these adaptations.

### **1.7 Aim and significance**

The research of Fleming and Vanclay (2010) challenges the work of existing research (Rossel & Bouma, 2016; Myhr & Traavik, 2003; Eltun, Korsæth & Nordheim, 2002; Raut & Sitaula, 2012), which seems to assume that the development of technology is the highest priority, rather than understanding and utilising farmers’ needs, and behaviour related to it. The research of Fleming and Vanclay sheds light on how technology can mitigate climate change and create positive adaptation measures in the agricultural sector. Methane capture technologies can be further developed and researched on to obtain better products. Behavioural change is necessary to be able to take sustainable choices, both in a wider and narrow context, which can be seen through the last decade.

Considering the reports of environmental challenges (Wheeler & von Braun, 2013; CCAASE, 2018; Skarbø & Vinge, 2017), it is to be seen if climate changes become more severe in the future. The importance of assessing information and challenges of what impact environmental changes will have on society, and the agriculture sector expands. New technology development in the agriculture sector to reduce emissions will be essential to have a sustainable future. As a result, it is interesting to look at how farmers relate to climate change policies and technological innovation to reduce greenhouse gas emission, how they are adapting, and what is essential for them to do so.

The contribution this study has will be that (1) it will give insight to Norwegian farmers perception of climate change in policies and technology development, through an investigation of the meanings, reasons, and goals with environmental mitigation from the actors’ point of view, and (2) This study will help to understand, and possibly provide, new information on the current situation in the transition process in Norway and the future of the agriculture sector.

This study's significance is that it will fill a gap where Norway's agricultural mitigation for climate change sector is somewhat diffuse.

### **3. Methodology**

In this chapter the research design and strategy will be explained. All scientific papers or master theses will have to make methodological choices, and a research design guides what plans and choices are made (Blaikie, 2010: 15; Bryman, 2016: 40). The aim is to show what has been studied and how it was conducted, and thus develop a trustworthy study. The design addresses the studies connection of research questions, data collection and the analysis of it (Yin, 2011: 76). In the following chapter the choices made for this thesis will be described, in addition to what has been done during the period for the research of this thesis.

#### **3.1 Case studies**

Case study was chosen to go in depth as climate change is a complex and multidimensional issue. The strategy "investigate a contemporary phenomenon in depth and in its real-world context" (Yin, 2014: 16) was chosen, since case studies have prospects to gain new insight from the agriculture sector. A case study of the Norwegian farmers' relationship to climate change, technology, and policy transitions is applicable here because the aim is to illustrate their environmental adaption, their perceptions, how they relate to opportunities and adjustments, and consequently the results they produce. Norway is particularly interesting due to the continuous change in general climate discourse, and their dedication to reduce emissions (Klimakur, 2030, 2020; Negotiations, Norsk Bondelag, 2021). New technology development to reduce emissions in reference to the policy strategies have potential to expand. By now there has been significant scientific development on how feed composition affects methane emission. However, little to no focus is on development related to methane capture and emission cuts in the field (Forskningsrådet, 2018: 1). Three farmers in the agricultural sector in Norway have been selected based on their field of work and interest in climate change. In addition, the development project "Methane capture from dairy and meat production in operations buildings" from Gjesdal Gard in Rogaland was chosen as a case to further research farmers' perception of technology development. The ability to deal with a substantial amount of data and evidence makes the case study approach unique (Yin, 2014). While the sources in the case study are limited, their approach to the subject is essential for this study.

### **3.1.1 Qualitative methodology**

Methodology can be separated into two groups: quantitative and qualitative research. The most crucial factor for these approaches is to present scientific knowledge for various phenomena in our society (Yin, 2011). Qualitative research has been undertaken to explore the discourses on climate change, to address technology development and mitigation in the agricultural sector. The distinct methodological approach aims to understand how and why social, political, and human issues happen. This thesis aims to create a better understanding of the phenomenon and seeks to explain the role of technology in agriculture. It does that by examining how farmers interpreted climate change and its policies and technology, how their interpretation affected their adaptation to climate change, how this adaptation can eventually be accomplished, and, finally, what kind of result this process can achieve in the case of climate change. Qualitative research contributes to expansion of knowledge, as it is currently relatively limited in this specific field.

An advantage to this approach is that the informant will be studied in their everyday life. As a result, they can provide in depth thoughts, reasonings and opinions on certain issues. The researcher will then be part of the conversation, and consequently, gather necessary information where it is needed. In my opinion, this approach is more suitable as it provides flexibility for the research design.

### **3.1.2 Abductive research strategy**

Abductive research strategy is chosen to analyse how the discourse of climate change is approached by farmers, and how farmers perceive technology adaptation to reduce climate impact. The research method, according to Blaikie and Priest (2019), aims to describe and understand social life. The constructed theories based on observation of different actors' language, meanings and motives contribute to an understanding of the climate change discourse in agriculture. Abductive logic investigates what inductive and deductive logics ignore, which is the meanings, interpretations, motives, and intentions that affect the choices people make. Using this strategy helps theory development which consequently would be elaborated repetitiously (Blaikie & Priest, 2019). The main goal of this study is to produce an understanding of a subject, and abductive research strategy is a great tool to observe, describe, interpret, and explain a phenomenon in a new context. It has potential to help test different frames of interpretation. In many cases, such as this one, several frames can be used to complement each other in order to grasp different circumstances and how these connections



can be seen in different perspectives. Abductions let us see objects of social science as individual phenomena's, which we can see in individual events (Danermark, Ekerstrom, Jakobsen & Karlsson, 2002) and for the purpose of this thesis will the individuals' actions and perception be valuable to answer the chosen research questions.

It is important to consider the fact that different actors in the agricultural sector, can, and will have different interpretations. However, these can change over time. The result in the analysis will also be an interpretation on how something can be, not necessarily how it is. The farmers experience situations differently, also decision making will be based on their respective interpretations of how the future of agriculture *can* be in the future, and how to get there. The main goal is to create an understating of the subject. This was done by providing value to an interpretation by connecting observations to theory. Nevertheless, it is not given that the conclusion will be logical or truth preserving, but it is probable, provided that collected perceptions has supportive arguments.

### **3.2 Data selection**

In order to collect primary data in-depth interviews were chosen. The interviews were semi-structured, audiotaped, and transcribed. An interview guide was developed to serve as an orientation while interviewing. The guide was sectioned by essential topics, as the aim was to gather individual views of specific issues. As a result of the interviews being semi-structured, the participants were asked questions to further elaborate when a topic had potential to be essential for the study. While the purpose of the interview was to gain insight into individual perception and perspectives, questions were purposely made open-ended to get free-flowing answers. The interviewee was then able to expand on their answers, which provides new perspectives to the interviewer. Thus, the interviewer will need to pay attention, to understand how the central phenomena of climate change, policy and technology development are perceived by farmers in the agricultural sector. In addition, the official data such as documents, reports and news articles were used to gain understanding of the primary data to achieve sufficient reflection. A disadvantage of conducting interviews is that it is time consuming. However, by the quality of collected data for the purpose of this thesis the interviews were considered highly valuable. The selection of method to conduct the interviews was to some degree non-probable, which means informants are chosen due to their expertise and relation to

farming and agriculture in Norway. The informants, except Kjell Ivar Ueland, were chosen by discussing the research with fellow students.

In the data collection was this thesis interested in how chosen actor account for their reality of climate change and agriculture which made the interviews semi-natural as they are key actors in their business. The individuals were treated as informants, where they gave an account of motives, perceptions and interpretations that can represent actors in the agricultural sector. The actors cannot represent the sector in full, however, as Norwegian agriculture is of small scale, the collected response is of relevance. The individual itself is also relevant for this thesis as representation is limited.

### **3.2.1 Interview strategy**

The cross-sectional approach was chosen for this study as it collects data from different areas and compare actors positions, in addition to collecting it at a single point in time (Blaikie & Priest, 2019). All participants are based in Norway. Due to Covid-19, for safety reasons, the interviews were mainly conducted digitally. Only one was conducted at the respective farm whilst maintaining appropriate distance requirements of the time. Participants contributed to gaining understanding of the agriculture sector nationally and locally. The participants were chosen due to their background in agriculture. Mainly dairy operations were chosen due to the value these farmers could provide to this study as the methane capture development initiated the interest and the project are particularly oriented to cow emissions. The consideration of participants gave insight in evaluation of the source's relevance for the purpose of the thesis. The relevance has been evaluated in the degree participants are involved in agriculture, and thus have perspectives on climate change, policy and technology, hence governmental involvement to adapt to sustainable mitigations.

### **3.2.2 Research ethics, privacy and confidentiality**

Research ethics are important to this study, and especially in collecting and analysing data. The participants must be treated with respect and feel comfortable to respond honestly and not feel exploited (Creswell, 2013: 56). Prior to all interviews, selected participants were sent consent forms containing all essential information relating to the study. They were informed of their options, namely that participation was voluntary, anonymous if preferred, and that they had the

option to withdraw at any time. In addition, they were informed of deletion of data when the research was completed (Creswell, 2013: 174).

There will always be an impractical dimension in ethics and research transparency as the participants have to be protected, and the information acquired will be public. Researchers should respect participants' privacy and integrity and when necessary, it is important to maintain confidentiality (Gomm, 2008). In this research, the acquired information from the respondents was not made totally confidential as it fitted the purpose of the research and anonymity. For this thesis, Kjell Ivar Ueland did not want to be anonymised, and will further in the findings and analysis be referred to as "Farmer 1". The additional participants will be referred to as "Farmer 2" and "Farmer 3".

### **3.2.3 Selection of interviewees**

While attending a meeting for "Samskipnaden i Stavanger" in February 2020 at Røysland Gaard in Rogaland, my initial interest for further research on climate adaptation in agriculture arose. The owner of the farm, Kjell Ivar Ueland, had a tour of the house and told us his story. For me, it was especially interesting to hear about the technology development project on "Methane capture in cowshed" that he was involved in to reduce emissions in agriculture. A helicopter interview (conversation and information gathering) was conducted in meeting with the partners developing the project. To acquire relevant information, Ueland was chosen as a participant in this study. The farmer was selected as the job duties relate to technology development in agriculture, and consequently to learn about the project, motivation, and climate change adaptation strategies. The selection was also done to receive general information about their farms.

Wanting to interview someone without known technology development on the farm, I searched for farmers in Rogaland and found Farmer 3. I called on March 19, 2021 and scheduled a meeting. Due to Covid-19 restrictions, the farmer wanted to meet digitally on Zoom. Furthermore, I established contact with a farmer in Gjerdrum municipality by talking about my project to a fellow student. The farmer was contacted by e-mail and was eager to participate.

### 3.2.4 Interview procedure and timeline

In-depth individual interviews were conducted with three participants from their respective farms: One participant by face-to-face at the farm, and two by internet zoom interview. Interviews were held between 22 March and 16 April 2021 (Figure II). While initially the interviews were scheduled for one hour, all interviews lasted between 28 and 56 minutes. All interviews were recorded, transcribed and then translated into English, with written consensus from all participants. The main language of the interviews was Norwegian as all participants were Norwegian farmers, in addition to maintain the best possible flow in the conversations.

Table I: The interview timeline

| Activity                                                    | Timeline      |
|-------------------------------------------------------------|---------------|
| Interview with Farmer 3                                     | 22 March 2021 |
| Interview with Farmer 2                                     | 9 April 2021  |
| Interview with Kjell Ivar Ueland, Røysland Gaard “Farmer 1” | 16 April 2021 |

### 3.2.5 Operationalization of the measures

The interview guide was divided into three topics: General understanding of their farm and perception of agriculture, climate change relating to agriculture and farming, and lastly technology to adaptation and mitigation. One additional category was used to understand more of the technology development in methane capture in cowsheds (Appendix 1).

Topic one consisted of seven questions relating to the participants’ work in the agriculture sector. It also included questions relating to motivation, positive and negative aspects, essential partners, and knowledge sharing. Finally, the participants were asked questions that allowed them to reflect on prospects for their individual farms and the sector at large.

Topic two consisted of ten questions that aimed to gather participants’ general knowledge and personal perspectives on climate change. Questions in this section helped me gain insights into how participants would adapt and their potential motivation for the direction they choose to go. In addition, there were questions that addressed potential challenges to acquire knowledge for the sector to reach full potential of their future operations. Questions also investigated the responsibility aspects in terms of solutions and potential risks of adapting.

Topic three consisted of five questions which looked at the interviewee's perception of technology as a means to adapt to climate changes. For this topic, the technology development of methane capture in cowsheds was used as an example of innovation in relation to adaptation for the sector. Questions investigated the possible technology optimism, and how the participants valued the potential use of the technological innovation.

Topic four consisted of eight questions and probed into the technology development of the methane emission project. Ueland was particularly of essence in this part as he was involved in developments of this new technology. He was asked about his motivation, importance and value of the project/product, knowledge acquirement and the process of development. As a result of this section, the remaining farmers were informed about the development and asked to reflect on whether it was adaptable for their farms.

### **3.3 Limitations of the research methodology**

#### **3.3.1 Validity and Reliability of Measurement**

Validity, or credibility, depends on what you measure and how it is done. The interpretation and explanation of obtained research data must be "correct" (Maxwell, 2013: 123). In other words, it is important that the researcher critically analyses their findings, and actively tries to falsify their results. Maxwell (2013) further addresses validity threats of started research, as qualitative research is challenging, and validity threats are difficult to avoid. For this study there are two validity threats: (1) researcher bias and (2) reliability.

Subjectivity could be the first possible threat. This refers to the selection of data that fits the thesis research goal, thus collecting theory and preconceptions to "stand out" for the researcher (Maxwell, 2013: 124). Reactivity indicates the influence of the researcher on the interview setting or participants to avoid undesirable cause of variability (Maxwell, 2013: 124). The possibility of researcher bias could appear for this study in the sense of controlling the interview with emphasised focus on how climate change and new technology is important for agricultural development, and that the need to act is important with or without subsidies. The researcher might try to influence the respondents to agree with narrow questions that contributed to none, or little reflection on the matter. In addition, the researcher could use established discourses to lead the responses to fit within them.

Reliability denotes to the extent that results are consistent over time, which further results in accurate representations and that the results of the study can be reproduced with the same methodology (Golafshani, 2003: 598). A weakness with the chosen method is that discourse analysis is challenging to make transparent (Sovacool et al, 2018: 29). It is further challenging because meaning will always be open to interpretation and negotiation. The subjective choices on where to acquire and collect data creates difficulties in replicating the study, which risks the reliability of the thesis (Bryman, 2016: 659). To ensure higher reliability for this thesis, a wider variety of participants could have been included, such as additional participants of varying age, gender and business establishment in different areas of Norway.

This could demonstrate more reliable discourse tendency. However, with the aim of the thesis the limited participants were sufficient and after a certain number of interviews the content acquired will be representative. As this research did not include a quantitative approach, the reliability will not be an applicable criterion to measure the quality of qualitative research (Stenbacka, 2001: 552; Patton, 2002; Lincoln & Guba, 1985: 316). Examination of trustworthiness is crucial to ensure reliability in qualitative research. Multiple methods, such as interviews, recordings, and secondary data, was used to test the validity and reliability for this study. This essentially results in more valid, reliable, and applicable construction of realities (Golafshani, 2003).

### **3.4 Methodology for analysing qualitative interview result**

Content analysis was used to analyse the interviews. This was in order to classify the content of transcribed statements, sentences and words in a system of categories. Content analysis was chosen due to it being an empirical method of describing different features in a message. Discourse analysis then helped me in deconstructing the interviews into categories which provide us with relevant insights that are discussed in the findings and analysis chapters of this study (Table 1 shows discourse categories). By doing this, it made it clear how the research questions fit the responses and defined the direction of the analysis.

## 4. Data and analysis

In this chapter, the results will be presented and further analysed. The data will be presented in light of chosen discourses. Three of the discourses are derived from the Fleming and Vanclay article “Farmer responses to climate change and sustainable agriculture”, and the two latter from Flemsæter et. al., (2018) article “Farmers as climate citizens” and Chavas & Nauges (2020) “Uncertainty, Learning, and Technology Adoption in Agriculture”. After the presentation of these discourses, the discourses and the farmers perceptions will be reviewed and discussed by their similarities, the research questions and to the existing literature determined in the introduction chapter.

In the data presentation, the interview guide categorised the elements of the study. The first part of the data presentation presents the farmers’ general reflections on being a farmer, their motivation to work within their field, information sharing in their region and how they view their prospects in the agriculture sector. In their interviews, farmers readily reflected on different aspects of being a Norwegian farmer in current times. A common denominator to their work was livestock farming, which was intentional for the study to obtain a similar foundation for the data collected. Cattle was particularly important but in two different ways: whereas Farmer 1 delivers exclusive meat from Wagyu Cows, Farmers 2 and 3 mainly focus on milk production in addition to, corn, meat and cultivating of grazing land. All farmers own 300-500 animals, consisting of cows, pigs, and sheep.

The second part of the data presentation explores the selected farmers’ reflections on causes of climate change. They were asked to reflect on their personal perspective, what sustainable farming means to them, and what adaptations they have implemented to be sustainable and cut emissions. Further, they were asked about the need to acquire new knowledge, how existing expertise exists in their region, and finally about responsibility and risks of adaptation.

The final part of the data presentation looks at reflections relating to technology and new developments to complement climate change. They were asked to reflect on what technology means to them, whether it is important, and how it can contribute to their sector’s future. Further, they reflected on elements they considered important to be included in new developments for agriculture to achieve both personal and national goals. Finally, their

motivation to use existing and new technology at their respective farms. Farmer 1 was particularly motivated by new developments and was part of the process for the methane capture technology.

An additional part was added to understand more about the technology development of methane emission project. Farmer 1 was asked to reflect on factors that made him take part in these developments, what was important and how it could contribute to further mitigation within the agricultural sector. Farmers 2 and 3 were also asked about their opinion and potential to adapt to the specific technology however, they were reluctant to add more work to their farm. This section was particularly interesting due to Farmer 1s individual moral obligation to take part in sustainable adaptation measures to reduce emissions and contribute to environmental agriculture for the future.

Five discourses were chosen to do the analysis: The Discourse of Money (DM), The Discourse of Human Responsibility (DHR), The Discourse of Questioning (DQ), The Discourse of Environmental Citizenship (DEC), and The Discourse of Technology (DT). All discourses argue for different aspects of adapting to sustainable farming. The collected data have been categorized in Table I to show the general response retrieved from the interviews to establish the discourses. The most essential findings are further described in detail through the representative discourses which are categorized by the priorities extracted from the farmers' response. The results were further described and prioritised by what the farmers expressed as important. As the responses have been comprised in Table I, some essential quotes have been emphasised in the discourse response analysis. They have been translated from Norwegian in best effort, and every quote is cited with source.

#### **4.1 Farmers' thoughts on agriculture, climate change and technology**

The importance of actions to reduce greenhouse gas emissions is highly emphasised by the Paris Agreement thus all countries part of it have the common cause of increasing the ability to adapt to new challenges. As the climate is changing and weather irregularities affect the environment, the importance of resilient strategies increases. The proposal of CAP determines the attitude to make the agriculture sector resilient and to tackle environmental challenges accordingly. The Paris Agreement also supports the realization of technology to improve



resilience and reduce greenhouse gas emission and the development must include different actors, i.e., government, engineers, and farmers to influence future projects.

The Norwegian climate policies are arguably mainly influenced by fossil fuel centred industries, but the report “Climate change – agriculture as part of the solution” points out the importance of agriculture to fulfil climate policy commitments. The government implemented the requirement of loose-housing-barns as part of the environmental strategy to complement animal welfare. However, the negotiations between the government and the NFA collide as the need for sufficient funding challenges mitigation to such structures. The analysis by Fossum & Teigland (2020) supports the mitigation challenges as small farms can consequently be closed due to lack of incentives.

Literature on farmers’ perception towards climate change policy included financial aspects, and how policies were seen as more challenging to adapt to than the climate itself. On the other hand, public perception was rather limited due to lack of farm experience and knowledge. Fleming and Vanclay (2010) studied farmers’ attitudes on climate change which resulted in four discourses, where three of them were used for the purpose of this study. The discourse of technology and environmental citizenship was a result of reviewing literature and the data collection. The discourses used for the purpose of this thesis will further be compared with the collected responses from the Norwegian farmers selected for this study.

Table II. Comparison of the five discourses influencing the Norwegian farmers.

| Discourses                        | Money                                                                          | Technology                                                                         | Human Responsibility                                           | Environmental Citizenship                                                           | Questioning                                                                                  |
|-----------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>Motivation to be a farmer?</b> | Produce and sell products to result in income                                  | Be sustainable                                                                     | Food security and important service provider                   | Put farmers and agriculture on the agenda                                           | Change society’s perception of agriculture                                                   |
| <b>Positive/negative aspects?</b> | Independency and flexibility, but it includes bad economy                      | Makes the work easier                                                              | Food security and self-sufficiency creates independency.       | Not being acknowledged as a resource                                                | Traditional thinking limits action                                                           |
| <b>Cause of Climate Change?</b>   | Anthropogenic causes: fossil fuels, carbon emissions and consumer consumption. | Less grazing animals historically which may be result of better production pr cow. | Anthropogenic causes: Societies travel and consumption habits. | Anthropogenic is a key feature: Easy access and consumption. Unnecessary traveling. | Lack of research in exploiting farmers as assets and key contributor to reach climate goals. |
| <b>Sustainable agriculture?</b>   | Profitable climate policies to utilize existing recourses                      | Sustainable resources, storage, and placement                                      | Produce healthy and safe food for the future.                  | Non-ideological Energy efficient sustainable solutions                              | Norwegian land efficiency and the meaning of it.                                             |

|                                             |                                                                                                |                                                                                             |                                                                                                                  |                                                                                        |                                                      |
|---------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------|
|                                             | while preserving production capacity.                                                          |                                                                                             |                                                                                                                  |                                                                                        |                                                      |
| <b>Who is responsible to solve CC?</b>      | Government, corporations, industries, consumers.                                               | More engaged and sincere developers of innovative solutions.                                | Society and all people equally.                                                                                  | Agriculture needs to be included as a key partner to succeed.                          | Research to adequate more knowledge.                 |
| <b>Adaptation measures?</b>                 | Subsidies to cultivate financially sustainable long-term management                            | Develop new technology of need                                                              | Existing environmental measures to reduce emissions: Draining, fertilizer placement and focus on animal welfare. | Difficult politics and misunderstanding of agricultural value                          | Farmers notice climate change consistently.          |
| <b>Knowledge sharing?</b>                   | Reduce emissions while producing profit.                                                       | Climate calculator: technology to reduce emissions individual easily.                       | Self-sufficiency and inclusion of politicians for efficiency                                                     | Climate calculator is a development in agreement with the government.                  | More collaboration between Policy makers and farmers |
| <b>Existing expertise?</b>                  | Political Elections prohibit future strategy and profit as they are elected for a limited time | Research facilities such as Norce and Sintef deliver attractive knowledge to be innovative. | Need more awareness of responsibility.                                                                           | Independence and utilize existing expertise for future goals                           | Lack of political knowledge                          |
| <b>Risk to adapt to CC?</b>                 | Financially adequate to continue.                                                              | To advanced and expensive technology to adapt.                                              | Reduce food production.                                                                                          | Regulations and policies which makes it difficult to produce while reducing emissions. | Misunderstanding of adaptation processes.            |
| <b>Future for agriculture?</b>              | Profitable Industry for the next generation.                                                   | Innovative technology                                                                       | Animal welfare.                                                                                                  | Inclusion in decision-making                                                           | Direct the agricultural necessity narrative.         |
| <b>Is technology development important?</b> | Optimizing of production and profit based.                                                     | Self-sufficiency and efficiency. "Precision agriculture"                                    | Sustainable facilities such as biogas is essential.                                                              | Independent adaptation measures.                                                       | Knowledge based interaction of technology.           |
| <b>Important for new development?</b>       | Make it financially attractive. Incentives to make it profitable to adapt.                     | Systems that work in correlation.                                                           | That someone needs it.                                                                                           | Change in behaviour. Be acknowledged.                                                  | Research to provide further knowledge.               |
| <b>Motivation to use technology?</b>        | Financial gain and profits. Subsidise those who adapt.                                         | Be part of the change.                                                                      | Positive for future generations and individual health.                                                           | Respect and acceptance in the innovative and climate reduction areas.                  | Be utilized better in society to reduce emissions.   |

#### 4.1.1 The discourse of money

The discourse of money refers to how profitability and economics become articulated by the farmers. As Fleming and Vanclay (2010) argue, the discourse of money sees nature as a

resource to be monitored, controlled, and optimized for profit. The interviewed farmers reflected these perspectives in how they related to climate change. Farmer 2, for example expressed the importance of supporting policies that would enable adaptation while maintaining a viable and profitable business. The farmers are equally motivated to work in agriculture to produce products efficiently while optimizing profit. Positive aspects mainly include the opportunity to be professionally independent and thus have flexibility in business structure. Nevertheless, this also points out the negative effects i.e., working all hours with difficulties of maintaining financially stable businesses for the farmers. When asked about the cause of climate change, they emphasised anthropogenic causes. All farmers instantly mentioned the vast volume of fossil fuels, CO<sub>2</sub> emissions and consumer consumption as distinctive factors. There is a high production rate which was highlighted as a need of “too much unnecessary stuff” (farmer 3). Constant access and production of consumer goods also makes it easy to replace it rapidly. Along the same lines, is the global access in terms of travel equally pollution, and public pollution habits need to change according to the farmers.

The farmers perceive climate change as a public concern, which makes gradual adaptation necessary to mitigate change. The responsibility to implement change is hence divided amid governments, corporations, industries, and consumers. However, as the discourse of money argues, different capacities to act, in addition to individual experience of responsibility, will make it difficult to see through. Much like the literature (Brobakk 2018; Flemsæter et al. 2018; Mittenzwei et al. 2017), the farmers were particularly concerned with financial incentives and support schemes in conversation of adaptation measures to mitigate environmental changes in agriculture. It is perceived as necessary to cultivate sustainable development and challenge existing and future environmental changes. The Common Agriculture Policy (CAP) supports these perceptions as their proposal points out the necessity of increasing investment and research to create a resilient and sustainable agriculture sector. The fundamental attitude to adaptation was the need to make a viable and profitable business. Farmer 2 expresses the importance of policy implementation of sufficient incentives to make changes for the sector to be sustainable. As Brobakk (2018) points out, the adaptation of new environmental policy is (or can be) more challenging than adapting to the climate itself. An example of this would be the implementation of loose-house-barns as a sufficient means to more sustainable farming. This however, is not given funding in the 2021 negotiations by the government after the NFA clearly has asked for incentives to be able to make changes in agriculture. The discourse of money clearly states the importance of internal changes through governments, as it is

challenging to act as an individual. Farmer 2, for instance, depends on regulations made by corporate businesses to sell their product and make profit.

“Need more subsidies so developments can happen quicker, similar to how it was done with electrical cars, so that within a few years sustainable options can compete in the same sense as everything else” (Farmer 2)

Reduction in emissions do not necessarily mean reduction in production. As the discourse of money is characterized of profit and orchestrating opportunities to maintain competitive advantage, the farmers have all made individual adaptation measures. In addition, the utilization of existing resources important, both financially and sustainably. The feeling of responsibility to adapt for the individual farmer and behaviour change varies. While the farmers of this study all seem to drive electrical cars, different measures are set to their business operations. Farmer 1 has for instance bought an expensive wrapping machine that facilitates environmental-friendly packaging and will further build a bio plant facility in collaboration with the Norwegian University of Science and Technology (NTNU) to make use of waste produced from their slaughterhouse. This is to be both sustainable, but also further develop their business. Farmer 2 has a catchment area which protects watersheds from pollution by agricultural runoff. The farmer also utilizes existing resources and emphasise the importance of grazing animals in agriculture as the grazing grass helps reduce CO<sub>2</sub> emissions. On the other hand, Farmer 2 also expresses the significance of using sufficient funds on proper feeding, as well as the use of sustainable fertilizer, which complements existing literature and research within agriculture (Rossel & Bouma, 2016; Myhr & Traavik, 2003; Eltun, Korsæth & Nordheim, 2002; Raut & Sitaula, 2012). The maximation of production is also described as sustainable:

“High yields are good for climate, because you harvest a lot per input factor, the emissions are equal either way in terms of harvesting and milk production. 10.000 vs 6000 has equally the same methane emissions. It is important to have more financial management at all levels, which result in a sustainable business” (Farmer 2)

Farmer 2 support the claim of Brobakk (2018) that farmers have production-related goals and financial management being more important than curbing emissions. The farmers support this by wanting to utilize existing resources as it is profitable, however, the motivation to do so is also to minimize consumption of new goods within the sector to further curb emissions. The

farmers describe this as sustainable business decisions. When discussing sustainable agriculture, the farmers do not trust the government to preserve production capacity effectively, and the need of subsidies and climate policies to have sustainable adaptation is thus necessary. Farmer 3 describes politicians as adequate, however, limited by election processes as these might prohibit long-term policies and developments. Nevertheless, Farmers 2 and 3 describe a positive collaboration between agriculture and the government as they have established a climate agreement. They developed a “climate calculator” which contributes to calculate which sustainable adaptation measures at distinctive farms are profitable to make. The farmers describe this as a device that can help constitute better financial management which also can result in improved animal welfare.

When discussing knowledge sharing and region participation, Farmer 1 demonstrates that the local areas should be utilized at a greater scale, as the consequence of this can result in sustainable and profitable business decisions. The farmer mentioned Bjerke municipality as an unutilized resource, due to farmers possessing 95 % of the land areas. The land areas consist of sustainable resources such as wind, hydro, and sun that could be exploited to create profitable and environmentally friendly mitigation strategies. This consequently makes the potential profit for both government and farmers not sufficiently utilized.

The farmers perceive important factors of new technology development to consist of creating attractive and profitable industry for the next generation. The discourse of money supports the perception in wanting to maintain economic growth, support of technological development, and to gain advantages for future opportunities. The farmers clearly state that new developments of technology must be crucial, or necessary, in the sector to mitigate adaptation, while also maximizing production and maintaining profits. The Norwegian government acknowledges environmentally friendly solutions in light of their policies; however, the farmers can note subsidies as important to be included for those who make efforts to adapt. The interviewed farmers are technology optimists and collectively agree that technology makes their job easier. Farmers 2 and 3 especially point out the need for subsidies in order to implement new technological developments. Farmer 1, however, emphasises the individual need to take sustainable choices as it is profitable to adapt environmental structures in agriculture. The farmer has implemented wind turbines at the farm to produce clean energy, and the self-sufficiency has allowed the opportunity to build a local slaughterhouse. The sustainable choices have also extended the need to explore new developments.

### **4.1.2 The discourse of technology**

The discourse of technology refers to how technology can mitigate risk, uncertainty, and produce necessary knowledge while maintaining profitable businesses. Chavas & Nauges (2020) argue that farmers are often perceived as Bayesian learners, which means they learn from internal and external experience. Access to information on environmental mitigation options is also essential for the discourse as uncertainty can be central when adapting to new technologies.

The overall motivation for all farmers is the opportunity to be sustainable. Moreover, the positive effects of technology are shown through existing technology as it makes their work efficient and remotely (autopilot features, variable-rate controllers, GPS), while it maximizes their profit and maintains economic growth. However, while climate change is a major disruption, “It has to be profitable to operate sustainable, we need to subsidize those who make an effort” (Farmer 2). Climate change is perceived as a result of anthropogenic causes in this discourse. However, a common public perception is that methane emissions from cattle are responsible for a significant part of the total amount in the sector. As reported from the methane capture technology project, grazing animals are responsible for 50% of the total emissions in Norwegian agriculture (Appendix I).

When asked about climate change, the farmers emphasised the importance and, to some extent, the misperception of grazing animals. Due to technology, Farmer 3 suggested that there are less ruminants historically because of a focus on maximizing production per animal; quality vs quantity. However, this claim is not supported in existing literature which makes the hypothesis inconsistent. Nevertheless, Farmer 1 complains that the uncertainty and lack of information within the field of technology adaptation requires more engaged and sincere developers of innovative solutions. By extension, Farmer 1 further highlights the need of innovative and adaptive farmers to use new technologies and manage solutions. As the discourse of technology suggests, farmers operate mostly through the learning by doing strategy. The need to develop indispensable technology in the sector is needed to obtain sufficient adaptation measures.

The “climate calculator” is a technological development established in collaboration with the government and the NFA. The device was mentioned by both Farmer 2 and Farmer 3. The farmers have no known interaction or contact personally, however, they both spoke highly of the NFA. The farmers experience the knowledge sharing through technology to be of great use,

as this specifically calculates risk and uncertain domains of their business. This supports the research of Chavas & Nauges (2020), where risk-reducing technologies are more likely to be adapted and the climate calculator can be a device increasing positive change for the daily work and reduction of greenhouse gas emissions.

Innovative developments are needed/necessary; however, advanced, and expensive technology is of concern for the farmers in discussing adaptation to sustainable solutions. They further stress the need of knowledge and efficiency, in addition to subsidies to take use of technologies. Farmer 3 highlights the need to maintain profit while being sustainable. In terms of existing expertise, Farmer 1 acknowledges NORCE and Sintef as sufficient research facilities as they deliver attractive innovative solutions. However, as Chavas & Nauges (2020) point out, the adaptation process slows as the technology is more likely to be adopted by farmers with specific needs. Farmer 1 has an individual interest in sharing experiences and knowledge to contribute to efficient technology development. According to Farmer 1, risk-reducing technologies and the utilization of all parts of the farm contribute to reduction of emissions.

“Technology in agriculture clearly exists, but we need to utilize and make it interact all over. A system that manages to work together will be positive. When renewable energy facilitates electricity, other parts run to keep the levels up, and opposite and the energy production has to be balanced to direct the energy to specific area when needed” (Farmer 1)

The farmer highlights the need of coordinated technology systems and further making all Norwegian farmers understand the importance of such systems. In this statement by Farmer 1, the data can be supported in Chavas & Nauges’ (2020) suggestion that the productivity of technology adaptation usually improves, and as it is implemented and evolves, it increases further. It can, by extension, provide safe and better food and household production. However, Farmers 2 and 3 are more likely to use the technology if subsidies are provided, which the research done by Brobakk 2018, Flemsæter et al. 2018, and Mittenzwei et al. 2017, supports by highlighting the need of financial incentives to adapt for new technology. The discourse is prioritized, by the farmers, by need and motivation to develop and implement new technology to make their respective sector more efficient in terms of emission reduction and maintaining economic growth. This is in some sense supported by the discourse of money, as farmers have diverse needs and will vary in aspects like personal capital, condition, and experience.

However, profitable adaptation to agricultural businesses is essential to the discourse of technology and this supports the farmers motivation.

The lack of individual interest to take part in development and mitigation is raised by Farmer 1. The necessity of collaboration between government, industry, and research development is further perceived as crucial to obtain sufficient sustainable adaptations. Farmer 3 believes that Covid-19 can be a positive factor to change technological behaviour within the sector, as the digital communication has shown rapid adaptation. However, the farmers hypothesis is yet to be researched. Being part of the methane capture technology development, Farmer 1 fits the argument of Chavas & Nauges (2020) that farmers with specific needs are more likely to adapt to new technology. Farmer 1, especially, believes in development of sustainable agricultural solutions, which is key to utilizing electricity, wind, and hydrogen. The need of storage technology for excess energy are also stressed. The solution has potential to save unexploited energy and be utilized when needed. The methane capture technology development was motivated by reducing greenhouse gas emission, and especially to develop a sustainable solution which can contribute to energy self-sufficiency. Farmers 2 and 3 were reluctant to use such technology due to the need of acquiring new knowledge, and reluctance in adding more work to their business. However, they do support larger biofuel facilities with the possibility to deliver waste, which further transformed it to sustainable energy. They underline that bigger facilities may be more efficient and profitable for their business.

#### **4.1.3 The discourse of human responsibility**

The discourse of human responsibility refers to the importance of societal action, responsibility, public engagement, and creation of acceptable government policies. As Fleming and Vanclay (2010) argue, there is lack of clarity on what actions to make in addition to a rather vague focus due to challenging social structures. When asked about the motivation to be a farmer the primary drive was to produce safe and healthy food for themselves and society while maintaining animal welfare. The ability to do their respective profession is perceived to be of great pride and provide food security in society are perceived as positive and motivating. This is supported in the discourse of human responsibility where the concern and responsibility to produce enough food for the increasing population is highlighted. Further self-sufficiency was of importance for the farmers, both individually and for Norway as a country. Covid-19 contributed to uncertainty in foreign trade, import and export of food. Self-sufficiency in production of local food has been highlighted as environmentally friendly, as it lowers transport



emissions. Farmer 1 produces food to exclusive restaurants, hotels, and such, while also delivering to grocery stores in the region. This contributes to quality food production and limiting transportation.

In discussions on climate change the anthropogenic causes are also considered as relevant for this discourse for the farmers. However, the consumer part of everyday society is highlighted as the major cause. The population's travel and consumption habits contribute to excessive emissions and the farmers signal the need to focus the responsibility to act for climate change on all humans equally. As the discourse of human responsibility point out, adaptation will be challenging due to lack of direction, social systems, and infrastructure. This is supported by the perception of the farmers, whereas adaptation can be implemented by having environmental choices accessible, i.e., available information which is made transparent and easy. This is perceived to make adaptation for Norwegian farmers more natural and effortless, and potential collective motivation to produce healthy and safe food for the public can thus help develop sustainable agriculture.

Self-sufficiency was particularly stressed by Farmer 1 in the discussion on knowledge sharing, as the aspiration of making farmers self-sufficient with energy is perceived as a great motivation. Further, the interest of achieving more public participation, which includes having politicians gain greater insight into agriculture to develop the best possible solutions. As Boogard et, al. (2010) argues, (non-farming) citizens have a common perception of where they think of agriculture as responsible for reconciling modernity, traditions and naturality, while however, still being open to change. Furthermore, the (non-farming) citizens need to acquire more knowledge of the field, which supports the farmers' perception of unimpressive existing expertise in society. The farmers express the need for more awareness of climate change effects in society in general, but especially how agriculture can be a useful ally to reduce emissions. The responsibility must be shared by different actors in society, which is a common dominator for the discourse of human responsibility. The government is particularly stressed as an essential actor to mitigate emissions. While the interviewed farmers feel responsibility to mitigate emissions, are government polices perceived as important to the development of societal system transformation.

When it comes to the topic of technology, biogas facilities are mentioned as one of the key sustainable solutions within the agriculture sector. In the farmers' perception, the agricultural

society can work together to reduce emissions in using such facilities. Further on, technology can result in low grade solutions at farm levels, which can also contribute to transformation of the environmental and social structures of agriculture and climate change. Key factors of new technology development are that someone needs it, while it creates opportunities for future farmer. The latter is expressed as a particular important motivation for Farmer 2 and 3 to use new developments, in addition to contributing to a clean and healthy planet.

#### **4.1.4 The discourse of environmental citizenship**

The discourse of environmental citizenship distinguishes between actor-and structure-centred perspectives. Flemsæter et al, (2018) refers to formation and understanding of obligation in the environmental perceptive and particularly how governmental structures strengthen the public's awareness of environmental changes. The farmers reflected on their motivation, and implementation of agriculture as a valued partner in future governmental strategies. Especially climate reduction strategies were particularly stressed by all farmers. As there is a lack of research on public perception, the need to make society and government acknowledge the crucial resource farmers are locally and nationally are important for the interviewed farmers. People's awareness of environmental issues is, as previously mentioned, strengthened through governmental programs, and (non-farming) citizen develop opinions about dairy farms regardless, as Boogard et, al. (2010) reports, and in the perceptive of the farmers can inclusion be positive. Inclusion and recognition can be crucial for change of perception, and thus behaviour. Main causes of climate change include anthropogenic causes, but the farmers particularly highlight social action i.e., easy access of goods and travel habits to be at fault. In other words, individual behaviour increases pollution domestically and globally. The discourse of environmental citizenship values teaching sustainable values and achieving a sense of community in addition to conducting formal guidelines to behaviour change. It further distinguishes the responsibility for action as asymmetrical, predominantly between privileged and underprivileged societies. The privileged bear the greatest responsibility for unsustainable behaviour as they have better prospects to act one way or another. Farmer 3 supports this by underlining collective responsibility shared by industries and government, and that consumers are crucial to conducting change. Farmer 2 also illustrates this by stating:

“It is up to each individual, even though it is a bit of a cliché, but we cannot - It is the government that is responsible for facilitating, but the fact that goods are so cheap means

a lot more to the total picture than people understand. Owning an electrical car is not enough” (Farmer 2).

They argue that to have successful adaptations for climate change, agriculture must be included as a key partner. Farmer 1 particularly stresses it by observing that 95 % of the land in Bjerke municipality is owned by farmers. The land consists of sustainable resources such as wind, sun, and water, and if included in policy making and strategies the resources could be utilized and maximized to reduce emissions. Further, Farmer 1 emphasises the importance of individual investment in sustainable energy, such as wind and hydrogen, at distinct farms. Further, it is stated that the existing funding in the oil and gas sector to the green shift should be more focused in other sectors, such as agriculture:

“They regularly get incentives to new development, while there should be greater balance between industries. The billions invested in offshore wind could be budgeted to something that is more long-term. It could be placed at farms to produce energy. I believe it is necessary to find solutions to store energy so it can be transferred to where it is useful” (Farmer 1).

This statement expresses a lack of awareness of potential benefits of agricultural inclusion in government. It further focuses on how farmers can be an asset to complement environmental adaptations. To maintain sustainable agriculture, energy efficiency is crucial, particularly for Farmer 1 and 2. Along the same lines, the farmers describe some politics as “too extreme” in terms of adaptation measures for climate change. In relation to agriculture, the farmers think that politicians misunderstand how farmers and agriculture cultivate Norway in essential ways. This lack of awareness can, according to the farmers, result in the reduction of agriculture structures. The revealed regulation of “loose-house-barns” are factors supplying reduction of farms, especially small farms. While sustainability is essential for all farmers, they emphasise the difficulties to adapt for ideological purposes. The change to sustainable agriculture must include emission-reducing solutions, while maintaining energy efficiency and sharing experiences in society. While the farmers see themselves as important individuals of society with important work, the need to be acknowledged through inclusion of policy making, decision making, and achieving subsidies to adapt is described as key factors.

In discussions on knowledge sharing, the climate calculator can be perceived as a development where the farmers have been included in the process by the government. The measures managed through the technology makes the work of cutting emissions easier for the individual farmers. Along the same lines, the farmers' independency is expressed as essential, especially financially to continue creating positive changes. The existing knowledge and expertise need to be utilized and shared to achieve common and individual goals. Westskog et. al. (2017) argue that local context is not sufficiently addressed, and the top-down approach characterises the standard requirements from national policies for climate adaptation. Utilizing knowledge in agriculture can, according to Farmer 1, achieve positive change. The farmer has been able to build a climate friendly shed, in addition to a slaughterhouse, as a result of investing in green energy while being interested in participating in new developments. The moral obligation to find solutions and implement them are in this case individual and fits to the ecological citizenship.

The obligation to act is more present with Farmer 1 in comparison to Farmer 2 and 3 as they fit into the environmental citizen and believe polity are responsible. They are all open to new technology developments and think the future for agriculture will be through inclusion in decision-making. However, the fear of new regulations and policies that restrict them in producing their products while reducing emissions is vital. For new development there is the need for change in behaviour within the sector, but also in society. Farmers need to be valued. Further, they need to be respected and accepted in the innovative environments to create collaboration and better developments.

#### **4.1.5 The discourse of questioning**

The discourse of questioning focuses on facts, truth, knowledge, information, and trust. Fleming and Vanclay (2010) argue that confusing information can develop distrust, and in discussions on environmental impacts will exaggeration hinder potential adaptation. The particularly stressed motivation for the farmers is to change society's perception of agriculture to create positive societal effects. As controversial or emotional information can disrupt adaptation according to Fleming and Vanclay (2010), the need to cultivate trustful information for the farmers will be essential. Farmer 1 further stresses the issue within the sector, as farmers are needed to create solutions/opportunities to generate change for the future. The traditional thinking is hence constraining the action, which can be a result of limited or incomplete knowledge.

Exaggeration is part of the questioning discourse in terms of climate change. However, the farmers perceive the lack of research in how to take use themselves as assets and key contributors to reach climate goals as part of the cause of climate change. In question of responsibility for environmental action are development of science, truth, information, and trust pointed out as essential for the farmers. Further, developed research will be important to acquire more knowledge in and for society of what agriculture provide for the public, e.g., food production. As there is a lack of research on public perception, new research has possibilities to acknowledge the farmers' position in society and in environmental adaptation. Information revealed as too confusing can develop mistrust and become neglected of adaptation measures. The farmers, nonetheless, emphasise that they notice climatic changes first-hand as it affects their daily work, production, and potential income in comparison to other industries. In terms of responsibility, Farmer 3 also points out that some farmers will deliberately be negative to change, however, still optimistic to others making necessary adaptations as they collectively understand that everyone is important in the mitigation process. The change cannot be avoided, and everyone must adapt.

To achieve reduction of emissions in agriculture will societal awareness of environmental solutions be important. Farmers 2 and 3 argue that the controversy of grazing animals as a negative factor in agriculture must be redirected into the important science of photosynthesis and their cooperation to reduce emissions. Sustainable agriculture is also perceived as something that includes awareness of what Norwegian land efficiency means for agriculture, the environment and society. Farmer 3 insists that grazing animals are important, as they eat grass which further binds  $\text{CO}_2$ . This is further emphasised by stating:

“It is not possible to grow anything other than grass in large parts of Norway, and there are no other animals that can make use of that grass. And then I think it's nice that grass can turn into meat, which then people can benefit from again” (Farmer 3.)

Existing knowledge can develop clarity and further engage society to explore relevant information to gain understanding and reflection on specific decisions, both individually and politically. The result of grazing animals can be adapted to society in sharing knowledge and collective benefits. The farmers point out the potential to take use of sustainable resources while preserving agriculture through collaborating in policy making within their respective regions, as well as on a national level. The issue of insufficient knowledge while conducting policies

and making decisions are perceived as destructive of agricultural prospects by all interviewed farmers. However, they emphasise the fact that the government has the potential to acquire and combine scientific knowledge with farmers' experience to create useful policies and environmental adaptation.

The risk in adapting to climate change includes the misunderstanding of adaptation processes. The traditional thinking and distrust, in addition to lack of sufficient answers can, according to Farmer 1 dictate how the next steps for agriculture will potentially be. Nevertheless, the farmers are optimistic for change, and express the need to direct the agricultural narrative in terms of climate change to trustworthy and positive. When developing new technology, the need to acquire knowledge and interaction within the sector is also emphasised as important. The development of research and trustful information sharing can contribute to adaptation processes, and research and open non-confusing information can add to that. The farmers' motivation to use new technology is the acknowledgment and inclusion in society as important actors in reducing emissions. Farmer 1 stresses this further by stating:

“Unfortunately, we are not understood by the authorities and “city-people” as they think we only cultivate the land. We own large areas of land, and have guts and courage, but we are not utilized enough. It’s easy to have a traditional perspective on farmers and repeat history, which now will contribute to further problems” (Farmer 1)

The farmers and authority's barriers to adapt due to uncertainty and information can according to Farmer 1 create future challenges if they as a sector are not prioritized and utilized. The farmers have in this perceptive great value to mitigate environmental challenges.

## **4.2 Storylines and discourse-coalitions**

In this section storylines drawn from the discourses will be presented. Further, the research questions will guide the analysis to understand the similar storylines and discourse-coalition better. The discussion will describe general relations between the discourses, then determine coalition in perception of climate change, climate change policies and technology adaptation.

Some storylines can be drawn out from the discourses. The storylines are a way of structuring arguments in addition to describing the reality as is presided by the farmers. They can advocate for the discourses and can be used with linguistic tools, such as rhetoric and appeals to

distinguish meaning to the perception that is uttered. The storylines suggested from the data is understood as:

- Norway has a need to develop further research on how agriculture can mitigate climate change
- Farmers must be included and acknowledged in this research, as well as policy- and decision-making
- The public, government, and farmers' traditional thinking of agriculture and climate change challenges future sustainable adaptations
- The government (policy- and decision-makers) are responsible in changing narratives and create reliability to the value of the agriculture sector
- The responsibility to act environmentally is both individual and collective
- Subsidies are crucial to mitigate change, and implement/start adaptation to technology and policies
- Technology is considered important when it can reduce emissions while maintaining, and maximising profit
- Energy efficiency, production efficiency and financial efficiency are considered essential for sustainable development of the agricultural sector
- Support self-sufficiency of energy, i.e., electricity due to sustainable recourses at farms to mitigate emissions

## **5. Discussion**

### **5.1 Relation between the discourses**

The discourse-coalitions are drawn upon when actors use the same storylines. The storylines form the meaning about climate change policies and technology adaptation perceptions. Climate change is understood as something important to adapt to in order to reduce greenhouse gas emissions. In the next section the coalitions between discourses and storylines will be presented to achieve a better understanding of the collected data.

Now that the discourses have been accounted for it is reasonable to understand them in relation to each other and discuss the discursive practices. The perception of climate change for the Norwegian farmers identified through the discourses are generally consistent with the findings

in other studies, i.e., economic, and political aspect (Aaheim, 2009; Kvalvik et al., 2011; O'Brien, Eriksen, Synga & Ness, 2006, Aaheim, 2003; Vennemo & Raasmussen, 2010, Næss, Bang, Eriksen & Vevatne, 2004). Nevertheless, as this research also seeks to understand how farmers relate to climate change policies in addition to what their perspective is of technological innovation to reduce emissions, the existing research does not take it to account.

As a result, the environmental citizen and the technological discourses were included to gain wider understanding for this study. Representation can be analysed to understand why certain aspects are left out while others have more power. Analysing stories and meanings of the responses of all discourses, money was clearly authoritative. A common denominator to this considering all research questions was how subsidies were essential to adapt sustainable policies and technological solutions. The different approaches to understand adaptation behaviour for climate change can as result of the discussed literature and explained discourses be categorized into perception of climate change, relation to climate policies, and perception of technological innovation. These are further elaborated on below to understand similarities or differences between the discourses.

### **5.1.2 Perception of climate change**

In the discussion of climate change all discourses were engaged, however, they were prioritized differently. Anthropogenic causes, i.e., fossil fuels, carbon emissions, were a common denominator for climate change in all discourses. Environmental changes were particularly perceived as consequence of societal habits, i.e., consumption and travel patterns. On the other hand, the lack of research was highlighted as limiting to reduce environmental changes. According to Farmer 1, research will have potential to develop sufficient knowledge and sustainable solutions for the sector to mitigate greenhouse gas emissions. Along the same lines, farmers inclusion in future research was interpreted as valuable to develop better environmental solutions, which is particularly characteristic in the discourse of questioning. In the perception of (non-farming) citizens agriculture is responsible for reconcile tradition and nature. According to Farmer 1, the traditional thinking of agriculture will limit sustainable action. The public, government, and farmers' perception of climate change and agriculture challenges mitigation opportunities as there is a lack of innovative thinking. On the other hand, Farmer 2 points out difficulties in making sustainable changes due to ideological purposes. The farmer perceives themselves as a valuable part of society and suggests that polity are responsible to find solutions



and implement them which is supported by the environmental citizen approach. Farmer 3 shows similar traits when arguing for collective responsibility.

To solve climatic changes, or at least adapt to them, the responsibility varies. Governmental action was observed as crucial for all discourses. Including subsidies, sustainable policies, change of narrative, creating reliability by facilitating more research and including agriculture in further decision-making. Environmental citizenship supports the observation of responsibility when arguing for governmental programs to make society behaviour more sustainable. Environmental citizenship further values individual responsibility and separates between state and individuals, which in this study can be difficult to separate as the farmer is both an individual while being an essential part of Norwegian food production. The farmers' individuality challenges the argumentative approach as the understanding of reality is formed by their occupation. On the other hand, the discourse of human responsibility emphasises the collective responsibility to act environmentally, which all interviewed farmers support in their responses. The lack of direction, social systems, and infrastructure challenges the course of environmental processes, as the farmers' main goal is to produce safe food can such implementation create understanding of the positions and responsibilities they have in society.

Efficiency was mentioned in all discourses, nevertheless in different perspectives and through varied motivation. The utilization of existing sustainable resources, e.g., producing safe food, and producing knowledge of land efficiency are different systems to generate efficient agriculture. Farmers 2 and 3 relate to efficiency mostly through financial aspects, wanting to be subsidised to cultivate sustainable management while maximising profit. On the other hand, Farmer 1 was more interested in creating change by utilizing existing sustainable resources to be self-sufficient with energy, thus maintaining more efficient farming. In contrast to Farmer 2 and 3, it can be observed that Farmer 1 fits the ecological citizen category due to the feeling of moral obligation to make individual sustainable actions to reduce emissions and adapt for the future.

### **5.1.3 Relation to climate change policies**

The environmental citizenship and questioning are also particularly prioritised in the discussion of climate change policies. Concerning the discussion of climate change policies for agriculture, public appearance, change of narrative, and policy-making and decision-making inclusion were particularly prioritised. As Hajer (2006) points out, language can affect how reality is

understood and how we view reality. In the discourse of questioning, society's perception of agriculture and farmers was pointed out as essential to create change. This can be correlated to how the farmers focus on how the government portrays and uses language to distinguish between perception and adaptation. According to Hajer (2006) this will have potential to generate change. All discourses emphasize the need for farmers to be included in policy-making and decision-making and the willingness to adapt to mitigate emissions is vast.

Policies are slightly perceived as destructive for the sector by all discourses as there is a lack of mutual understanding. The perspectives brought by all farmers indicate support to how Norwegian climate policy is mainly influenced by fossil-fuels industries. The report "Climate change – agriculture as part of the solution" points out the agricultural importance to fulfil climate policy commitments. The loose-house-barn policy, for instance, complements the strategy to obtain better structure of operations, where farmers are essential in implementing mitigation measures. However, the NFA fronts a perspective that argues for the valuable role of agriculture in society. While the NFA negotiates financial opportunities and positive policy implementations for the agriculture, the government however, does not accommodate realistic policies to be adapted for (Stor avstand til bønder og realiteter, 2021). The 2021 governmental negotiations and the lack of sufficient funds supports the interviewed farmers' perception of politics to be challenging to implement without sufficient support. Farmer 1 particularly stresses the adaption barriers by arguing that political elections prohibit future strategies as the politicians do not think long term.

The implementation of loose-housing-barns is along the same lines' contradictory, as the national guidelines seek to prioritise small businesses. The study of Fossum & Teigland (2020) argues that the policies can result in closure of farms. This supports the concern to adapt, as regulation and policies make it difficult to produce and especially adapt solutions to reduce emissions. While the discourse of money and technology, supported by Farmer 2 and 3 aim for productivity and profitable policies to mitigate change, Farmer 1 and the discourse of Environmental citizenship is particularly concerned with change in behaviour by collaboration in both arenas, i.e., farmers and polity. The obligation of polity is highlighted as important to produce adequate strategies in order to have farmers being part of the prospects when the environment continuously changes, and shared responsibility is essential. Farmer 2 and 3 report of concerns to be financially secure, to continue due to challenging policies, which supports Brobakk's (2018) point that adaptation to policies are more challenging than climate itself.

Conversely, Farmer 1 values subsidies to generate interest in agriculture for future generations. Further, the incentives are perceived as acknowledgement in order to reduce misunderstandings and increase collaborations between actors, i.e., farmers, government, and the public.

### **4.3.3 Perspective of technological innovation**

The interesting aspect of the discourses is how technology is perceived to complement climate change. The discourses of money and technology share values in the sense that new development is needed while maintaining optimized production and profit. Common denominator between the discourses was particularly how technology could assist to reduce emissions while maintaining profit. The discourse of technology and the discourse of money had most similarities in comparison to remaining discourses. However, it does include elements of uncertainty, risk and learning of new developments, which is supported by the responses. If Norway is to maintain status quo regarding consumption, technology adaptation will be essential in agriculture which is. According to Farmer 1, this is necessary adaptation to sustain Norway's emission reduction. Farmers 2 and 3 complement technology in their personal life, and how it contributes to making their business effective, and suggest that those who try to be sustainable should be subsidised. Farmer 1, on the other hand, demonstrates a certain moral obligation to act individually. This is supported through the methane capture technology development, which is motivated by reducing emissions and particularly to cultivate self-sufficiency in energy production and consumption. The farmer stresses how individual action is of need to mitigate, as well as develop new technologies. Farmer 1's arguments call into question whether agriculture is overlooked in decision-making, and the data suggests that both polity and farmers are needed to collaborate to achieve competent solutions.

Scientific knowledge and competent application of technology is essential for farmers within this discourse. It follows then barriers to adapt due to uncertainty of environmental effects due to either controversial or radical information for persuasion. System correlation can increase productivity in financial aspects, while maintaining greenhouse gas emissions. The learning by doing strategy is further highlighted as a key feature. The social interaction and learning are interesting whereas the climate calculator is perceived as a positive technology to reduce emissions, however, the discourse of money is prioritized here as well. Farmers 2 and 3 emphasise the financial functions whereas the mitigation strategies are prioritized according to what is most profitable. All farmers imply that a lack of knowledge within the sector is a barrier to implementing more technology. Farmer 1 supports the possibility to adapt to technology due

to specific needs as the farmer wanted to fill a gap in the research of methane capture and utilization.

#### **4.3.4 Relations between the farmers' perspectives**

The farmers employ same sets of storylines, while they still maintain individual perceptions of climate change policies and technology adaptations. The storylines are connected to each other, and it can thus be argued that common interest form the basis of the storylines. While different interests are important to understanding the dynamics of the discourses, the argumentative approach is made by storylines of the discourses which indicates the constant relation and clash between the discourses, which indicates (that there is) no absolute truth. The storylines represent what the farmers perceive as their reality, or “facts”. The “facts” are considered correct in all discourses given their definitions, in addition to the determined indications for Norwegian climate policies support as well. However, this research is limited in conflicting perspectives which could challenge the farmers perception and the chosen discourses. The storylines in the selected discourses are good examples of how language affects the perception of the world (Hajer, 2006: 66, Jørgensen & Phillips, 1999: 9). This suggests what the argumentative approach tries to underline, which is how the subjects [farmers] produce and takes account for the transformation of the different discourses. The difference between Farmer 1, and Farmers 2 and 3 can be understood due to various necessities and suitability to increase adaptation. In the ten steps of doing a discourse analysis (Hajer, 2006:73) was actors positioning effects for representation ought to look for, their perception will, as the discourse theory suggest, reflect their personal and professional experiences.

All discourses draw upon various categories and concepts. On the one hand, the discourses of money and technology draw particularly on the concepts concerned with financial aspects. On the other hand, the discourses of environmental citizenship, human responsibility, and questioning focus on concepts of research development to tighten gaps of distrust in information and develop adequate knowledge to challenge responsibility. The argumentative structure of the discourses makes it interesting, as all discourses draw upon climate change. The farmers vary in their intentions, and the message they convey is delivered differently.

For Farmers 2 and 3, the focus is on what society and polity can provide for agriculture in adapting for climate change issues. Nevertheless, they also have a sense of responsibility, which fits with the description of Environmental Citizens. However, they are highly motivated by

financial incentives to adapt. The financial motivation can be understood as a metaphor to be acknowledged in their field of work in Norwegian society. It is clear they wish not to be wealthy by their efforts, but much like the NFA, they want to reduce the financial gap to adapt to future challenges i.e., climate change and new generations of farmers.

By contrast, Farmer 1 is motivated by the moral obligation to act sustainable on an individual level and can be perceived in some sense as an ideologist. The financial aspect is valued in the sense of contribution to new sustainable developments. Farmer 1 distinctly argues for involvement in research, and policy and decision making to challenge existing structures and increase the farmer's value in society. The motivation is driven by competitiveness and involvement in sustainable developments for the industry and arguing through storylines can be valuable when trying to obtain political attention and influence.

While climate change may seem distant and abstract, public understanding will be reliant on future research to develop adequate knowledge, and the government is seen as the conduit for this information to transfer to the public. The resistance observed can be due to confusion of what to do and how to implement practical actions. The barriers of social and governmental structures challenge the optimism to change, which demonstrate unexploited potential on sustainable development. If given resources, the behaviour is likely to change and support new forms of action.

The narrative of agriculture challenges potential adaptation according to the farmers, and lack of information can thus be key to collaboration in order to reduce emissions. The farmers emphasise the need for sufficient information, and community involvement to cultivate progress, as public distrust challenges adaptation behaviour. The conflicting perceptions of the science, polity, and the public in discussion of acknowledgement, citizenship, responsibility for action, knowledge and inclusion in policymaking are in this study colliding through the discourses and retrieved data. Science is a common determiner for the farmers with the position and effect to overcome scepticism of farmers and agriculture, and climate change. It can further provide sufficient tools, such as accessible policies and technology to overcome climatic challenges.

Increased energy production by sustainable resources is important and necessary, and the energy self-sufficiency and efficiency are argued to be crucial for future technology

developments. Farmer 1 challenges the traditional thinking with innovative solutions and can be a subject of positive behaviour change for the future of sustainable agriculture as farmers are considered Bayesian learners (Chavas & Nauges, 2020). By highlighting information of potential benefits of sustainable actions, it could challenge and overcome existing scepticism about mentioned storylines. It can be argued from this perspective that the government, farmers, and society would benefit from the potential effects.

The storylines including farmers' inclusion and governmental responsibility try to destabilise the existing perception of agriculture, and they are also trying to influence upcoming policy decisions. The ongoing negotiations of incentives for the agriculture sector seek to gain political support in the struggle of how agriculture is part of Norwegian industry. In the policy development that is happening (e.g., loose-house-barns), farmers try to use reactive arguments to influence future decision-making and describe challenges included in mitigating them (lower income, closure).

It is empirically evident that the discourses of money and technology has a great influence on the farmers' perspective of climate policies and technology adaptation, and thus discursive authority. Money is more anchored in the decision-making landscape, and particularly due to acknowledgement and profit. However, the discourses coalition between Environmental Citizenship, Human Responsibility and Questioning has discursive authority considering general behaviour and perception of climate policy adaptation. It can be argued that the barriers of adaptation will be challenged due to different ideological perspectives, but it does account for the struggle for the discourse to move forward.

This discourse analysis shows that are different perceptions of the role policies and technology can have in accommodating environmental challenges in agriculture. Fleming and Vanclay (2010) argued that agriculture and behaviour change would be essential to facilitate sustainable adaptation. As a substantiation of this, one argument of this thesis is that the subject of the study supports reviewed literature in perception of climate change policies and technology adaptation. Another argument is that a focus on transparent process of policy and technology development can make the process understandable and relatable for the farmers, thus achieving more satisfactory and effective decision-making. This discourse analysis can be interpreted to specific aims from participating farmers, and other perspectives argue for their role which makes it more easily to understand what agriculture consists of, as well as their aim, and present

and future motivations. These findings can give better insight to what needs ought to be understood in a business decision-making process.

## **Concluding remarks**

In this study the discourse analysis has been used to gain understanding of Norwegian farmers' perceptions on climate change policies and technology adaptation to reduce greenhouse gas emissions. Discourse analysis has been a suitable analytical framework to recognise how the collected data was to be understood as existing knowledge was limited. The argumentative approach of discourse analysis was applied in order to investigate storylines and obtain an understanding of the structures the farmers had. By understanding the structures, the discourse-coalitions became more transparent, especially the financial and responsibility perceptions. It became noticeable when the farmers continuously use the same sets of storylines in the different discourses, which indicates what influence exist in their sector. The relation between storylines can also be argued to represent "facts" in the perception of the discourses which also influences how the discourses operate with reality.

The data retrieved through interviews with the farmers of the Norwegian agricultural community support the discourses identified through literature, however through different ways of framing the issues of climate change policies and technology adaptation to reduce greenhouse gas emissions. The storylines draw particularly on the value of Norwegian agriculture to society. It is related to development of both sufficient climate policies and technology development, and the desire to make use of the agriculture sector as it has great potential for the prospects to reduce greenhouse gas emissions.

In light of the problem statement, there is not only one specific perception of climate change policy and the role of technology adaptation. Ultimately, what is at stake is the unutilized resource farmers ought to be to develop prospects for the future and thus be a valuable actor to reduce emissions. From the discourses determined and elaborated in this thesis for the Norwegian farmers' perceptive, there are points of opportunity for change. By understanding the issues framed in selected discourses, the way forward can be corresponding to them. Motivations for action can minimize misunderstandings and provide mitigation structures. Although Farmer 1's concerns seem idealistic and privileged, the concerns discovered should be further highlighted in the agricultural sector and embraced by society. The response

challenges the existing political and social structures to mitigate transformation on different levels, and all actors of society are key to construct positive environmental changes which is a consensus between the discourses. Technology represents systems of productive reduction of greenhouse gas emissions, and offers a positive alternative for mitigation, but it remains a struggle between individual and collective responsibility of action.

### **Future research**

For future research, it is suggested that the value of farmers should not be underestimated by researchers. There should be conducted an investigating analysis in the agricultural landscape to map out what knowledge and resources can be included to create a better sector. Along the same lines, technology and innovation should be evaluated and directed to relevant environments to challenge the sector and government to reduce greenhouse gas emissions. The narrative should include what farmers represent to the Norwegian landscape, and such research can challenge the political aspects too. It is highly necessary to investigate the effects policy- and decision-making have on the agricultural sector, and thus how it is presented to society. In addition, research on farmers' inclusion in policy and technology-development to reduce emissions will be interesting if the hypothesis of inclusion will challenge the existing strategies and have sustainable results. The effects have the potential to reduce emissions nationally and internationally. A discussion and assessment of what farmers role should have in Norway to mitigate climate emissions will be important to direct future environmental structures.



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# Appendix

## Appendix 1: Methane Capture Development technology



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| <b>Prosjekttittel: Metanfangst fra melke- og kjøttproduksjon i driftsbygninger</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                           |
| <b>Søker – prosjektansvarlig</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                           |
| Bedriftens navn: Gjesdal Gard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Administrativt ansvarlig: Frank Emil Moen |
| Org.nummer: 974 496 526                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | E-postadresse: fem@energyinnovation.no    |
| Adresse: Sygnivollen Gjesdal 116, 4330 Ålgård                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Telefonnummer: +47 91591714               |
| <b>Prosjektleder</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                           |
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| <b>Navn på kompetansemegler som har hjulpet bedriften med utformingen av prosjektet:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                           |
| <b>Terje Handeland</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                           |
| <b>Forskning og innovasjon – begrunnelse for prosjektet</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                           |
| <p>For at vi skal være i stand til nå forpliktelsene om reduksjon i klimagassutslipp i Norge, er det svært viktig med innsats på alle fronter, - så også i Landbruket. Klimagassutslippene fra norsk landbruk er betydelig, med 4,5 million tonn CO<sub>2</sub>-ekvivalenter per år (2016). Dette utgjør 8,4 % av de totale utslippene i Norge. En stor andel av disse utslippene skjer gjennom fordøyelsen hos små- og storfe, gjennom metanutslipp.</p> <p>Det har blitt lagt ned en betydelig forskningsinnsats for å se på hvordan førsammensetningen påvirker utslippene av metan. Men, det er lite fokus på forskning og utvikling knyttet til fangst av metanen som slippes ut. Dette forprosjektet har som mål å klargjøre hvilke mulige teknologier som kan benyttes for slik fangst gjennom tilpasninger av fjøs med ventilasjonsanlegg.</p> <p>Gjennom vesentlige deler av året oppholder dyrene seg i driftsbygninger med kontrollert ventilasjon. Vi ønsker å se på muligheten for å fange metan før</p> |                                           |

**Greenhouse gas emissions from agriculture in 2016**  
Emissions to air (mill. tonnes CO<sub>2</sub>-eq)

| Category                                          | Value (mill. tonnes CO <sub>2</sub> -eq) |
|---------------------------------------------------|------------------------------------------|
| Oil & Gas                                         | 14,8                                     |
| Transport                                         | 16,5                                     |
| Industry                                          | 11,7                                     |
| Energy supply                                     | 1,7                                      |
| Construction                                      | 1,2                                      |
| Waste                                             | 1,3                                      |
| Other emissions                                   | 1,7                                      |
| CH <sub>4</sub> from domestic animals (digestion) | 2,3                                      |
| CH <sub>4</sub> from manure                       | 0,3                                      |
| N <sub>2</sub> O from manure                      | 0,7                                      |
| N <sub>2</sub> O from fertilizer                  | 0,5                                      |
| N <sub>2</sub> O other sources                    | 0,7                                      |
| Other                                             | 0,1                                      |

Source: Modified from Norwegian Environment Agency

**Figure 1: Sources of emissions in agriculture in Norway.**



ventilasjonsluften slippes ut til atmosfæren.

Dette forprosjektet har til hensikt å evaluere ulike muligheter for å gjennomføre metanfangst gjennom ventilasjonssystemet, og i tillegg vurdere hvordan fanget metan kan benyttes som lokal energikilde. Her inngår evaluering av muligheter for å øke den relativt lave konsentrasjonen av metan, uten fare for antennelse, - enten ved å holde konsentrasjonen tilstrekkelig lav, eller innføre tilstrekkelige sikkerhetstiltak.

Videre ønsker vi å vurdere bruken av gassblandingen til lokal energiproduksjon. Det vil f.eks. kunne være mulig å benytte gassen sammen med biogassproduksjon fra organisk avfall fra gårdsdriften, gjennom f.eks. en kombinert varme- og elektrisitetshet (CHP).

Bakgrunnen for prosjektet er et sterkt ønske fra Gjesdal Gard og Røysland Gaard om å bidra til reduksjon av klimagassutslipp i egen virksomhet, og samtidig bidra til løsninger som vil kunne benyttes av andre melke- og kjøttprodusenter, både i inn- og utland. Som vist i figur 1 utgjør klimagassutslipp via metan fra husdyr 50% av de totale klimagassutslippene fra landbruket, og er dermed den klart største enkeltfaktor. Dette mener vi kan reduseres med minst 50%, forutsatt at dyrene tilbringer minst 6 måneder innendørs. I Norge er perioden innendørs lenger, og mulighetene for klimagasskutt større. For Gjesdal gard: Melkekyr 8 mnd inne + ca. halvpart av resterende (snitt 10 mnd), kjøttproduksjon fra ammekyr og sau ca. 6-7 mnd. inne, og kjøttproduksjon fra stuter – inne hele året).

Det er foreløpig ingen kjente løsninger for å fange metan fra ventilasjonsluft i driftsbygninger. Det er derfor nødvendig å vurdere ulike muligheter og utarbeide et grunnlag for videre utvikling og verifisering via testing i et autentisk miljøet. Dette vil kreve en teknisk og tverrfaglig tilnærming som bare finnes i samarbeid mellom bøndene, industrien og erfarne og flerfaglige forskningsorganisasjoner.

Så langt har det meste av fokuset på kutt i klimagassutslipp knyttet til kjøttproduksjon vært på husdyrgjødsel (=> f.eks. husdyrgjødselbehandling og biogassproduksjon) og hvordan førsammensetningen påvirker metanproduksjonen. Dette dekker foreløpig bare en liten del av det totale klimagassutslippet. Skal en lykkes med vesentlige klimagasskutt, så vil fangst av metan være helt avgjørende.

Gjennom en begrenset forundersøkelse er det ikke avdekket teknologi som er utviklet til dette formålet. Men, det er sannsynlig at teknologi og system utviklet til industrielle formål kan videreutvikles til vårt formål. Litteraturstudier viser dog at denne teknologien er begrenset til høyere konsentrasjoner av metan enn det vi vil finne i fjøs med kjøttproduksjon.

### **Virkning og effekter**

Hvis forprosjektet lykkes, med et etterfølgende fullskala utviklings- og testprosjekt, er potensialet for klimagassreduksjon svært stor, - ikke minst i internasjonal sammenheng. Bønder vil ha nytte av å redusere miljøpåvirkningen av landbruksaktivitetene og dermed gjøre produktene deres mer konkurransedyktige i et samfunn med økende skepsis til produkter som påvirker klimaet på en negativ måte. Videre har involvert industri mulighet til å produsere og selge nye produkter og tjenester knyttet til levering av et teknisk system / løsning, ikke bare i Norge – men, også globalt.

Potensial for klimagassreduksjon i Norge: I overkant av 1,1 millioner tonn CO<sub>2</sub>-ekvivalenter

Potensial for verdiskaping er svært vanskelig å estimere gitt både direkte og indirekte virkninger, men det vil kunne være snakk om flere 100-talls millioner kroner.  
Prisen på CO<sub>2</sub>-utslipp i EU var 26,2 Euro/tonn i uke 38 2019. En reduksjon på 1 millioner tonn CO<sub>2</sub>-ekvivalter vil da ha en overført «verdi» i utslippsreduksjon på nærmere 300 millioner kroner.

### Gjennomføring – plan for prosjektet

Prosjektet vil bli utført gjennom følgende arbeidspakker:

#### AP1 - Bakgrunnsdata

Arbeidspakken vil fokusere på nødvendige avklaringer gjennom litteraturstudier knyttet til selve metanutslippet fra kjøttproduksjonen; mengde og konsentrasjon knyttet til hvilke og hvor mange dyr per produksjonsenhet, innvirkning av fórtype, utforming av fjøs / geometri, ventilasjonslufthastighet mv. Utgangspunktet vil være Gjesdal Gard, og vil inkludere deres planer for utvidelse av kjøttproduksjonen. Informasjon fra andre kjøttprodusenter kan bli benyttet som supplement.

Siden gården også ønsker å installere et biogassanlegg og lokal strømproduksjon, vil arbeidspakken også belyse mulig utnyttelse av metanfangst i denne sammenhengen.

Videre vil det være behov for å identifisere kriterier som utviklet system trenger å oppfylle. Disse dekker tekniske, men også økonomiske forhold, så vel kompleksitet og robusthet. Kriteriene vil bli benyttet for å finne den mest kostnadseffektive løsningen.

#### AP2 - Gjennomgang av eksisterende løsninger og tekniske tilnærminger

Målet med denne arbeidspakken er å gjennomgå eksisterende løsninger i andre bransjer som kan være relevante, eller å utvikle et nytt konsept. Slike tilnærminger kan overføres, eller et nytt konsept kan danne grunnlaget for en mulig teknisk løsning. Identifiserte mulige løsninger skal sammenlignes i en matrise i henhold til kriteriene definert i AP1. Det vil bli avholdt en workshop med deltakere både fra Gjesdal Gard, ventilasjonsprodusent (Covent AS) og ulike forskningsmiljø, med sikte på å velge den mest kostnadseffektive løsningen.

#### AP3 - Teknologisk evaluering av det valgte konseptet og planlegging av videreføring.

Det valgte konseptet som framkommer i arbeidspakke 2 vil bli teknisk evaluert. Målet med evalueringen er å identifisere problemstillinger som det er behov for klargjøre gjennom et hovedprosjekt. Her inngår også en vurdering av nødvendige ressurser. Dette danner grunnlaget for utforming av en prosjektplan, for i neste omgang å gjennomføre et nasjonalt eller internasjonalt finansiert hovedprosjekt.

Frank Emil Moen er daglig leder i Energy Innovation AS, utdannet Cand. Scient., og har ledet/leder en rekke utviklingsprosjekt innen fornybar energi og miljøteknologi.

Frank Emil Moen er prosjektansvarlig og ser til at prosjektet gjennomføres i henhold til tidsplan.

Det nedsettes en tverrfaglig prosjektgruppe hvor eieren av Gjesdal Gard bidrar med detaljkunnskap og bakgrunnsdata. Samarbeidspartner fra Røysland Gaard deltar i prosjektgruppen som referansegard. Utførende forskningsinstitusjon er NORCE, med Peter Breuhaus som leder av prosjektgruppen. Han har med seg et forskerteam med erfarne forskere innen energi (energisystemteknologi, termodynamikk, fluidmekanikk etc.) og bioteknologi (mikrobiologi, biogassproduksjon, gjæring etc.). Vi vil også vurdere å involvere ventilasjonsprodusent som deltaker i prosjektgruppen hvis det synes nødvendig. Prosjektgruppen vil slik vi ser det dekke alle relevante temaer i prosjektet.

Forprosjektet tar som nevnt sikte på å evaluere gjennomførbarheten (teknisk og økonomisk) for et konsept som skal samle metanutslipp fra dyr i en driftsbygning som er spesialtilpasset dette formålet, og mulig bruk av oppsamlet metan til lokal energiproduksjon. Forprosjektet skal presentere en foretrukket løsning som skal danne grunnlag for utvikling av en prototype for implementering når Gjesdal Gard skal bygge ny driftsbygning i tilknytning til utvidelse av kjøtt- og melkeproduksjonen.

Videre finansiering til gjennomføring av et hovedprosjekt kan skje gjennom ENOVA, Innovasjon Norge, eller internasjonale program.

### Relevans

Gjesdal Gard har som ambisjon å bli et mønsterbruk med lavest mulige klimagassutslipp, og ha et energiregnskap som går i pluss (mer energi produsert på gården, enn det som forbrukes). Allerede i 2012 ble det gjennomført et mastergradarbeid knyttet til konseptet «nullutslippgård». Gjesdal Gard planlegger nå en betydelig utvidelse av gårdsdriften, og vil bygge et nytt løsdrieffjøs. Nytt husdyrrom er planlagt ventilert med undertrykksventilasjon gjennom overbygg, som vil kunne egne seg godt til metanfangst. Gjesdal gard ser svært positivt – og nødvendig å involvere forsknings- og innovasjonsmiljøer for at de skal kunne oppnå sitt ambisiøse mål om å bli en nullutslippgård.

Regionalplan for energi og klima i Rogaland fylkeskommune har følgende mål for klimagassutslipp knyttet til landbruk: «Utslippet av klimagasser fra landbruket skal reduseres med 15% innen 2020, tilsvarende ca. 100.000 tonn CO<sub>2</sub>-ekvivalenter». Ett av seks delmål under seksjon «Reduksjon av klimagasser» er: «Rensing av ventilasjonsluft fra driftsbygninger».

Forprosjektet er forøvrig i tråd med bioøkonomistrategien til regjeringen, og til VRI Rogaland «Strategi for bioøkonomi i Rogaland 2018 – 2030». I sistnevnte angis følgende formål (relevant for denne søknaden):

- Styrka den regionale innovasjonskrafta og Rogaland som ein innovativ region
- Mei aktivitet innan forskning og utvikling, FoU, knytt til bioøkonomi
- At Rogaland tek eit samfunnsansvar når det gjeld klima

### Bedriftens FoU-erfaring

Har bedriften hatt rollen som administrativt ansvarlig (lead partner) i et prosjekt med finansiell støtte fra Forskningsrådet, Regionale forskningsfond (RFF) eller EU (for eksempel Horizon 2020) tidligere?

Kryss av:

|     |          |
|-----|----------|
| Ja  |          |
| Nei | <b>X</b> |

Hvis ja; utdyp nærmere:

## **Appendix 2: Interview guide**

### **General**

1. What kind of farming do you do? For how long?
2. How many animals do you have? (How many cows?)
3. What is your motivation as a farmer to do what you do?
4. Can you describe your situation of being a farmer? Positive and negative aspects.
5. Who are your most important partners? Do you share knowledge in your region?
6. What do you think is important for the future of agriculture?
7. How do you see the future of your farm? Will it be traditional use?

### **Climate change**

8. What is the cause of climate change?
9. what is your perspective/relation to climate change?
10. Is it important to you to adjust to climate change? Why, why not?
11. Are you adapting to climate change today? How?
12. What is sustainable agriculture?
13. Are you in need to acquire new knowledge? If so, who do you consult with?
14. Do you use, or have you used available expertise in the region? What?
15. Can the region offer enough knowledge/competence for what you do?  
Something you miss (or appreciate)?
16. Who has responsibility for solution to climate change?
17. What is your biggest risk of adapting to climate change?

### **Technology**

18. In your opinion, Is technology important to adapt to/solve climate change in your field of work?
19. Can technology help your farm to achieve its goals?



20. What is, in your opinion, important for new technology development for the agricultural sector?
21. With the technology to reduce methane emissions in cowsheds, what factor of it is most important for you?
22. How is the future of your farm in relation to technology development in relation to climate change?

### **Methane capture in cowshed technology development**

- 1) What is the reason to develop the product? How did you get the idea?  
What is the motivation?
- 2) What is special with your product?
- 3) What value do you see in the product for the future?
- 4) What kind of knowledge do you need for this development?
- 5) How was the process? (Where do you go to get this? the knowledge?)
- 6) Do you feel that you get enough help from the region regarding what you want to start with? On which manner? Something you miss / praise?
- 7) Is the knowledge well enough organized?
- 8) Do you need to acquire new knowledge for what you do today? Who do you consult if so with?