

MASTER IN ENERGY, ENVIRONMENT AND SOCIETY

Department of Media and Social Sciences

Attitudes towards implementing climate change mitigation measures
among farmers in South-Jæren, Norway:
Opportunities and barriers for action

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Master Thesis 2020



University of
Stavanger

MASTER DEGREE IN
Energy, Environment and
Society

MASTER THESIS

CANDIDATE NUMBER: 5631

SEMESTER: Spring

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MASTER THESIS TITLE: Attitudes towards implementing climate change mitigation measures among farmers in South-Jæren, Norway: Opportunities and barriers for action.

SUBJECT WORDS/KEY WORDS: Climate Change, Agriculture, Mitigation, Thematic Analysis.

PAGE NUMBERS: 69 (including references and attachments)

STAVANGER

31.08.2020

.....
DATE/YEAR

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Preface

Becoming a master student has been a journey I would not be without. It has enriched my life and I've experienced a personal growth together with all my classmates from every continent of the world. Throughout the journey of being a master student in Energy, Environment and Society at the University of Stavanger, my curiosity often led the knowledge I received in lectures, in good conversations with my classmates and readings into thinking and looking deeper into the agricultural sector. I often thought about how the different greenhouse gas (GHG) and climate change (CC) problems are being met and treated within the sector. Growing up and living in the South-Jæren area where agricultural business is a large part of the areas industry, together with my personal interest in the sector as student, my goal became to create knowledge that could be beneficial for the agricultural sector. When reading and studying GHG and CC problems in the agriculture sector from several different angles, I saw that there was a need for a deeper focus to gather information from the farmers perspective in the agricultural sectors climate issues. My interests in the agricultural sector and food production in the future of CC is why I have chosen to focus on GHG emissions and CC mitigation within the agricultural sector in Norway. My goal is to create knowledge about to which extent the farmer itself is concerned about the Norwegian agricultural sectors plan and action for reducing GHGs, as well as the forecasted CC risks that could impact the farmers farm practices and future.

Abstract

The agricultural sector in Norway has to reduce greenhouse gasses, and there is established a political agreement between farmers organizations and the government. In relation to the greenhouse gas reduction goals in the agricultural sector, the study looks into the farmers perception of reducing greenhouse gasses for climate change problems and mitigation within their farm business. The research problem that is investigated is «What are the major obstacles for cutting emissions in the agricultural sector in South-Jæren, Norway?”. The farmer is a part of a larger agricultural structural system and the topic of climate change and greenhouse gasses within the agricultural sector is fairly complex and often expert knowledge, the farmers recognize the ongoing discussions, but do not necessarily have the time for investigating the complexity of the problem. Knowledge about climate change in general as well as within the agricultural sector, is often mediated by experts from the field of climate change. Therefor the strategy for communication of knowledge about climate change and greenhouse gasses is important for communicating knowledge that could create a common platform of knowledge for further sectoral development.

The purpose of the study is to do research and create knowledge within the agricultural sector in the South-Jæren area, within Rogaland county. The study investigates the farmers perceptions and attitudes in the case of greenhouse gas reduction and climate mitigation within the farm businesses. There is used a qualitative in-depth interview method as primary data collection, to be able to study and gather data in a semi-natural setting. Secondary data is collected by using the findings from a recently conducted national qualitative questionnaire. The primary data findings are analyzed by using thematic analysis to be able to find similarities and differences across all the studies interviews. The findings from the analysis is then used in the discussion part and is discussed with the case of the theory of climate change mitigation, as well as discussed within the lager context of the thesis.

The conclusion presents the studies extracted knowledge, that explains farmers experience of top-down pressure of needed investments that is expensive for the farm business. The farmers are used to having to do investments in the case of authority decisions. The political focus on large-scale efficient farming, as well as most small-and medium scale farms has

closed down the business, a pressure occurs to investments (e.g. new effective technology solutions) needed for sustaining the farms income. Therefore, a pressure for investment in the case of greenhouse gas reduction in an already pressured industry, could may then have an influence for several agricultural businesses to closing down the farm business. Farmers are then locked into an agricultural system that already demands large investments, and there is no Kapital for climate investments. The problem of reducing greenhouse gasses within the agricultural sector is may not mainly the farmers responsibility, but a larger structural problem, with larger sectoral actors that will have to take larger amount of responsibility in the case of reducing greenhouse gasses from the agricultural sector. This study is focused on the farmer for the reason that farmers perceptions and attitude in the case of greenhouse gas reduction at farms, is knowledge that is necessary and needed for the future sectoral development.

List of abbreviations

CC – Climate change

GHG - Greenhouse gas

IPCC - Intergovernmental Panel on Climate Change

NSD - Norwegian Centre for Research Data

PA - Paris agreement

RQ - Research question

Acknowledgments

Many thanks to my Supervisor Reidar Staupe-Delgado, for positivity, motivation and support. And I'm so grateful for Oluf Langhelle who created such important master course.

As well as my husband Owe, who has stood steady by my side in these years of studying and personal development.

My 4 yr. old daughter Vilde, who lighten my days, and making me see how important it is to learn about our existence on this planet and contribute with knowledge in the development of a sustainable future for younger generations, something we saw the importance of this year with the COVID-19 pandemic!

I am heartily grateful for the farmers who gave some of their time and energy for meeting me for my interviews. I am humbled to see the positive attitude and interest in the thesis topic. I saw how important the work was to the people I met and talked to, that made it extra rewarding to work on. My feelings about the importance of gathering data directly from farmers was confirmed in how I was received as a researcher asking questions.

Thanks to all my classmates in MEES year 2017, for being awesome people. I'm proud of everyone's effort and development, good years together that will be missed and never forgotten.

I am grateful to my lovely horse Spax, that gave me the opportunity of feeling weightless and distracted during this master course, our rides in the forest really cleared my mind.

This master course encouraged a wide range of emotions, but the most important emotion has been pride in what has been mastered.

Times as a student has ended. I hope the study is a useful contribution within the agricultural sectors development and future. My goal has been to produce useful knowledge for the agricultural sector, and I hope my goal has been reached.

*I am grateful
Lovise Hetland
30.08.20*

1. Introduction

Climatic changes are affecting the planet and is a wide problem at a global scale. The agriculture sector is no exception, and the sector face different challenges due to climate change (CC). The stated scientific consensus by scientists from several sectors worldwide in the Intergovernmental Panel on Climate Change (IPCC) declares increasing challenges due to global warming (IPCC, 2018). A changing climate leads to changed weather variations, that further on makes variations in the Earth's environment, which also is the agriculture sectors production resource. The future scenario about the agriculture sector and CC could in the case of IPCCs scientific consensus and research be problematic due to tougher weather variations globally (IPCC, 2019). In relation to the Paris agreement (PA) 2-degree target (Streck et. Al., 2016) and the IPCC report (IPCC, 2018), the world will have to start mitigating and cutting greenhouse gas (GHG) emissions to slow down CC problems rapidly in order to reach a 2-degree global temperature target. To succeed this would demand drastic and rapid decrease of GHG emissions into the atmosphere. The PA is the first of its kind when it comes to the global problem of global warming and CC. It indicates that there is a global political consensus about the global CC, and that there is a need for climate actions to keep the planet within the 2-degree target. (UNFCCC, 2015). Although the agreement is a positive happening for climate actions to occur, it's also being criticized for not being committed strictly enough for participating countries, and that today's actions is not good enough for reaching the 2-degree target in the established timeline (Rogelj. et. al., 2016, 634). The CC actions will have to develop more rapidly in order to get closer to reaching the 2-degree target (Rogelj. et. al., 2016, 636) for limiting global warming.

The risks of CC problems, extreme weather- and environmental changes (IPCC, 2019) is a threat within the Norwegian agricultural sector. In Norway, due to CC and a warmer global temperature, there will be heavier rain as the global temperature rises. (Meteorologisk institutt, 2017). Climate mitigation and adaptation actions for handling CC varies depending on the geographical location around the world. The global agricultural sector and its dependency on climatic and environmental resources in its production and industry, will benefit by embracing the issue of future global warming and its risks in the sectors development and future scenarios at an early stage. *"Rising temperatures, changes in*

precipitation regimes, and increasing frequency, duration, and intensity of extreme events negatively affect crop yields and fodder production." (Toreti et. al., 2019, 652). Food security is crucial, and if a global food crisis occurs there is an increased risk of hunger, poverty and war. A report produced by Lobell et. al. (2007) argue that there is a risk of global food crisis when it comes to the impact that CC has on the agriculture sector.

As Blaikie (Blaikie, 2010, 59) discuss, the pivotal for qualitative social research is the spearhead collection of RQs, and that the collected data for the RQ's is useful for the overall academic discussions. The collected data for the RQ's gives an explorative view of understanding the farmers perspective within the agricultural sector, it highlights the farmers position in a future development of the sector. The problem statement and RQ's I have chosen to study in my master thesis is:

«What are the major obstacles for cutting emissions in the agricultural sector in South-Jæren, Norway?»

The followed RQs for answering my problem statement is:

- 1) What are farmers doing to reduce GHG emissions?
- 2) How do farmers perceive their role in national efforts to reduce GHG emissions?
- 3) What are the main obstacles for further reductions?
- 4) How do farmers perceive that their efforts to reduce GHG emissions could be better facilitated by higher levels?

The farmers view about the reduction of GHGs in their business needs to be researched. Many decisions are being made based on different discussions at a national level, however more attention is needed on the working farmers at local level. The complexity of GHG emissions and the different ongoing discussions makes it highly relevant to research the farmers point of view and gather data that could be useful in the discussions where there could be a gap of knowledge and thereby confusions. I have been studying and gathering data from the farmers

perspective, by arranging qualitative interviews with a representative collection of farmers located in the South-Jæren area, as well as doing a brief literature review.

In the case of this master thesis research problem and RQs, the strategy for investigating the research area and its social context is an exploratory case study, that manages to capture data that leads to explorative descriptions and gives answers that is connected to the problem statement and RQs. The study is in the category of applied research (Blaikie, 2010, 49), filling a knowledge gap in the ongoing discussions about the farming businesses in the case of GHG's and CC, that could be useful knowledge for the agricultural sector. The study aims to contribute with knowledge that can be useful and contribute within a possible knowledge gap. The gathered knowledge will be answering this studies RQ's and may be useful for other research projects, and hopefully inspires to further research in this studies topic. *"While social research helps us answer questions about the social world, it also raises new questions and may change how we look at the world as well"* (Neuman, 2014, 8). Studying a social phenomenon gives the stated and investigated issued problem some forms of attention. 'Standing on the shoulders of giants' (The phrase finder, n.d.). When studying an issued problem and creating new knowledge that could give intellectual progress in the relevant academic discussion, could lead to sociological and societal development and progress.

The research is in a qualitative manner where data collection is qualitative in-depth interviews with informants that are classified for the studies case study: «the case of obstacles for cutting emissions in the agricultural sector». The unit of analysis is a group of farmers in the South-Jæren area in Rogaland county who has a farm business that provides a full-time work position. The gathered data from the exploratory case study and in-depth interviews, is coded and analyzed by using thematic analysis (Braun & Clarke, 2006). The study could be a helpful contribution to the farmers that manage the producing farms within the larger agricultural system and could contribute with knowledge in decision-making processes within the farm business and in agricultural politics.

The purpose of the research's problem statement and RQs is to get closer and get access to empery within the farmers thoughts and everyday practices, as well as their thoughts on the governmental climate decisions and agreements. I have studied to what extent there is a

connection and communication between the farmers at a local level and the national agricultural climate agreements. Communication could be crucial for successfully achieving the common goals of cutting GHG emissions within the Norwegian agricultural sector cutting GHG emissions. The perspective of the farmers could be useful information for the future development of the sector. As elaborated by Zahl-Thanem & Melås (2020) there is a need for sociocultural knowledge within the agricultural sector, a need for knowledge about the farmers thoughts, meanings, plans and decisions (Zahl-Thanem & Melås, 2020, 10).

The Norwegian agriculture sector is number 7 in the line of polluting sectors in Norway (see fig. X) and the total emissions are 4,4 million-ton CO2 equivalents (Statistics Norway, 2020). The governmental agricultural agreement (Ministry of Agriculture and Food, 2019) commits to reach an ambitious goal of reducing 5. million tons CO2 equivalents from the agricultural sector within year 2030 (Ministry of Agriculture and Food, 2019, 3). According to the established agreement and goals, it raises the questions of to what extent the agreement is communicated to local farmers and their businesses, and what is the farmers perception of the climate agreement and its goals.

Emissions to air				
	Million tonnes CO2 equivalents ¹		Change in per cent	
	2019	1990 - 2019	2018 - 2019	
Emissions	*50.3	*-2.3	*-3.4	
Oil and gas extraction	*13.9	*70.2	*-1.7	
Manufacturing industries and mining	*11.7	*-40.7	*-2.1	
Energy supply	*1.7	*307.4	*-4.4	
Heating in other industries and households	*1.0	*-64.7	*15.2	
Road traffic	*8.4	*16.4	*-7.7	
Aviation, navigation, motor equip. etc.	*7.0	*20.6	*-6.5	
Agriculture	*4.4	*-6.0	*-0.7	
Other	*2.2	*-17.1	*-3.9	

¹ Greenhouse gas emissions expressed in CO2-equivalents show how much warming effect a greenhouse gas has, converted to the amount of CO2.
Corrected 19 June 2020. Figures on the total, manufacturing industries and mining and energy supply are corrected due to errors

(Figure X). Emissions air. Gathered from: (Statistics Norway, 2020).

The total national emission for all sectors in Norway, including the agricultural sector, is 52 mil. ton. CO2-equivalants (Norwegian environment agency, 2020) and is obligated to reduce national total emissions in order to be a part of the actions for slowing down global CC in the case of the PA (UNFCCC, 2015). Followed by the transport sector within the non-quota

register, the agricultural sector is accounted as one of the main contributors of GHGs emissions in Norway (Norwegian environment agency, 2020a), and is therefore an important sector that need to cut GHG emissions in order to contribute to the national GHG emission cut. The Norwegian agricultural sectors political agreement between farmers organizations and the government is the first step for GHG reduction (Ministry of Agriculture and Food, 2019). Some argue that the Norwegian agricultural sector is a smaller GHG contributor, although at the same time the sector is featured as one of Norway's largest contributors of GHG emissions equated with the Norwegian transport sector.

Even though the agricultural sector has small number of GHG emissions compared to other Norwegian sectors, the agricultural sector is one of the largest in the statistics for non-quota sector (Ministry of Climate and Environment, 2019). It can be discussed that the complexity of biological processes in the agriculture sector cannot be valued in the same frame as the transport sectors measurable emissions. The agricultural sectors biologically processes both receive and emits GHGs and is a larger complex system to understand in the case of measurable GHG emissions. (Svebestad, 2019) The issue of the sectors complexity has been a limited part of the discussions about the agricultural sectors GHG emissions (Hertzenberg, 2020).

There's also the discussion of farm animals being the largest polluter within the agricultural sectors emissions, and that there is a need for higher vegetable-based diet. This was stated as the most efficient climate action within the agricultural sector in the climate cure 2030, a report created by the ministry of climate and environment to map climate actions within the non-quota sector (Norwegian environment agency, 2020a). The report with the statement about reducing meat production has received large critique from the agricultural sector and is considered to show a limited perspective of the agricultural GHG emission complexity (Eide, 2020). Different ideas and theories about GHG emissions in the agriculture sector has been drawn, but it's often not presenting the complexity of the agriculture sectors GHG circulation well enough. The report "Norwegian agricultural climate plan 2021-2030" (Norges bondelag, 2020) relates and describes the complexity of the agricultural biologically GHG circulation and emission processes.

Despite the different discussions that has been mentioned so far about climate actions in the agricultural sector, the research of this thesis focus on the case of the farmers business model and practices, focusing on the farmers thoughts, attitudes and understandings of CC mitigation and GHG reduction in the agricultural sector and business. To what extent does the farmer experience proper communication and relation to the national agreement and the governmental climate goals in the agricultural sector.

In the case of the history and sociology of Norwegian farmers, family farming is an integrated part of the Norwegian agricultural business model today. The farmers business and practices are therefore largely affected by the farmers personal life and lifestyle, and every informant is closely attached to their farm in both a historical and futuristic timeline. The data gathered for this thesis will give an indication of how climate actions are included in the farmers personal life and business, since it is strongly connected. The study may then get a closer understanding of the farmers in South-Jæren, and their concerns and relations to GHGs and CC mitigation in the agricultural sector in general and within their personal farm and life, and the farms future business plan.

The farmers climate actions:

The sector is known to be adaptive, innovative and capable of handling structural changes. Farming is a business that is dependent on its environment and climate, and the industry is vulnerable to environmental and climatic changes and variations. Within the historical development of farming practices and industrialization in the agricultural sector, the farmer had to be adaptive and innovative to handle the vulnerability to weather variations and changes. The agricultural sector has developed practices and technology in order to get an efficient and often large-scale food production. Today's agriculture sectors practices could have a negative impact on the climate and environment of the earth, and the industry experience external political pressure for changing practices to limit the sectors GHG emissions and destructive environmental exploitation (IPCC, 2019). In the future there will have to be improved solutions for producing food in a sustainable manner, with lower negative impact on the Earth's climate and environment. There are a lot of problems, and we don't know how to solve them as of today. However, an innovative and adaptive process, will hopefully solve many of the problems and mitigate future CC and its challenges.

CC occurs differently depending on the planet's geographical variations, and different geographical locations have different ways of experiencing and mitigating CC. Norway's geographical climate is projections is to experience increased amount of rain (Metrologisk institutt, 2017), which will create more wet land areas and flooding issues. These kinds of problems already have an impact on today's agricultural structure and practices in Norway (Norwegian Environment Agency, 2017). So far Norway has experienced some years where the weather has acted with more extreme variations then the agricultural sector was prepared for, which lead to crop devastation that clearly evolved to an animal food crisis in Europe (Bondebladet, 2018). Since I am personally a horse owner and a crop manager where I produce and sell hay, what happened in Europe and here in Scandinavia felt threatening and serious to me, which got me thinking about the seriousness of food security in a changing climate.

How the global food scenario will look like in the future is unclear. Perhaps the production of food and the human diet will have to change and develop in a direction that is better for the climate and its environment. It is also unknown how humanity manages to accept and embrace upcoming changes in the food system. There are technological innovations like GMO (Shephard, n.d.), and lab grown cultivated meat that could be the solutions of feeding people in the future (Lucas, 2019). Global food politics and purchase agreement could be a solution, but this has been challenged by the corona virus pandemic, where countries saw the need to stop the export of food (Dyer, 2020). Technology innovations could prove to spear the people of the world from hunger, but at the same time we cannot only rely on technology to secure the humanity from future devastation's (e.g. trusting larger complex and expensive technology innovations like the CCS technology solution, where removing co2 from the atmosphere could solve the problem of global warming). One thing is becoming clear to me, and that is that we do not want to experience a food crisis. We have to embrace new knowledge and develop a food system that handles global CC and its challenges. All tools could be handy to embrace this, i.e. geo engineering, technology innovations and work in balance with the natural resources of our planet.

1.1 The studies limitations

There is a wide spectrum of ways CC affects the agricultural sector, and many issues would be interesting to investigate further. In this study I have chosen to limit the study to the farmers perspective, and the aim is to investigate to what degree the farmer focuses on CC mitigation in their farm business. The studies will be limited to mainly be investigated from the farmers perspective about the issue of CC, and obstacles with CC mitigation actions in their farm business. I'm also curious of to what extent the CC mitigation discussions at national level has reached the farmer. The purpose of studying the farmers perspective, is to gather and create knowledge to contribute to the ongoing discussions today.

The case study is limited to South-Jæren which is located in Rogaland county, meaning that a large portion of agricultural industry in Norway has been eliminated. I wish it was possibilities to study the agricultural sector in all of Rogaland county, but that would demand a study on a much larger scale compared to the size of a master thesis. CC and its impacts are a fairly complex topic, and the study therefore does not investigate deeper within the science of CC but uses secondary literature reference for complementing this kind of knowledge. The study is limited to CC mitigation, the case of CC adaptation would be highly relevant to include as much as CC mitigation, but due to the studies size and time limit the main focus is on CC mitigation.

The data collection of the study is gathered from case study, with in-depth interviews of a defined set of informants which gives an exploratory view. This creates new data and empery in the discussions about agricultural GHG reduction and mitigation actions. An even wider data collection from a larger set of informants would give an even deeper understanding of the problem. In this case the study is done in a set timeline for my 30p master theses, time pressure is also a factor that could affect and limit the studies wideness and depth understanding to the studied cases and problems. The study looks deeper into the farmers view, who literally works on and with the ground for food production. It would have been interesting to collect larger amount of primary data from politicians, leaders in agricultural industrial institutions and scientist as well, but more time and resources would be needed, secondary information for this study is gathered by reviewing published literature.

1.2 Structure

The introduction gave a brief explanation of the thesis's larger context, main topic and the research problem that is being investigated, as well as explanations of the political climate agreement and the problem of global emissions. The introduction also presented an overview of the position of Agriculture sectors within national Norwegian governmental GHG reduction goals. Followed is chapter 2. where the research problems background and context are explained. That includes agricultural vulnerability to CC problems, presentation of the Norwegian agricultural sector and the study area, South-Jæren, that is located within Rogaland county. Agricultural emissions and the obstacles for reducing GHG's at farms is explained, as well as Sociology of Norwegian agriculture and the culture of family farms.

Chapter 3. explains what theoretical perspective the research problem is connected to, and elaborates about climate mitigation, planetary boundaries, and the communication of climate change in the case of the public and experts. Chapter 4. Presents the studies method and explains the tools and descriptions of the conducted study, as well as its strength in the case of validity and reliability. Data collection method, the analysis of collected data and ethical reflections within the project is presented as well. Chapter 5. presents the study's collected and then analyzed data and elaborates on the study's findings.

Chapter 6. is the main discussion of the larger context, theory and findings. In this thesis discussion I will use the gathered empery from doing the literature research and interviewing the farmers. In the discussion I will include my findings and add them in the wider discussion about the thesis topic. Chapter 7 presents the study's conclusion, that entails the conducted knowledge from the accomplished study project that answers the research problem and RQ's. The chapter also presents recommendations in the case of agricultural sectoral development. At the end, there is also recommend further research, there is so mush interesting within the agricultural sector to study, but the section is limited for topics related to further studies on this projects study topic.

2. Background

The chapter will present the background information platform of the thesis research problem and questions. Here I will give an overview of the agricultural sectors position in Norway's national GHG emissions and the political work that has been established in national politics today. The research area South-Jæren is presented, and this area is within Rogaland county that is also presented. As well as the sociology of Norwegian farming, and the today's obstacles in relation to CC mitigation and GHG reduction.

2.1 Climate change, agriculture and food security

Political actions for mitigating future increasing CC as McCarthy et. al. (McCarthy et. al., 2001) discusses, the case of the uncertainties and limited knowledge about planetary system and thresholds levels in the case of CC, it is difficult to decide mitigation actions. The level of complexity and uncertainties in the case of the planetary system and CC gives uncertainties that could slow political mitigation actions. Instead CC adaptation could be needed and highly prioritized when a crisis occurs. An increasing visibility of the problem can lead to political adaptation action, which also leads to higher prioritized mitigation actions for future crises. (e.g. McCarthy et. al., 2001, 948; Hogue, 2020). The struggle of initiating and planning political mitigation actions at an early stage also influences the problem of food security and an increasing risk of a food crisis if this is not being prioritized highly enough. The risk of food crisis could be increasing and be related to slow climate mitigation actions in the agricultural sector all around the world.

It is of great importance to the agricultural sector that mitigation measures are initiated. There has been scientifically warnings about food insecurity. *"Our results show that it is highly likely (greater than 90% chance) that growing season temperatures by the end of the 21st century will exceed even the most extreme seasonal temperatures recorded from 1900 to 2006 for most of the tropics and subtropics."* (Battisti & Naylor, 2009, 240). In the case of the increasing problem of CC, the insecurity of food security increases, and thereby the importance of the agricultural sector to focus on mitigation actions to prevent food crisis is increasing in relevance. Increasing weather variation and agricultural practices as of today, when exploiting environmental planetary resources, is vulnerable in the case of extreme

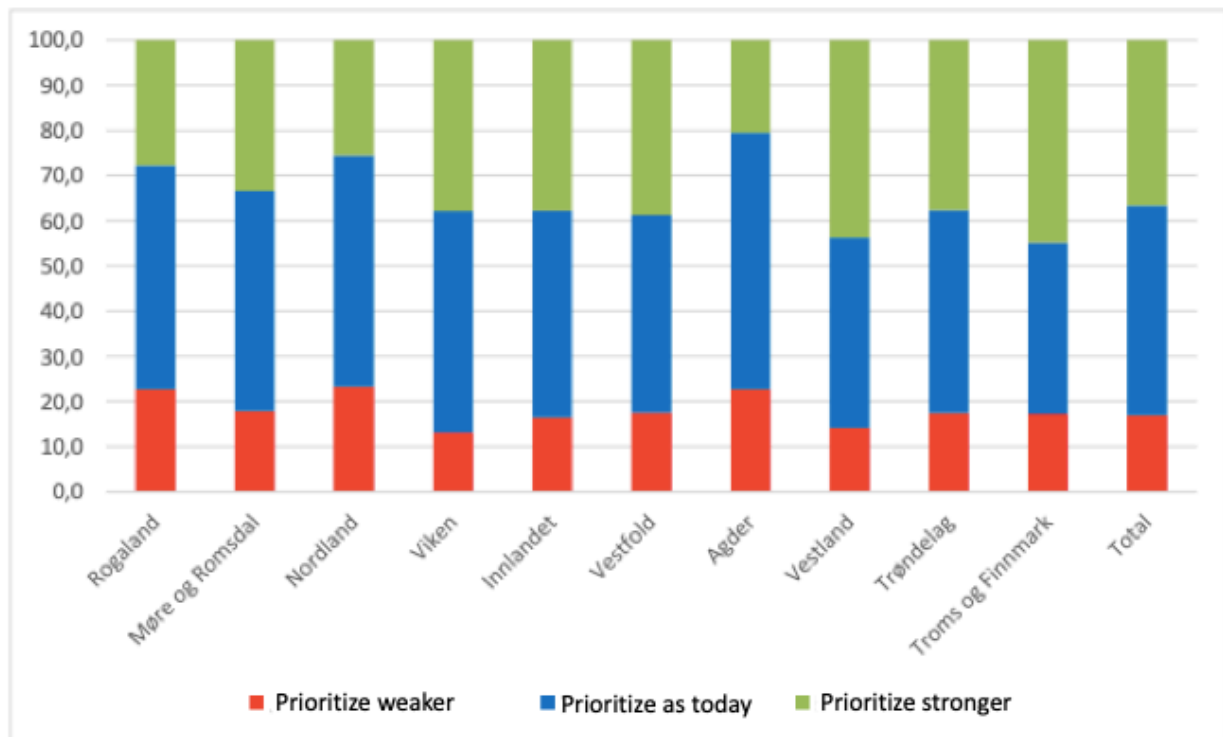
weather. "*Climate change poses particular challenges for agricultural production systems as plant growth is affected by climate conditions*" (Toreti et. al., 2019, 652). Global warming and CC that leads to more extreme weather variations could be problematic for the agricultural industry, that further on is connected to worlds food security.

2.2 Norwegian agricultural sectors emissions

The Norwegian agriculture sector is the fifth largest GHG emitting sector in Norway, the sector accounts for 8.5 per cent of total national GHG emissions annually, i.e. 4.5 million tons of CO₂ equivalents per year, and the agricultural sectors GHG emissions has decreased by 6 per cent from year 1990-2019 (Norwegian environment agency, 2020b). Even if there could be several factors for the decreasing numbers of emissions. e.g. declining number of operating farms over a long time period (Statistics Norway, 2020a, 5). At the same time, being the first sector in Norway to establish a national GHG reduction goal together with the Norwegian government (Ministry of Agriculture and Food, 2019) makes the agricultural sector in Norway proactive in the case of CC mitigation actions, and the focus needs to be anchored and an early focus on anchoring in the farmer's agronomy profession and business could pay off in the long run and give the sector a well-established development. Today there is a lack of numbers over emissions at the farm business level, and there is established a governmental economically supported project called klimasmart landbruk (klimasmart landbruk, 2019). The project was given 20. million NOK in the agricultural settlement 2017. In 2017 they started the development of a climate calculator that gives an overview of the farm's total emission accountings, there is an emerging need for more numbers on climate emissions on farm level, therefor an climate calculator at farm level will be and is a needed tool for GHG reduction and mitigation at farm businesses (Barman, 2017).

Connected to the agricultural climate agreement (Ministry of Agriculture and Food, 2019) the Institute for rural- and regional research started the project called CLIMPLEMENT (Ruralis, 2020). The project is a research project within the period of year 2020-2022, funded by KLIMAFORSK with 9,8 million NOK. (Forskningsrådet, 2020) with the goal of collecting knowledge and create tools for communicate knowledge about climate actions and reducing GHG in the agricultural sector, the report and its findings is used as this study secondary data

collection source. First step in the CLIMPLEMENT project is a questionnaire that maps trends and attitudes in the agricultural sector (Zahl-Thanem & Melås, 2020), results from the report shows that Rogaland county has a lower score on the opinion of prioritizing GHG reduction stronger, as well as a high score on prioritizing GHG reduction weaker. And a regular score on prioritizing it as today (Figure Y). The produced report is relevant to mention in this study because of the part of the report that is mapping farmers attitude in the case of CC actions.



(Figure Y). To which extent the farmers believe that priority must be given to reducing GHG emissions, sorted by county, showed as percentages.

Gathered from: (Zahl-Thanem & Melås, 2020, 41).

The agricultural sector is a part of the Norwegian 'non-quota sector', that means the sector is not included in the UN's market for emissions quota trades. (Norwegian environment agency, 2020c) In the UN's quota market, the included industries (such as the oil and gas industry) pay's emission quotas, and the industries gets affected by market prices of emission quotas (Øvrebø, 2020). The Norwegian agriculture sector is within the in the non-quota emissions category (Ministry of Agriculture and Food, 2019, 2) and releases 16.5 per cent within the total of Norway's non-quota emissions.

To get an overview of the possible emissions cuts within the Norwegian total non-quota emissions, the report Climate cure 2030 (Norwegian environment agency, 2020a) was published, the report was an result of the political governmental group 'Granavolden-platform' (Office of the Prime Minister, 2019), the investigation of possible emission cuts in the non-quota emissions in several sectors. The report involves examining obstacles, challenges and solutions for cutting emissions by at least 45% GHG's within the non-quota emission sector emissions by 2030 based on national emissions numbers from year 2005 (Office of the Prime Minister, 2019, 84), the agreement with UN is to cut 40% in the Norwegian non-quota emission sector. (Norwegian environment agency, 2020c) The political governmental Granavolden-platform (Office of the Prime Minister, 2019) is a political governmental initiative in the case of a non-quota emissions collaboration with UN. The collaboration with UN and the emission budget is expected to be settled in the end of year 2020 (Norwegian environment agency, 2020c). As of today, there is still no UN agreement established yet.

2.3 Agriculture in Rogaland county and the South-Jæren area

The topic of this thesis takes a look at the agricultural culture in the South-Jæren area within Rogaland county, studying farmers within the South-Jæren area to find farmers perceptions of CC and GHG reductions and the experienced obstacles for cutting emissions within their farm business. The studies case is highly relevant in the case of the sectors established national climate target (Ministry of Agriculture and Food, 2019). Reports and the agreement from higher level within the sector, raises the questions of to what extent climate actions and mitigation is mediated to and received by the working farmers, and to what extent this is included in future plans of the farms businesses. The agricultural sectors politics has to be in front in the development to lead the industry towards a pathway for reducing its GHG emissions, larger sectoral changes are needed, and the changes will have a larger influence in the agricultural business. The farmers motivation and awareness for mitigation actions is an important perspective to study. The farm business is highly interconnected in the farmers lifestyle, so future plans and choices within the farm business becomes highly influenced in the farmers personal family life and economy. To investigate farmers perspective within the case of CC and GHG reduction is an interesting topic and is highly relevant topic to study today.

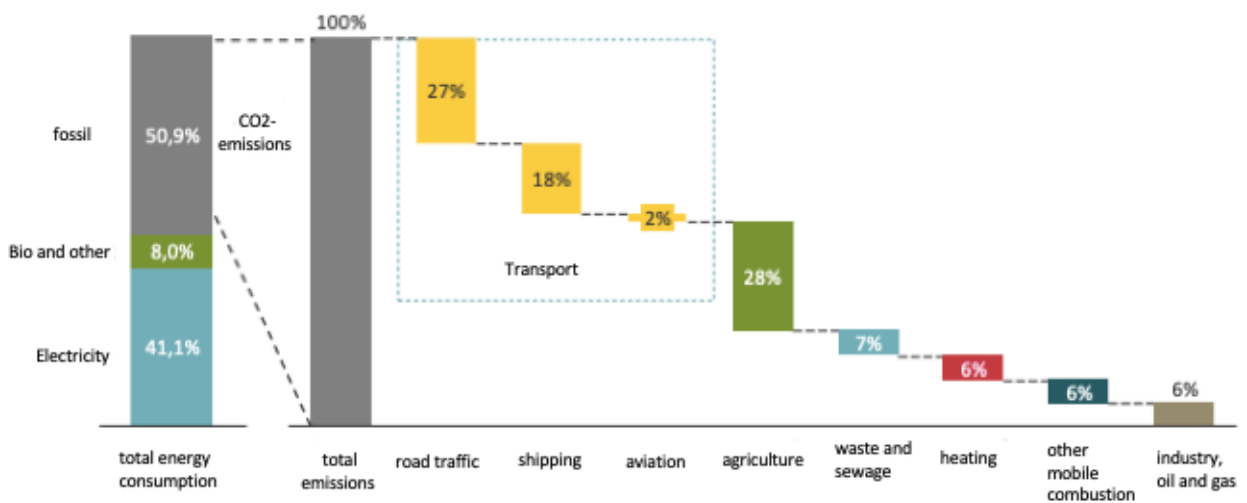
Rogaland county:

Rogaland county numbers for total emissions in year 2018, in all sectors, is 4 347 879,9 ton. CO₂-equivalants, the agricultural sector within Rogaland's emissions is 659 665,3 ton. CO₂-equivalants. (Norwegian environment agency, 2020d). The agricultural sector in Rogaland county is the second largest industry after the fossil oil and gas who is the largest industry in the region. There are 5300 farm businesses, that has 10 000 Full-time equivalents (FTE) work positions. The industry had a value creation of about 3 billion within Rogaland county, included the ancillary industries the value creation is about 14 billion. Rogaland county holds 9,7% of Norway's total agricultural land, and 10% of the agricultural land in Rogaland county is cultivable farmland (Norges Bondelag, n.d.).

South-Jæren the study area:

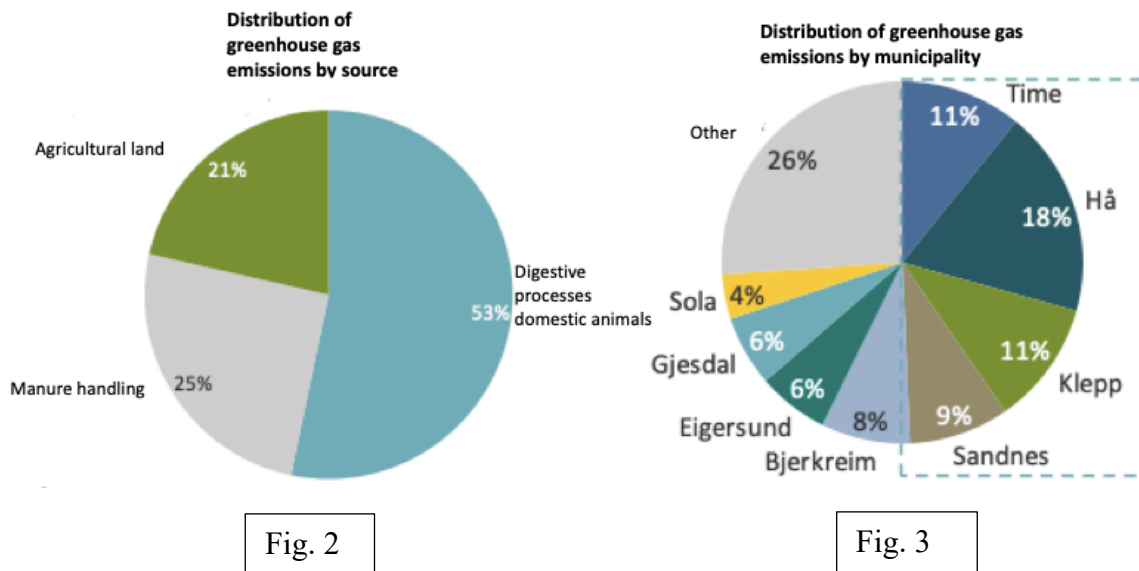
The South-Jæren area is an area of 4 municipalities within Rogaland county, the different municipalities are Hå, Time, Klepp and Gjesdal. The agricultural emissions in South-Jæren is, with numbers from year 2017, 524 500 ton. CO₂-equivalants, that is 28 per cent of Rogaland county's total emissions (THEMA, 2019, see figure 1., 2. & 3). The agricultural sector emissions in South-Jæren are a large part of the region's total emissions, because of the larger share of the agricultural industry in Rogaland in relation to the whole of Norway (THEMA, 2019, 2).

Overview of emissions within South-Jæren area (Figure 1.):



(Figure 1). Gathered from: (THEMA, 2019, 2).

The illustration (Fig. 1.) shows the different sectors within South-Jæren, and each industries emission. The agricultures sector is the most polluting sector in the South-jæren area, with its emissions at 28%.



(Figure 2.) & (Figure 3.). Gathered from: (THEMA, 2019, 15).

Fig. 2. illustrates the distribution of GHG emissions within the South-Jæren area. Fig. 3. illustrates the four municipalities that categorized as South-Jæren, and also gives an overview of emissions from the rest of Rogaland county's municipalities.

2.4 The farmer and the farm business

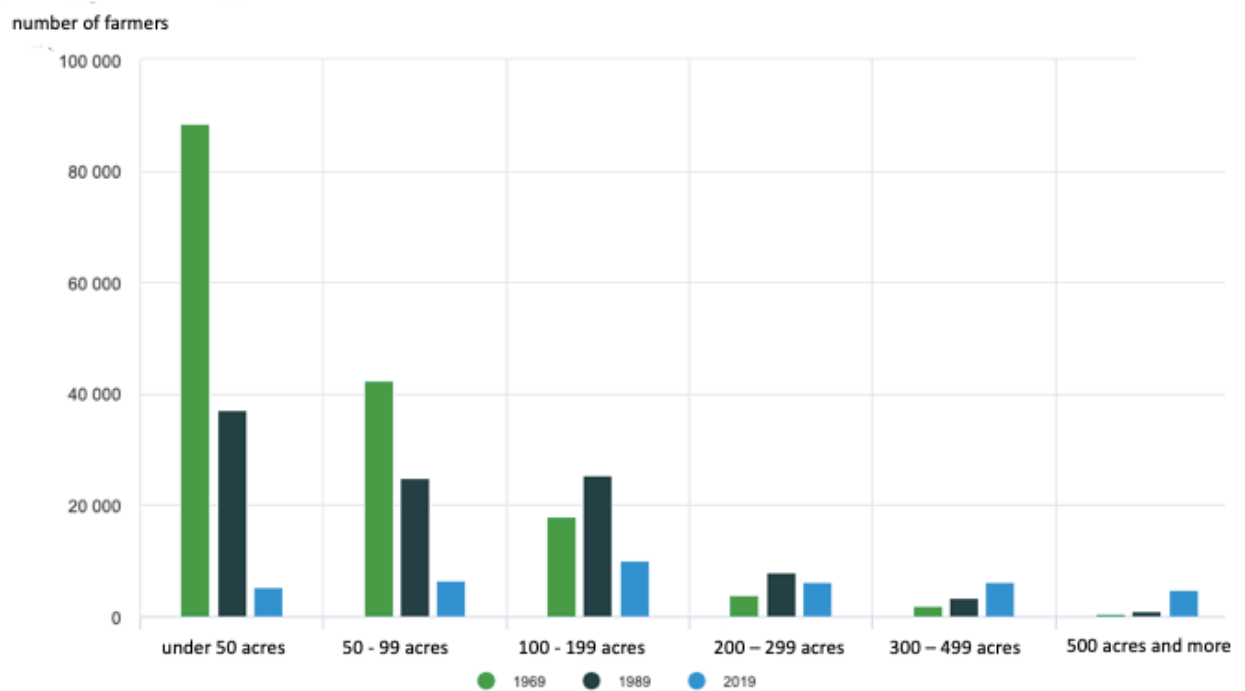
The problem statement where farmers could be experiencing a pressure related to CC and GHG's into their farming business is in the category of a 'social' problem (Blaikie, 2010, 45) and the study investigates the issue of CC and GHG emissions from the farmers perspective and the farmers role in the Norwegian agricultural sector to produce social scientific knowledge. The studies work is to collect data about different farmers perspectives, analyzing the different perspectives and creating empery that answers the studies RQ's. Producing empery that fulfill a narrowed social problem, may lead to useful empery for a wider 'sociological' problem. (Blaikie, 2010, 47). In the study of the farmers perspective, the sociology of

Norwegian agriculture is included in the study, since it gives a deeper meaning that is connected to the interviewed farmers answers.

Family farms in Norway is often a concept of pluriactivity, that means that the farm business is a combination of several different labor tasks connected to the farm business to increase the household income. (Bjørkhaug, 2016, 14) The family farm has over a time period changed from being a workplace that employed the whole family where many people were needed for managing the farm, towards a modern family farm who barely employ one person, except season workers in only seasonal periods. Pluriactivity is today in a new format, where external jobs make sure that there is increased income for the family farm. (Bjørkhaug, 2016, 22) The importance of pluriactivity when Norwegian farmers organizing and creates cooperative business models has made it possible for the concept of family farms to survive the development of capitalism models in the agriculture sector.

Family farms is still private owned and has control over its own equipment and resources (Almås, 2002) gathered from (Bjørkhaug, 2016, 19). At the same time, the development of the farms pluriactivity, has developed in a different shape where increasing income comes from external jobs, as well as the income from the family farm itself decreases. Development and new investments for technology to achieve new standards on the farm with efficiency and modernization, could then set the family farm in high risk of surviving as a business and many farms is getting shut down. (Gray & Lawrence 2001, 53. Bjørkhaug, 2007) gathered from (Bjørkhaug, 2016, 20). Demand for technology, modernization and larger scale farming for being able to survival economically has made small-and medium scale farms close down rapidly in the latest time period. As illustrated in Fig. 4. there has been a development reduction of small and medium scale farmer, as well as the total number of farmers is radically decreased.

farmers' agricultural area



(Figure 4). Farmers agricultural area. SSB. Gathered 15.07.20 from:

<https://www.ssb.no/jord-skoq-jakt-og-fiskeri/faktaside/jordbruk>

Even if the trend has been that farms need a second income, there are farms who manage to have the farm as their only income with family members included in the farm business. Some of the interview candidates (Number 5, 6 and 7) managed to develop the farm in different ways to manage it, candidate number 5 invested in innovations, a biogas facility, and has several income sources at the farm by exploiting different resources. Number 6 has stock-based

company, with modern vegetable production facility, and is a family business fully private owned anymore. And number 7 managed to have full-time work with their meat production farm for the husband and wife by running the farm financially and practically carefully planned. But like number 7 mentioned, there is very limited possibilities for further investments that are not financially viable. The rest of the candidates had spouse with a regular income for the family or was a permanent employee in addition to the farm.

Today's obstacles for GHG reduction and CC mitigation:

The agricultural sectors climate agreement (Ministry of Agriculture and Food, 2019) is an agreement to reduce GHG from the agricultural sector, at the same time there is little focus on political governance and instruments to stimulate changes in the agricultural sector (Bondebladet, 2019). The agricultural sector has a goal of increase climate investments, but economic capital and sectoral arrangements is necessary (Bondebladet, 2019). Governmental incentives as well as a climate fund as tools for investments could have been implemented. There has been governmental focus on Research within the issue of CC and agriculture, but there is need for a focus of agricultural climate reports that manages to registrations a wider specter of emissions as well (Bondebladet, 2019).

3. Theoretical perspective on climate changes, mitigation and GHG reduction

This chapter shows theory of science that this thesis places itself into, which also is relevant to the thesis problem statement and RQs.

3.1 Climate change and environmental disruptions

The global temperature has been increasing and is expected to increase further on in the future. The increasing temperature is connected to the historical perspective of human activity and societal growth (Smil, 2017), that has led to increased emissions of GHGs. Intergovernmental Panel on Climate Change (IPCC) projections describes that *"Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate."* (IPCC, 2018b, 6). The Scientific consensus put forward in the IPCC report (IPCC, 2018) describes that increased global temperature causes a changing climate followed by experience of increased extreme weather all over the planet. There is a need for larger structural changes in the pathways for limiting global warming *"Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems"* (IPCC, 2018b, 17). Political actions is crucial in larger sociotechnical systems transition and change towards a future with less emissions all round the world. One example of political agreement that acknowledge the GHG and CC problem is the PA (Streck et. Al., 2016). Political will and agreements are a crucial factor in the large task of achieve actions to mitigate CC.

In the case of CC, most of the largest polluting sources, touches upon human freedom to live a comfortable life, like the luxury of energy and food. Creating energy is creates some form of emissions (Smil, 2017, 102). Energy gives humans freedom to live a comfortable and efficient lifestyle, what creates freedom for personal development. Energy is a valuable

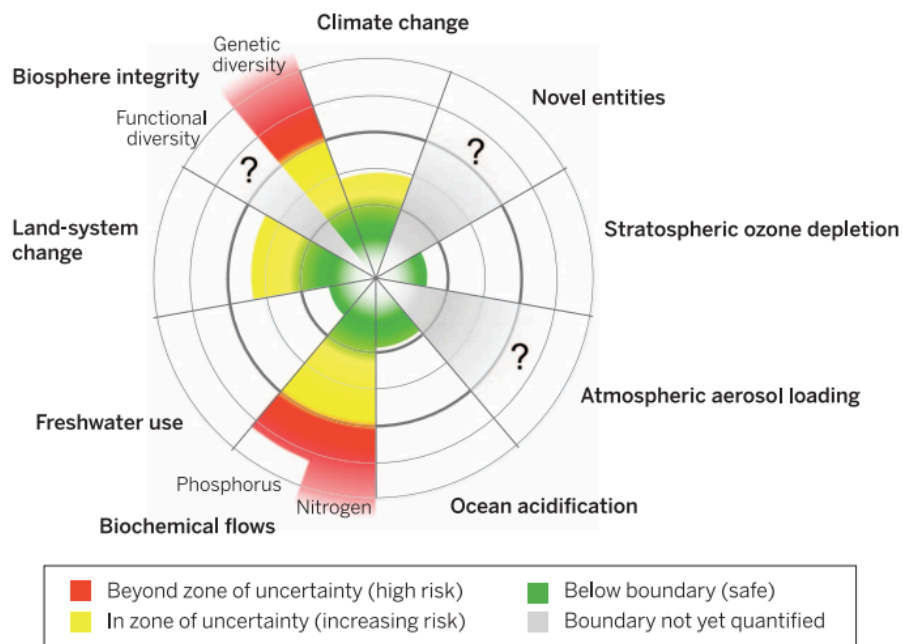
source that manages to lift societies to get higher human prosperity (Smil, 2017, 102). reducing global emissions is connected to the privileges for a higher comfortable way of living. like the invention of the steam engine and the industrial revolution (Smil, 2017, 100). Stop emissions, either demands to stop polluting activities and live less privileged and find new way of extracting energy. Imagine only how much more effort we would have to give, in the struggle of living without a fridge or freezer, that keeps food fresh for a longer period, and easily makes food available for longer periods and minimal effort is needed in thinking about preserving food...

Planetary boundaries and the Sustainable development goals and climate stability:

The theory of planetary boundaries (Rockström et. al., 2009), in the case of humanity going from the Holocene and into the Anthropocene time epoch (Steffen et. al., 2015), the industrial revolution started in 1700s (Steffen et. al, 2015, 847), and humans became able to influence the chemical composition in the planet's atmosphere (Steffen et. al, 2015, 846). The scientific environment declared an increase of GHG as a consequence by human actions year 2001 (Steffen et al., 2015, 852). Planetary environmental limits must be prioritized for reducing struggles in the future of human's habitat on earth. Ecological footprints and humanity, in the case of earth providing resources for human consumption, (Meadows, H. D, 2004) stresses that there is a limit of human exploitation of earth's environment, and that there is a risk of unbalance in the planetary system from human actions.

In the future of CC, the prioritizing of mitigation action is crucial, and it mainly involves the reduction of GHG's, but also prioritizing environmental mitigation actions, in the case of future planetary boundaries thresholds and its consequences in the human habitat on earth (Nordhaus et. al., 2012). "All these different means of mitigation and adaptation will have to be weighed against each other in the pursuit of climate stability, based on their social, political, economic, and technical feasibility and desirability" (Nordhaus et. al., 2012 ,33). As demonstrated by Steffen et. al. (2015) entails a model that shows the risk evaluation for 7 planetary boundaries (Figure 5.). The boundaries that is at high risk is to a large degree connected to the agricultural sectors industry. A global political action that is connected to the planetary boundaries is the UN's sustainable development goals (UN General Assembly, 2015) that presents 17 numbers of goals that summarize the important goals to give a focus

and has to develop in a symbiosis for a sustainable development on earth, these goals are also connected to planetary boundaries and also acts as mitigation actions.



(Figure 5). The model illustrates the risk evaluation for 7 planetary boundaries.

(Steffen et. al, 2015, 736).

3.2 Climate mitigation and adaptation different and in synergy

The publication of the IPCC (2018) report, puts an increased pressure on governmental level to reduce GHG emissions for a green transition to start. The PA (Streck et. Al., 2016) and IPCC (IPCC, 2018) stresses the issue of a future with rapid CC at a global scale, and that there is an urgent need for mitigation actions. In the case of the agricultural sector, CC has a large impact in the agricultural sector all over the world, and future CC is a challenging tasks for the sector to meet and handle, therefore, a focus on early mitigation actions will be beneficial for the sector in the future of CC problems.

As explained in the IPCC (2014) report "Mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2014, 4). Mitigation action is in a preventive manner for future expected problems, also defined by NASA that mitigation is when "reducing and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere" (NASA, n.d.), that describes the human intervention in the atmosphere's levels of GHG's. And the definition from NASA about adaptation is that "Adapting to the climate change already in the pipeline" (NASA, n.d.), and is the actions we do when a CC problem first occurs. As elaborated by Smith & Olesen (2010) mitigation and adaptation actions is connected and could affect each other, and together act in synergies that could act both weakening and strengthening. Mitigation and adaptation actions could both have positive and negative impact on each other. (Smith, 2007, 24) Both could act as a disturbing action within the larger complex biologically system (e.g. Adaptation to forest fire could strengthen further mitigation work for forest fires. (IPCC, 2014) or have a negative effect (Smith, 2007, 24) (e.g. increasing use of nitrogen fertilizer to overcome falling yield leading to increased nitrous oxide emissions). Norway's agricultural sector has experienced more extreme weather that has resulted in crop loss the past years (Bondeblad, 2018), that could create a pressure towards the agricultural sector to reduce GHG emissions and prioritize mitigating actions towards the escalating CC problems in the agricultural sector. As well as mitigation actions for adjusting and preparing the sector for future CC problems within the agricultural sector and industry, these mitigation actions is also in a synergy connection to adaptation actions when CC problems first occurs.

Why the thesis focuses on mitigation action:

CC mitigation and adaptation are in this study both facing the same problems in the case of CC problems, but the differences are the fact that mitigation actions are the work of establishing shock absorbers into a future with expected uncertainties and CC problems. As well as focusing on actions that could prevent the occurrence of future problems (e.g. upgrading water pipe drain systems to handle a future heavier rain pattern). That is different than the case of adaptation actions, that rather responds to an immediate problem. Both mitigation and adaptation in the case of CC problems, works in symbiosis with each other in different stages in actions to CC problems. In the case of this thesis research problem and

RQ's, the study investigates the farmers thoughts about mitigation actions for future CC problems within the agricultural sector, and not what adaptation actions farmer does to problems they meet as of today, as well as the study do not look further into farmers experienced adaptation actions, that could be strengthening in the case of mitigation actions. Mitigation actions in the case GHG reduction and future CC problems is the main focus in this study.

3.3 Communication of CC, from expert level to the working farmers

Communication of CC even if it's been communicated since late 1990's, is a fairly newly popular topic within social science, alongside traditional enterprises e.g. risk communication (Nerlich et. al., 2010, 97). Even though communication of CC has been going on for a long time, GHG emissions has been increasing to a large extent, and global warming creates problems within the human habitat on earth. Despite the large amount of uncertainties and skepticism about GHG emissions having an effect in CC communication, it now seems to be more commonly acknowledged within science, politics and the public, this also gives a larger room for communication mitigation and adaptation actions, even if uncertainties in scientific projections still is an issue to deal with. At the same time, there may be a knowledge gap, and basic CC knowledge is not necessarily common knowledge, e.g. the difference of chaining weather and changing climate, and that CC has to be seen in a very long-time perspective (Nerlich et. al., 2010, 98). And communicating basic knowledge for CC is a highly important part to include in the case of CC communication, and for CC mitigation actions to happen. Discussions about CC is today a fairly known topic, but still, people have a large amount of new knowledge to embrace, and the understanding of CC variates from different people's interest and opportunity to read up on the topic. This thesis study and investigation of farmers perspective and on GHG and CC mitigation, also highlights the level of the farmers experienced CC communication within the farmers personal and business position.

4. Method

This chapter presents and explains the methodology for this research project, which is the tools that are used when collecting data for the research. The chapter elaborates on the thesis design, strategy, theory, data collection, data analysis, validity and reliability and at the end the research's ethical reflections. As Neuman (2014) states that:

“Methodology means understanding the entire research process -including its social-organizational context, philosophical assumptions, ethical principles, and the political impact of new knowledge from the research enterprise. Methods refer to the collection of specific techniques we use in a study to select cases, measure and observe social life, gather and refine data, analyze data, and report on results.”

(Neuman, 2014, 2).

The chapter explains the research process and what it entails. In that case of the research being in a qualitative manner, the purpose of the chapter is to guide the reader in how the thesis's research itself is carried out, the purpose is not to guide research that gives a set of verifiable results, but rather to make the research project itself verifiable to be able to find comparable results. This current research is qualitative research that collect cross-sectional data (Blaikie, 2010, 201) the main task is then to explain the verifiability of the research design and methods, so the same research could be conducted all over again in a different time. The study's results is valid within the studies time period, and in a different time period the results itself will not be verifiable because it is an qualitative study within an organic moving society, that gives us a unique set data in a new time period in a new societal context, that also conducts a new unique set of findings and results. Results is to be compared with the previous conducted results by redoing the exact same research project, to find differences and similarities in the different time-periods and societal contexts.

To get access to literature I have used the University of Stavanger's Library and digital library Brage.bibsys.no, as well as internet search engines on internet like Google Scholar and google search to get insight in relevant discussions in media and governmental documents. I have also found literature from our syllabus in the Master program for this thesis - "Energy, Environment and Society" as highly useful to get a wide and deep understanding of the thesis topic.

4.1 Choice of research design and research strategy

I have chosen the abductive research strategy to answer the studies 'what' and 'how' RQs. The strategy operates in a qualitative nature and is a bottom up approach to gather and collect data to produce knowledge from the social actor's perspective. *"The aim is to discover why people do what they do by uncovering the largely tacit, mutual knowledge, the symbolic meanings, intentions and rules, which provide the orientations for their actions"* (Blaikie, 2010, 89) The 'what' questions needs a description of the farmer as a societal actor and I use socio-economic characteristics (e.g. education, employment status) and describes the Farmers as self-employed at their farms that provides a full time work position. The 'What' questions then conduct a summary description, and the studies 'how' questions gives explanations within the study. As discussed by Blaikie in (Blaikie, 2010, 82), a researcher's choice of characteristics that is being studied, could be discussed in the case of the researcher's objectivity. To some extent completely pure objective description is impossible to achieve, and the reliability of the studies descriptions of characteristics relies on the researchers concerns and skills to maintain as an objective researcher. During the qualitative interviews, the objectivity as a researcher was considered during each interview.

4.2 Theory of science

Ontological and epistemological assumptions in the research strategies has the aim to describe and understand social life in terms of social actor's meanings and motives. As Blaikie (2010) describes, the *"Ontological assumptions are concerned with the nature of social reality"*. (Blaikie, 2010, 92) This study is based on an 'idealist ontological assumption', where the assumption of social reality is constructed by social actors and their shared interpretations, and that social actor's everyday life produce and reproduce interpretations.

(Blaikie, 2010, 93) A social reality depends on the social actor's individual life and how it's interpreted by the social actor itself.

The studies epistemological assumptions are the 'constructionism epistemology assumptions', where everyday knowledge is mediated by social actors to the researcher who receive and interpreted the knowledge in a theoretical perspective and creates theoretical knowledge. (Blaikie, 2010, 95) The ontological and epistemological assumption chosen for this research gives an explanation of the scientist's scientific view when studying a social science research phenomenon.

The study is within the classical research paradigm, 'interpretivism' (Blaikie, 2010, 99), that has a logic where the social actor is a participant in an experienced common social reality. The social actor that is the studies study object within this thesis, is a part of and to some extent affected by a larger common societal reality, created by social actors' thoughts, actions and beliefs. The larger societal reality is taken in account by the scientists scientifically observation during the data collection of the study object, where in this case, is the interview of selected farmers in the South-Jæren area that is in a larger social network of different farmers, and is to some extent affected by a common societal reality as a farmer with a farm business.

The studies classical research paradigm 'interpretivism', as explained above, is connected with the 'Hermeneutic' tradition (Blaikie, 2010, 119), and is a bottom up approach to investigate society, as done in this study project. The hermeneutic tradition investigates societal actor's language, different study objects have different language and as the researcher, the task is to gather an overview to find the similarities and differences from the different informants that could be compared and analyzed, and then to set the gathered information in category's to extract findings that creates an overview of the farmers different thoughts and concepts. The overviews of the collected data material create different concepts that is being analyzed to create new knowledge for the study. *"Concepts are regarded as the building blocks of social theories. Theories, in turn, specify the relationship between concepts and why these relationships exist. Good theories are supposed to represent what happens in the social world"* (Blaikie, 2010, 111). Having the in-depth interview with a representative set of farmers gives

the opportunity of closely investigating the individual farmers as social actors within a larger societal reality. During the conversations, the focus was pointed to understand the farmers personal thoughts and social reality, that also could be connected to a larger common social reality.

Reflections of objectivity is important when scientific theory is chosen and during observation of study objects within this study, regularly reflections and being aware on the issue of objectivity was considered with the goal of achieving as valid and authentic data as possible. During the interview with the farmers who were the studies informants, followed thoughts of objectivity was taken into consideration:

- The presence of a researcher in the farmers private house and environment, could have an effect on the study object's authentic perspectives, thoughts and behavior during interviews that is scientific observed. It was important for me as the researcher, to dress casual in the purpose of not getting tension by a formal impression when entering the informant's environment.
- The study object may adapt to the setting and studied topic, that could negative affect the authentic thoughts and behavior. e.g. Hawthorne effect (Franke, R. & Kaul, J., 1978, 623). As the researcher, it is limited ways of preventing this kind of objectivity, a planned interview will always have some affection on the informant's contribution.
- Objectivity could be affected by the fact that the researcher itself could get a narrowed perspective of what look for, that could delimit what data that is being collected. During the interviews, there was room for the conversation to slip over to other conversation topics outside of the scheduled interview guide. This is because it is also an important part of the data material to be able to analyze and find and obtain the larger contexts and deeper opinions.

4.3 [Data collection](#)

This chapter contains the theory for the studies data collection. For answering the thesis research problem and RQ's, data is collected from qualitative interviews and relevant documents is gathered from a brief literature review. Before the interviews, the research project was approved by the Norwegian Data Protection Services (attachment number 2), a statement of consent was sign by all informants.

The research's primary data is gathered from 'semi-natural settings' (Blaikie, 2010, 166) where the studies informants reports from their everyday situations and life in the in-depth interviews, the goal was to achieve as authentical answers as possible. The shared and gathered information is the studies primary data and is a representative data collection for farmers with full-time work positions at their farm within the location of the South-Jæren area (Blaikie, 2010, 167). As elaborated by (Blaikie, 2010, 170) primary data from a semi-natural setting is challenged by the researcher abilities to manage the skill of objectivity when observing the informant's societal reality and context, different perceptions of the mediated information could create hidden errors in the validity of the data. Also discussed by Everett & Furseth (2012) *"Primary data is depended of how the interpreter manages the collected data, the objectivity is challenged by the wide specter context around the collected data"* (Everett & Furseth, 2012, 132). Focusing on objectivity when observing and collecting primary data from 'semi-natural setting' is crucial for getting the essence of the informant's information and was in my thoughts in the studies field work of interviewing the farmers. During the interviews there was regularly focus on follow-up questions that made sure for the common understanding of the shared information, even if this was prioritized, some meaning and deeper understanding was first observed when listening and transcribing the interviews for the study. Therefore, audio recording became valuable in enhancing validity.

The selected informants are a 'single-stage non-probability sampling' of representants (Blaikie, 2010, 176) the chosen key informants are a smaller collection for a larger group to give an explorative view of the society of farmers within the South-Jæren area. The single-stage non-probability sampling is chosen to get the opportunity for doing a qualitative research on a random collection of representative farmers. Qualitative in-depth interviews are chosen to get a deep understanding of the sociological reality for the chosen farmers. As

discussed by Blaikie (2010, 176) qualitative in-depth interviews make the gathered data validity stronger and is beneficial for the random non-probability sampling method that easily could be judged as biased and not representative enough for a larger society. The researches sampling, to collect the data, is within theoretical sampling (Blaikie, 2010, 179). The goal is to collect samples that extracts theory, with single-stage non-probability sampling among the farmers, sample size is determined by when the collected data's gives a collected set of what attitudes there is among farmers within the South-Jæren area, in this case there was 7 interview candidate, a few more would have been preferred but the study ended up with 7 informants finally. At the same time, the informant's answers showed more and more similarities that created meanings that were observed. As well as collecting primary source data by arranging interviews, there is done a broad literature review for gathering a collection of secondary data from existing research and reports done by other scientists in relation to the research's problem and RQ's. As discussed by Blaikie (Blaikie, 2010, 207) the data collection method encapsulates informants in the interviewing setting to tell about their social experiences, the researcher interprets the told information and narratives in the studies scientific theory, as opposed to methods where researcher collecting data from observing a natural environment, will this selected method be the researcher that is observing and communicating with the informant that is telling about their present life within their natural environment, this work gathers the studies primary data.

The cross-sectional data (Blaikie, 2010, 201) gathered in present time, using qualitative in-depth interviews needs time to establish a good conversation and be able to get an understanding of the informant's context. The interviews were expected to last about one hour per informant, and one hour was the average of how long the interviews lasted. The form of data in this research had some written notes during the interviews, as well as the interviews was recorded to get the possibility to listening and transcribe exactly what had been said after the interviews. The recorded data material is transcribed into words, in that way, it is easier to go back to examine findings. As the researcher effort in collecting findings that is truly representative for the informants, and not let manipulation happen during transcription is the goal, and as Blaikie (2010, 162) discusses, an researcher could have an influence in how original data is manipulated into technical language, in the same time, the researcher (and its nature of being a human being) that produces knowledge will always have

a degree of influence in the data manipulation process. The importance of authentically data was considered when looking for and collecting finding from the interviews.

Primary sources:

For this research I am collecting data though interviewing farmers located in the South-Jæren area. The study has interviewed 7 farmers that has farm business large enough to provide full time work position/s. Interviews lasted around 60 minutes. Each farm is unique in the combination of what kind of productions and income sources, this also means that farmers meet different challenges in the case of CC problems and actions within their farms. I got in contact with the informants by friends who could set me in contact with random farmers outside from my personal network. As well as I got contact information for relevant candidates from farmers I interviewed, and was allowed to present myself, and explain that I got the contact information on the basis of the farmer who was already involved in the project. This led me to a random group of informants where 2 informants were within my personal network, and 5 was unknown to me. My impression was that the farmers I was sat in contact with was interested to help in the case of me being a student who needed help to get informants for my research, but that they did not have any special relation to the studies research problem. Except for candidate number 5 that is highly interested in agriculture and GHG reduction, that I specific contacted myself for getting a candidate with expert knowledge and information as a variation in the collection of candidates.

The interview candidates, all within the South-Jæren area in Rogaland county:

Number	Gender	Age	Municipality	Farm business
1.	Woman	30	Hå	Pig (breeding business of Landrace Nucleus herd SPF)
2.	Woman	30	Hå	Cow (breeding, milk and slaughter) and pig (breeding and slaughter)
3.	Man	39	Klepp	Cow (milk and slaughter) and meat chicken
4.	Man	40	Hå	Cow (slaughter and nursing cows) and pig (slaughter)
5.	Man	60	Klepp	Pig (slaughter), potato, cereal, berries and flowers
6.	Man	56	Hå	Vegetable and owns (but rents it out) farm with milk production
7.	Man	44	Klepp	Cow (milk and nursing cow)

The chosen candidates:

- Candidate number 2, 4, 6, 7 was randomly chosen after being sat in contact by friend and was not within my personal network. They were all owners of farms who provide fulltime work positions.
- Candidate number 1 and 3 was contacted by me and was within my network of farmers. Where chosen because on the reasons that they have a farm that provides fulltime work positions.
- Candidate number 5. was contacted by me but was not within my personal network. The informant was chosen because of the expert knowledge in renewable energy technology in the agricultural sector, the farmer is the only farmer in Rogaland who has an operating biogas facility at he's private farm.

The goal with the chosen set of farmers, was to get an explorative overview of farmers perspectives about CC mitigation and GHG reduction within the South-Jæren area. With the intentions of gathering a varied collection of informants that contained mainly of the working farmer without being special interest and a known person within agricultural climate debates, except for candidate number 5. that was already known within the climate and GHG reduction debates.

Followed the interview guide, as well as maintaining a relaxed conversation that was allowed to slip a little to the sides of the interview guide to talk about topics where the farmer was engaged. The conversations mainly concentrated about climate emissions and CC, a within this topic there was shown engagement from the farmer in different ways. The main goal was to extract data from the farmers perceptions, what knowledge their perceptions where based on and to map how involved they were in the topic of CC mitigation, CC problems and climate change discussions. And the interview guide was built up with the goal of what information I was looking for.

Prior to the data collection the research project was approved by the Norwegian center for research data (see attachment number 2). Participants were receiving an information sheet about the study in forehand of the interview that also included a consent form for research participation. In the start of every interview I presented the information sheet as well as the informant signed the declaration of consent. The interview was in a semi-structured form, the interview had a list of premade questions that are asked, but as the interviewer I was also free to ask follow-up questions along the way during the interviews. An external audio recorder is used to record the interviews, the recorded data was then transcribed into written words by me, the researcher, a time-consuming work, but beneficial for getting a deeper understanding of the collected data. Having the data in written form also makes it easier to go back and forth, reading specific parts of the interviews again as well as search for words to make sure I captured the fully information about a topic talked about in different parts of the interview. When analyzing the data, codes were collected and categorized in clusters, and the collected clusters got suitable themes that describes the collection of codes.

Secondary sources:

Data material and finding is received as secondary literature by the published report "Trends in Norwegian agriculture 2020" (Zahl-Thanem & Melås, 2020). The report is a national qualitative questionnaire study, that collect data from farmers all over Norway. The questionnaire was held in January 2020, and the questionnaire was sent to random selected farmers all over Norway. The findings from the questioner gives an overview of farmers opinions within the area of Rogaland county. That means the results includes all Rogaland's 23 county's municipalities, therefor a larger area then South-Jæren who includes 4 Rogaland's municipalities (see Fig. 3). Even if it is not accurate for the specific South-Jæren are, the results of the report give an indication of attitudes amongst farmers in Rogaland county, where farmers in South-Jæren is included. One of the report's section is about climate and agriculture (Zahl-Thanem & Melås, 2020, 38) and the results shows to what degree farmers in Rogaland believe priority must be given to reducing greenhouse gas emissions within the agricultural sector. That is why it is relevant data to use for this study. Unfortunately, the questionnaire contained several climate questions as well, but to use in another report who

are not yet published (Zahl-Thanem & Melås, 2020, 39). These answers would also been highly relevant for this thesis, if they had been included in the report included in this study.

4.4 Data analysis

The collected data is reduced to further process of analysis, the method of data reduction that is used is the 'typology construction' (Blaikie, 2010, 208) to discover and develop typical meanings that describes the relevant findings in this research. "The goal is not to produce a standardized set of results that any other careful researcher in the same situation or studying the same issue would have produced. Rather it is to produce a coherent and illuminating description of and perspective on a situation that is based on and consistent with detailed study of that situation" (Schofield, 1993, 202) gathered from (Blaikie, 2010, 217). And as discussed by Blaikie (Blaikie, 2010, 217) a qualitative conducted research of present time and contexts, as well as the hermeneutic process involved in the process of conducting the research, creates unique discovered findings. The typology construction is within this study called themes, the themes is created in relation to the used thematic analysis method (Braun & Clarke, 2006). For analyzing the gathered data, thematic analysis (Braun & Clarke, 2006) is used. Practically, the qualitative interviews were transcribed into text form, similarities across all interviews was clustered together in codes written as notes. The clustered codes became four categories that transformed and gave birth to four different themes. When sorting codes from the interviews into themes, similarities and differences could then be seen and described.

When transcribing the interviews, I experienced that I got a deeper understanding of what the informants was trying to tell, meanings and contexts could not clearly be seen during the interviews got clearer presented during the transcription. Connections that became hard to see probably because I asked questions and tried to keep a good conversation, as well as adding follow-up questions where discovered. My capacity to listen really well could then have become limited. It was such a positive experience to transcribe the interviews myself and get a much deeper understanding of what the candidates said, and I really saw the value of recording the interviews, only having written notes and my memory would have limited for a deeper understanding. Transcribing the interviews into written text made it clearer to

get an overview and collect the codes, at the same time as I could go back to the transcribed text to double check if there is some kind of meanings or a new chain of similarities I hadn't seen yet.

The themes:

Every interview candidate has been coded and distributed into four categories that developed to four themes, in this way I managed to see similarities and differences between the informant's contributions and compare the findings.

- The 1th theme is called "The farmer and climate mitigation actions" and is connected to the studies RQ nr 1.
- The 2th theme is "The farmer and the national GHG reduction goals". and is connected to the studies RQ nr 2.
- The 3th theme is "The farmers limitation and obstacles for climate action and GHG reduction". and is connected to the studies RQ nr 3.
- The 4th theme is "The farmer, an actor in a larger agricultural sector and food system". and is connected to the studies RQ nr 4.

4.5 Validity and reliability

The gathered data's reliability is also affected by the fact that it is collected primary data that could be affected by the data sources contemporary context in life at the time data collection is done, that means that the data source could have answered differently if the data collection is being implemented again (Everett & Furseth, 2012, 135). In the case of my personal interest for the agriculture sector, I could to some extent be biased in the studies empery, my job as a researcher is to be an objective receiver of information, and not let the collected data be affected by my personal interests when collecting and analyzing the collected data.

The collected data's reliability would be higher if there was gathered data from a larger representative group in the limited time period with the purpose to get a larger representative group of informants in a common time period. The representative group for this task is limited due to the research size and time limit. The research could be affected by

the studies limitations, in the case of the studies topic delimitation that has the purpose of gathering specific and exact information, at the same time there is a risk for excluding data that could be relevant within the studied context and the research's discussions.

Verifiability:

The fact of the study being a qualitative in-depth interview that collects data from primary sources, the degree of verifiability has some limitations. The research it-self is verifiable and could be conducted, but even if the exact same informants was used, we cannot check the validity of the data received from the informants. The fact that times goes by, and the collected data is valid at the time informants were participating the research. What could be tested is the verifiability of the conducted research, to the exact research over again in a different time, and compare the collected data done in the different times and look for differences.

4.6 Ethical reflections

An importance for me in the interview situation with informants, is the common information and consensus about the purpose for the data collection is clearly understood, as well as the informant knowing the purpose of the study and how the collected data will be used, where the researcher is the only one who works with raw data material that is stored electronically stored on researcher's private computer, and collected data is being discussed with the studies supervisor. Collected data is not being used to any other purposes than the actual research, the study may be published with open public access. Informants could be recognized, by published information, but the candidate name is anonym. All data about the informants, except for information used in the research is deleted December year 2020. The informant is explained the ethical values as well as the scope of the study before signing the declaration of consent.

5. Findings

In this chapter, I am presenting the discovered findings that is in relation to the research's research problem and RQ's.

What are farmers doing to reduce GHG emissions?

Overall, every informant was positive to do changes, the business regularly gets new rules and ways to do things, they often adapt and change towards new information and regulations and start doing new practices fairly quickly. To some extent, every interviewed farmer had the CC problem in their mind but to a varying degree of personal believing it, but no one of the candidates would refuse doing changes in their business in the case of CC issues, there was an openness for change and new solutions.

CC mitigation investments:

To what extent the researches candidates had invested in renewable energy sources was that no one had invested in solar panels, but everyone was familiar with solar panels as an option to produce energy for their farm business. They all been thinking about if it's relevant for them to invest in. Not everyone saw it as an economically sustainable investment, and some others would have invested in it if they had the capital for it, and as informant number 1. thought, "it was a problem that technology was not good enough developed yet, not yet good enough technology for storing the energy for use in 24-hour operation that is the case of the informant's farm industry building. Collecting the energy but not storing it for use overnight therefore would not be good enough, because it's not satisfying for the business that need regular energy inflow all day and night. But a solar panel plant would at the same time supply the farm with much needed energy, energy consumption is high in the farm operation and the electrical bills are very expensive for the farm business."

Every informant had heard about biogas technology and informant number 5. had an operating biogas facility installed on his farm. The construction of the biogas facility is a highly expensive technology that is hard for the farmer to invest in for their farms, but every farmer

interviewed saw it as an interesting solution if there was constructed a common biogas facility in the local area. Some farmers (candidate number 1, 2 and 3) mentioned the problem of larger amounts of manure produced on their farm (except number 6. with vegetable farming with no livestock animals) and that they do not have enough grassland area to put it. There are strict rules of how much manure there can be placed on grassland, but they don't think the investment would be affordable and profitable for the farm to have the facility on their own private farm, but farmer number 1, 2, 3 and 7 was interested in the idea of a common facility solution at South-Jæren. To get the most use of the technology and facility of biogas the informant number 5. that had the facility on his farm also has other projects to get maximum use of the dry manure material gathered from the biogas facility, in that way it becomes several economically incomes from the facility. Like growing organic strawberries and raspberries, as well as flowers for sale in the dry manure residual product from biogas production (Climate friendly solution compared to peat that is commonly used) as well as the residual product of fluid manure is used as fertilizer of the berries and plants, and also on the fields of potatoes and grain, that is also grown on the farm.

The overall problem for all studied farmers in the case of investing in renewable energy technology and other CC mitigation solutions, was the fact that there is no money to invest with, investments is too expensive and the industry has already been meeting problems that demands economically investments in many years, as for example animal welfare, new building regulations, air quality, feeding and so on. Many demands on farmers to invest, gives the farmer limited capital for investment in renewable energy and GHG reduction on their farms.

How do farmers perceive their role in national efforts to reduce GHG emissions?

Informant number 1, 2, 3, 4, and 6. mentioned that blaming the farmer is unfair, compared to other industries are unfair because farming includes biological processes that both received and emits GHG's. Compared to other businesses and industries that produce products that we don't need for surviving as a human being, the agricultural sector is producing food, and food is one of the three main things we need for existing. As stated by candidate number 6. The three basic needs for humans is water, food and energy (as example bonfires). All 7. informants where aware and agreed on the responsibility where the

agriculture sector must take their part in the GHG reduction, but there was varied opinions of to which extent the farmer should be held responsible for taking actions for reduction, as candidate number 4 pointed out that actions at farm level has no point, larger changes in the agricultural system and food chain is needed, especially the fact that food is transported across countries and all over the globe only for being processed and packaged, and then sent back again to the origin of the product to be marketed and sold as local produced meat. In the perspective of food politics and power, the farmer is such a small actor in the food chain but is also designated as the worst emitters of GHG's, that is experienced as an undeserved accusation from a farmer's point of view.

Every farmer believed that everyone has to take their part in the CC problems and reduce GHG's, even if they feel that they get unfair much blame, they do have emissions that could be reduced but economy is an obstacle for the investments. Number: 1, 2, 3, 5, 6 and 7 farmers saw it as a clever investment for future development because that's the path the industry is developing, we are heading towards a future with less GHG polluting. The agriculture sector has to take their part of the cake, as well as every other sector has its responsibility to reduce.

What are the main obstacles for further reductions?

All 7 interviewed candidates stated that economy is the main obstacle for climate action investments, and if doing such an investment it has to be economically prudent for the farm business. Candidate number 2 mentioned that the problem is that even if the farmer receives incentives, it can still be too expensive and "less necessary" investment for the farm business. And that it cannot be invested money when there are few clear value gains from the investment, as well as the value of the produced products on the farms doesn't rise by the investment. That is also in relevance to what candidate number 6 mentioned, about there being a need of facts and numbers, as of today they do not have enough knowledge to know what to invest in on their farm, knowledge is needed for dealing with decisions about investments in the farm business model. The CLIMPLEMENT project (Ruralis, 2020) is therefore a highly relevant project in the case of the issue of there being lack of knowledge and information about climate actions at farms. The lack of knowledge and facts about climate actions investments, makes it risky and daring for the farmers to invest in such

investments as of today. And taking risks in the farm business has larger effects, as candidate number 7 states that they cannot take investments on the farm that have a negative impact in the farm's finances, as the farm is also the family house and homestead. Personal economy is affected by non-profitable investments. Therefore the overall problems explained to me during the research was the lack of capital and lack of knowledge, and the feeling of gambling with the farm business economy, with the possibility of meeting unknown risks by doing the investments.

How do farmers perceive that their efforts to reduce GHG emissions could be better facilitated by higher levels?

The solution of incentives and economical support is a much used but not always a suitable solution, as informant number 7. stated, that the problem is not about receiving money from higher holds in the system, the main problem is the value on the product that the farmer produces. If the farmers would get a higher value for their product, they would have had a larger capital and possibility to invest in climate friendly solutions within their farm business. Giving money from higher holds in the system to fix the problem of reducing GHG's at farms, would only be a quick fix of the problem that do not fix the main issue, as well as it may be a disturbing action in the balance of power between higher holds and the farmer within the sectors system. Distribution of money to fix the problem of climate gas reduction would have a neglecting effect on the fact that the farmer produce a high quality product, that has a way too low value in the food system, it neglects the value of the farmer who do their job and produce the best quality they can all year around round. So, informant nr. 7 wishes for an improved system where the farmer gets the value for its product that it is worth. There could also be a stronger connection to the consumer who buys the food in grocery stores, that also becomes a part within the food chain, to be made responsible for what kind of meat they are supporting, e.g. long-distance transported food from Africa or if the consumer buys locally produced food with less GHG emissions and climate footprints. But this is a fairly complex system to change, and the power to influence the system is mainly in politics and the grocery stores owners, the self-employed farmers has become a small piece within the larger food system, as well as the working is often presented as the main polluter in the agricultural sector and receive an high pressure of reducing GHG emissions. As candidate informant nr. 4 stated that seen in a larger perspective, as long as the food chain system is transporting food in long

distances for distribution and packing, as well importing food that are produced in countries from the other side of the world, the farmers climate actions to reduce GHG's will not be anything particularly significant. The farmer is such a small piece of the game, who is easy to blame.

Five candidates mentioned that everyone has to take their parts but the main problem is within the politics and the food chain systems and who has the power, because the farmers is not one with power in the food system, the only power the farmer has, is that if the pressure is getting too high and the farmer gets blamed because it's easy to blame on, the power we then have is to quit and close down the farm business, because we don't absolutely have to be farmers. This statement is said by several of the informants, many of them have additional educations that easily will give them jobs if they quit the farming business. They are not farmers because it's the only thing they could do to have some income. Some of the farmers also had additional work and income (60-100% job positions) beside the full-time farm business.

Farmers locked in a structural problem:

All the farmers I talked to is proud of their products and always has the best intentions and passion about how they run their farm business. As informant number 7 stated, would wishes to have a smaller number of animals (150 cows, instead of 250 cows) and larger room for them but that's not how the economy in the agricultural sector is build. The products low value demands that you have a lot of animals to get high enough income to run the farm. That also means that it is limited how much the farmers manages to invest in bigger buildings and rooms for the animals, so in a way you are squeezed in having large number of animals, in the set frame of regulations on how big farm buildings have to be constructed. Informant number 7 tries to invest in larger farm buildings because the farmer personally had the opinion that larger space for the farm animal becomes profitable because you got more products from the production animals because of the animal welfare increases. But low value on the produced product makes the farmer limited in capital to invest in larger buildings, at the same time as the farmer cannot reduce the number of animals due to the farm's economical balance.

All over the 7 informants, there was different degrees of believing in CC being a threat to the planets climate, but to some extent all the informants shared the common opinion about all sectors in Norway, included the agricultural sector, has to take their part of the job with reducing GHG's. The informants was to an variated degree believing that GHG would have a negative impact on future climate, some believed human GHG's creates an disturbance in the earths balance, and others believed that the earths system is not affected by GHG's, and that climate variates like it has been doing over a long time in the human history.

After doing several interviews I saw a similarity, where some informants did not know the difference between CC and environmental pollution problems, I saw that there was limited knowledge about GHG problems because it was often mixed with environmental issues like polluting fluids from agricultural practices, plastic problem from bailing forage, spraying animal manure on the fields and how this and the other problems impacts the water in rivers and the ocean. There has been discussions, solutions and actions for environmental issues in the agricultural sector in a long time, that has been integrated in farming practices, but when asking about GHG's and the problems with it, some of the farmers believe that it is an environmental issue and that it is connected to air pollution in our planetary habitat. And some of the farmers had knowledge about global warming and GHG problems, but it depended on the farmers personal interests if the farmer had a deeper understanding within complex global warming knowledge. By transcribing and reading the interviews I could clearer see and understand the deeper meanings of to what extent the farmer had a knowledge base on GHG's and the consequences by releasing them, or if the farmers knowledge was based and limited by knowledge of environmental pollution problems. The CLIMPLEMENT project (Ruralis, 2020), as mentioned above, the last part of the research projects tasks is dissemination of knowledge within the sector, with developing syllabus for agricultural high school education as well as educate advisers within the sector.

6. Discussion

The thesis discussion is taking a look at the study's findings, and how they answer the thesis research problem and RQs. And discusses the answers in a wider perspective that is presented in the thesis literature review.

The agricultural sector is the second largest industry in Rogaland county, as well as the agricultural sector is a large part of the regions emissions because of the large share of agricultural industry in Rogaland county, this is because of the high density of farming business in the region, that is why agricultural emissions is high in Rogaland compared to the rest of Norway. (THEMA, 2019, 2) The agricultural sector as a value creation of 14 billion NOK in Rogaland and is a valued industry. (Norges bondelag, n.d.) Being the second largest industry in the county, it has a high value as an industry in the region, could create an early pressure on reducing GHGs. And it is of great importance of facilitating GHG reduction by the local politics, local politics could have a crucial impact of how smooth the sectors GHG reduction will be experienced. As shown in figure 1, the sector with highest amount of GHG emission in South-Jæren area is the agricultural sector. And the sector may experience larger pressure for reducing GHG's.

As shown in figure 2. 53% of the agricultural emissions in South-Jæren is from the digestive process from livestock, research and development (R&D) is being done if an adjustment in the livestock animal's diet could reduce emissions, e.g. adding enzymes in the cows feed (Fjeld, 2019). The agricultural land releases 21% of total emissions, and R&D is ongoing to figure out how to absorb and store larger amount of CO₂ in the agricultural lands soil, plowing releases larger amount of CO₂, but there is limited available practices to replace the method of plowing in the industry yet (Hojem & Ohna, 2010, 15). Livestock manure handling makes sure for 25% of total agricultural emissions, there is developed solutions like biogas facility, that is a larger complex and expensive facility. Or as informant number 5 informed about the development of cooling system for the manure storages, as well as mount ceiling to cover manure pit storages (Norges bondelag, n.d.,B). There are solutions that could be implemented today, at the same time as there is need for more R&D to develop solutions. The problem is who is going to pay for it, and how will policy govern this development?

Interview candidate number 5 who had already invested in biogas facility on his farm, pointed out that the agricultural sector will have to do major changes in the case of GHG reductions, and that the sector may not yet be fully aware of the larger changes that has to be done. The agricultural sector is the largest industry at the rural jæren area and includes a large number of cattle and milk farming. As the most GHG polluting industry in the area, the sector will have to do major actions in the future, and we will benefit from being prepared and start rapidly. Informant number 5 also mentioned that one of the climate actions solutions that is arriving soon, is to cool down the manure pits with easy pumping cold air in pipes into the pits, that cools down and reduce a larger amount of GHG release from the storing of farm animal manure.

The fact that energy is a valuable source that manages to lift societies to get higher human prosperity (Smil, 2017, 102) is reflected in the Norwegian agricultural sector. Large scale farms are mostly high energy demanding industries with technology that makes it possible to run large scale farms efficiently, and the agriculture economy has mostly been dependent on such investments to be able to run the farm economically viable. The consequences of this development are the rapid closure of small- and medium scale farms all over Norway. (Bjørkhaug, 2016, 20) also illustrated in Fig. 4. Due to Norway's luxury of large amount of hydropower as well as a well-established electrical grid in South-Jæren, even if it is a rural area, the agricultural industry has access to large amount of electric from the grid. GHG's from energy use is not a problem, and like candidate number 6 mentioned, they have recently built a new vegetable storage hall based on heat pump system with electricity from the local grid. Easily availability energy at a good price, may have had an influence in the large-scale farming industry at the South-Jæren area. Some of the informant mentioned very high electricity costs within the farm business, and was considering the investments of solar panels, with the goal of reduce electricity costs. And with the consideration where Norwegian energy from the grid is a green energy source, an investment in renewable energy is to move to a new type of green energy source within South-Jæren that provides high energy from the local grid.

What worried Norwegian farmers the most for having a negative effect on the farm business in the future was a scenario of increased energy prices. There were also asked for how

negative effect CC could be on their farms, and the answers was no significant and small negative impact. And the question about the future impact of requirements for reduced climate emissions, the answers was mostly that it will have no significant and small negative impact. (Zahl-Thanem & Melås, 2020, 70) This is interesting in the case of many farmers investing in solar panels on industry roofs, and as the interviewed candidates stated that investment in renewable energy like solar cell panels, is in the purpose of reducing high electricity bills, if its beneficial for the climate as well, then that's good, but it's not the reason for the investment.

As the findings discovered a perception of there being a high focus of CC mitigation within the agricultural sector, there was at the same time not mediated a significant worry about climate changes in both the interviews and in the questionnaire by (Zahl-Thanem & Melås, 2020). In the case of planetary boundaries (e.g. Nordhaus et. al., 2012, Steffen et. al. 2015, meadows, H. D, 2004). Some areas, on which agriculture depends on, are starting to reach a level of high risk in reaching its limits (e.g. genetic diversity at high risks and land-system change at medium risk (figure 5.). In the case of the interviewed findings, there was some worries about a changing weather patterns, and others believed that the weather goes back and forth in periods and in the case of the agricultural sector the farmers are used to implement adaptation actions when variations affects the farm business. Mitigation may not be the main focus, but the focus is to reduce GHG's in the case of national goals, as well as the sector gets prepared for adaptation actions when problems occurs. An even larger focus on mitigation would be beneficial for the sector, as mitigation and adaptation acts in synergies (Smith, 2007, 24), mitigation could give a relieving effect on future problems. There seems to be a common knowledge about CC problems happening, but a wider understanding of the problems complexity could be beneficial for the sectors development, this kind of complex knowledge has to be broken down and mediated in simpler explanations than what is used at as an explanation at expert level.

There was a varied degree of knowledge about CC and GHG's at the interviewed candidate for this theses study. In the case of the interview question about to which extent is Climate action a discuss topic in the farmers network of farmers, all informants answered to a very little extent. That is interesting in the case of the national questionnaire by Zahl-Thanem &

Melås (2020) that shows what forms of sources that is most important for new knowledge on the farm, based on answers from farmers all over Norway is the local areas, magazine and newspapers, internet, and consulting from agricultural advisers that was the sources the farmers all over Norway said was very important as sources for gathering new knowledge in the case of the farm business (Zahl-Thanem & Melås, 2020, 60). The CLIMPLEMENT project (Ruralis, 2020) plans to create syllabus for to use in agricultural high school courses and educate advisers to help farmers. In the case of filling the gap of knowledge about global warming, CC and GHG's, there platforms are then considered as important for imparting knowledge.

The issue of releasing GHG's and the followed problem of global warming could be a fairly mature topic for the general public, where education is needed for understanding the complexity and to be able to understand the importance of reducing GHG's, the problem of limited knowledge was reflected in the farmers point of views, independent if they had agronomy education or not. As well as knowledge base could be limited by the fact that farmers are practical workers that has to know really a lot of different things in their farm business, therefor there is a limited capacity for studying the issues of GHGs and global warming. Except, if the farmer is personally interested. Knowledge could also be affected by the problem where media presenting GHG from the agricultural sector in a negative angle, as candidate number 2 stated that "media most often presenting farming and climate problems in the worst way, and therefore I skip reading it because I cannot bear how the media presenting the farmer in a negative manner as usual, but they probably have to angle it negative for getting people to want to read it". Some of the candidates had board memberships in agricultural organizations, and candidate number 2 mentioned "climate reduction been talked about in meetings", and candidate number 3 mentioned "climate change is sometimes discussed in the farmers' association", except for this, all candidates stated that climate change is not a common discussed topic in their network of farmers. When CC and GHG emissions is not a relevant topic for farmers to discuss within their network of farmers, it then seems like the farmers knowledgebase may be depending on to what extent they read about the topic in different media and journals or being active members in organizations within the agricultural sector.

It became clear that most farmers care about taking the responsible for environmental problems in their business, but knowledge about GHG emissions, global warming and CC was quite unclear to what extent they had knowledge about it, as candidate number 6 stated a need for more information and numbers about GHG emissions and CC actions within the farm business, because he would like to know the status of he's farm better. The governmental economically supported project developing a climate calculator that manages to get an overview and accounting of the farm's total emissions (Klimasmart landbruk, 2019) is highly relevant due to the problem of lack of climate accounting at farms (Barman, 2017) as of today, candidate number 6 did not know what and where to do CC action investments, due to lack of knowledge about it within he's farm.

Every informant had heard about the problem of the cow that farts and burps, but I don't know what category they sat this kind of pollution within because I think some of them was unaware of the gas having an negative impact in the larger earth's climate and global warming, some of the candidates was thinking that it affected the environment, like fossil fuel cars, that it has an effect on pollution of air and being bad for the environment. GHG's and global warming are fairly complex and not necessarily common knowledge but maybe it is to a higher extent a common knowledge for younger generation growing up since it has become a fairly relevant topic in today's society. And the problem of GHG and global warming matures with a new generation going into the farm business. Education seems to be needed for future development, and the project CLIMPLEMENT (Ruralis, 2020) is a needed contribution since it seems like the issue for the future development of CC mitigation and GHG reduction could have a connection to an existing knowledge gap between the working farmers and science.

The agricultural emissions entail biologically GHG emissions as well as the industries products is a crucial need for human beings. Results from the studies interviews tells us that most of the interviewed farmers, thought it was to a higher importance to reduce emissions from other sectors in Norway than within the agricultural sector, and that the agricultural sector is a small contributor in the case of other Norwegian sectors. Results from the questionnaire by Zahl-Thanem & Melås, (2020) tells us that Norwegian farmers to a higher degree believes that the Norwegian agricultural sector do not release too much GHG emissions, and that it is more important to reduce GHG's in other sectors. As well most participant answered that they

agreed in that there is a high focus on climate challenges in the Norwegian agricultural sector today (Zahl-Thanem & Melås, 2020, 68). Similar opinion was found in the interviews, where all farmers thought there was a focus on CC and GHG emissions within the Norwegian agricultural sector, as well as they all agreed that the agricultural sector has some emissions that could be reduced.

Farming is not the only option as peoples work, in the case of the thesis interviews, there was mentioned by several of the candidates that they did not have to be farmers, and if they quit farming, they would easily get a different job. This is also investigated by Zahl-Thanem & Melås (2020) within their questionnaire answered by farmers all over Norway, very few candidates answered that farming was their only possibility as work, and that the work as a farmer is mostly based on personal interests (Zahl-Thanem & Melås, 2020, 20). Many farmers also have additional work positions, either the farmer itself or the partner has additional work position. The pressured economy also mentioned by interview candidate number 7, where the farmer has little extra economical capital for investments, is also reflected in answers by the questionnaire done by Zahl-Thanem & Melås (2020) where the findings shows that "More than half of all farmers receive less than 1/4 of the household's total net income from farming" (Zahl-Thanem & Melås, 2020, 21) and that "It is clear that Norwegian agriculture is dependent on non-agricultural income. This is nothing new, but it may have an impact on how farmers assess the economy and plan investments" (Zahl-Thanem & Melås, 2020, 23). The limited capital within the agricultural sector could then give limitations in the case of which investments the farmer chooses for their farm, and that there are limited sources for investing in GHG reductions and CC mitigation unless the investment is beneficial for the farm business or economically viable. As candidate 7 describes that larger farms are not a synonym for the farm's profitability, and that people often believe that having a large number of cows, means there is a high income within the farm business. Large-scale farming is developed in the case of being economically viable in today's agricultural system. This could also be a factor in the case of small and medium size farms not being easily economically viable and is a part of causing the high number of small and medium size farms closing down the farm business.

As stated by interview candidate number 7, there is a too low value of the farms produced product, and that food chains have a large amount of power in price regulation. Results from the data collection by Zahl-Thanem & Melås (2020) farmers thought to a very high degree that there should be less focus and priority on cheaper food for the Norwegian consumer (Zahl-Thanem & Melås, 2020, 70). The farmers in this research and in the national questionnaire agrees that there is no need for further pushed prices on agricultural products, as it goes at the expense of the farm's finances. International food trade agreements, as well as food chains affecting market prices, could create a pressure on keeping the value of the farmers produced products low. The farmer's position as producers within the food system makes it easy to feel that the larger problem for GHG reduction is not mainly the farmer's responsibility, rather a problem where the larger actors in power in the agricultural and food distribution system has to take a larger extent of responsibility.

Like in many different sectors, the sector needs to develop towards a future with less negative footprints, to contribute in the global pressure and responsibility to climate actions and mitigate future problems. The process of how to reduce GHG's from the agricultural sector was a high prioritized topic in conference "mat og Landbruk 2020" food and agriculture in January 2020, sustainability and climate mitigation were the main topic for the conference. As well as the questionnaire by (Zahl-Thanem & Melås, 2020, 68), shows that farmers in all over Norway thought the agricultural sector has a high focus on climate emission, and all interview candidates agreed that there is a focus about in within the sector. The sector is starting to move from the thinking phase, into the action phase in the case of the political agreement (Ministry of Agriculture and Food, 2019). As of today, published reports only presents suggestions for possible ways of reduction within the agricultural sector, outlined pathways for how to proceed within the GHG reduction goal is yet unclear. All farmers interviewed indicated that they were curious of how the plan will be for reaching the climate agreement goal of reducing 5 mill. tons CO₂ equivalent within year 2030 in the agricultural sector.

7. Conclusion

The aim of this study has been to research the farmers perceptions of CC mitigation and GHG reduction and gather data that could answer the thesis research problem and RQ's. When comparing the gathered data from the interviews with the studies selected farmers, there could be seen a larger common opinion, as well as there also were several differences. The common overall opinion was that there is GHG emissions from the agricultural sector that could be reduced, and that the agricultural sector has a responsibility of reducing emissions, like every other sector in Norway.

1) What are farmers doing to reduce GHG emissions?

Farmers want to produce and run the farm business as best as possible, and there were different views of what kind of actions and to what degree actions was needed and most beneficial for the farm. But all farmers saw that the climate actions are a part of future investments. And CC mitigation investments was seen as beneficial for the farm business future.

2) How do farmers perceive their role in national efforts to reduce GHG emissions?

The agricultural sector has a responsibility, but the farmer is not the only one to blame, larger sectoral actors has to take a larger share in the sectoral GHG reduction. But as farmers, they always try their best to develop a farm who is well managed and prepared for the younger generation that takes over the business in the future.

3) What are the main obstacles for further reductions?

Farmers experiences that the pressure for GHG reduction is difficult to meet in the case of economically limits. Investments has to be economically viable, the farm business is economy vulnerable, and investments are well considered within the families before decisions are taken. There is may not room for the pressure of CC mitigation within the agricultural sector, since the sector is pushed to the limits in several areas. As well as knowledge about GHG's and CC, some interviewed farmers wishes they has the capacity to learn more about it, but the topic is fairly complex and demand time and interest to understand. There was a high

interest in learning more about it, but the obstacle is that it requires a greater effort to explore on their own for understanding the complexity of GHG emissions and CC problems.

4) How do farmers perceive that their efforts to reduce GHG emissions could be better facilitated by higher levels?

The farmers mainly perceive it as a general structural problem that has to be solved, the responsibility is not mainly on the farmer itself, but the farmers is at the same time aware of that changes is needed to be done in near future, but the question is how is it going to be done, and how it is going to be economically solved.

And the overall research problem in this thesis: **«What are the major obstacles for cutting emissions in the agricultural sector in South-Jæren, Norway?»**, the main conclusion for this is that the main obstacle is the financially problem of the needed investments. A low value on the farms produced product, and an industry pushed to economical limits, becomes a major obstacle for cutting emissions and mitigating CC within the farm businesses. The farmers could be experiencing the feeling of being within a limbo state, where there is pressure for the farmer to reduce GHG's, but no one knows the pathway of how it is going to be done yet.

7.1 Recommendations

This section has the purpose of giving recommendations that is relevant to the thesis study area and topic. Within the interviews, there could be observed that there is need for knowledge dissemination about CC and GHG, and the recommendations is that information is broken down in smaller portions to be easily explained. A common understanding and knowledge base would be beneficial for future communication and could stimulate cooperation within the agricultural sectoral development. It could be beneficial for keeping an equilibrium balance of power as farm businesses could be vulnerable for authority and top down management as the farmer itself is a vulnerable part within the food chain, that in a historically perspective often has been the actor with less power compared with sectoral authorities. Within the CLIMPLEMENT project (Ruralis, 2020) where the goal is to educate advisers within the agricultural sector, there could also be beneficial of take into account the

case of power balance between farmers and authority advises, informant number 7 had several years of work experience as a farm adviser before becoming a farmer, and stated that he had to act really carefully and act respectfully to gain trust when giving advises. The power balance could easily be affected, and the framer's experiences top down authoritative approach. The choice of communication method in the case of CC mitigation and actions will be important in future developments in the agricultural sector.

7.2 Further research

The section has the purpose of highlight recommendations for further research. There is a wide range of topics that would be relevant to research within the agricultural sector. While studying this thesis topic, there was some other research topics that emerged as important. It would be highly interesting to do further research in the case of whether the farmers experience a pressure for investments by authorities' regulations and standards, and if it is near by reaching a limit, what will be/or is the consequences of reaching the farmers limits?

In the case of historical development of regulations and power, the farmer has been a weaker actor in the case of power (e.g. like the recent cases of 'Food safety Authority' institutional crises (Fraser & Lien, 2019) and the fur farming gets forbidden after political collaboration agreements (Storaas, 2019). As told by several interview candidates, they experienced authority decisions, where farmers have minimal power of influencing within authority decisions. The historical perspective of the power balance within farmers and authority institutions has to be taken into account in the process of GHG reduction and CC mitigation within the agricultural sector, and this issue would also be interesting as further research topic.

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9. Links

CLIMPLEMENT project:

<https://climplement.no/>

Norges bondelag:

<https://www.bondelaget.no/>

Mat og landbruk 2020 conference:

<https://www.matoglandbruk.no/>

Statistics for agricultural sector Norway:

<https://www.ssb.no/jord-skog-jakt-og-fiskeri/faktaside/jordbruk>

10. Attachments

Attachment number 1: the interview guide

The interview guide is a set up for a semi-structured interview, where there is a set of planned questions to ask the farmers, as well as there is room for having a conversation and add follow up questions during the interview. The flexibility to adjust the conversation given by the semi-structured interview method is needed in the case of every farm being different with its own unique business Modell. The interviews are based on a set of questions with a room for a flexible conversation around them, adjusted to the individual farmer.

Introduction (about 5-10 minutes)

1. Starts with presenting myself and what I'm studying.
 - Agricultural GHG emissions, studied from the perspective of farmers and their business model.
2. What is the purpose by having these interviews, why I need to collect the data.
3. Declaration form for data storage, needs to be signed.
4. Is there any questions from the informant?
5. Start audio recorder
6. Start asking the informants name, age, education and their farm business.
 - To what extent is the farm your work, do you have other income outside of the main farm business?
-and are other family members a part of the farm business?

Thematic questions (about 40-45 minutes)

(Research problem: «What are the major obstacles for cutting emissions in the agricultural sector in South-Jæren, Norway?»)

(RQ nr. 1 What are farmers doing to reduce GHG emissions)

1. What are your thoughts about the agricultural sectors GHG emissions?
 - And what do you think about GHG emissions in the case of your own farm business?

- What are your thoughts about the problem of GHG emissions from the agricultural sector?
- Is the problem of GHG in the agricultural sector a often discussed topic in your network of farmers?

2. What are your thoughts about CC mitigation

- Are you worried about CC in the case of your farm business?

(RQ nr. 2. How do farmers perceive their role in national efforts to reduce GHG emissions?)

1. Are you familiar with the agricultural agreement between farmers organization and the Norwegian government?

- Are you familiar with the agricultural climate plan year 2030

2. Is GHG reduction a part of the farm's future business plan?

- Does the Norwegian agricultural sector have a responsibility in the case of the national GHG reduction goal?

(RQ nr. 3. What are the main obstacles for further reductions?)

1. What are the farmers obstacles for reducing GHG on their farms?

- What are the experienced obstacles for including GHG reduction in the future businessplan of the farm?

(RQ nr. 4. How do farmers perceive that their efforts to reduce GHG emissions could be better facilitated by higher levels?)

1. What do you think is needed, for the farmer to reduce GHG emissions in their farm business?

- Should GHG reduction be better facilitated by higher level?

Summary questions (about 5-10 minutes)

1. Summarize statements, and make sure its correctly understood, to avoid misunderstandings.

2. Is there something you would like to add to the interview?

3. Is there any questions before the end of the interview?

Attachment number 2: statement of consent

I have received and understood information about the project "Attitudes towards implementing climate change mitigation measures among farmers in South-Jæren, Norway: Opportunities and barriers for action", and have had the opportunity to ask questions.

I agree to:

- To participate in interviews
- That Lovise Hetland can provide information about me for the project
- - if relevant
- that information about me is published so that I can be recognized (information about the farm can be unique and recognizable to others).

I agree that my information will be processed until the project is completed

(Signed by project participant, date)