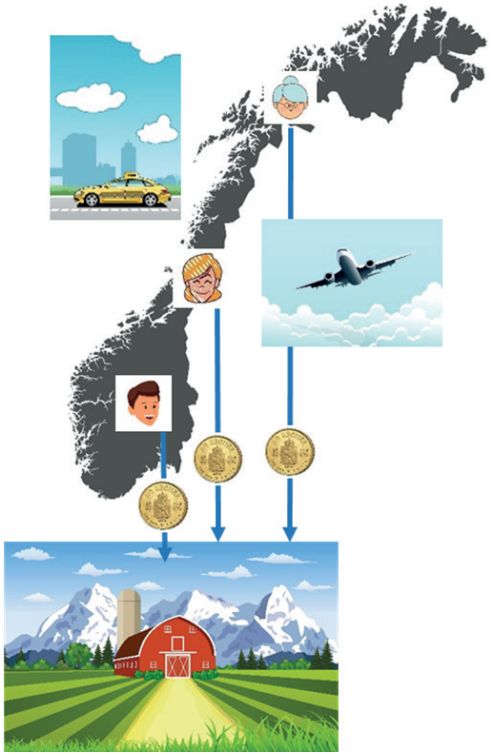
Norwegian farmers' willingness to participate in a local climate crowdfunding program - results from a national survey



Pia Piroschka Otte
Alexander Zahl-Thanem
Sissel Hansen
Natalia Mæhle

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RURALIS - Institutt for rural- og regionalforskning
Universitetssenteret Dragvoll Telefon: +47 73 82 01 60
N-7491 Trondheim Epost: post@ruralis.no

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Tittel: Norwegian farmers' willingness to participate in a local climate crowdfunding program - results from a national survey

Forfatter: Pia Piroschka Otte, Alexander Zahl-Thanem, Sissel Hansen, Natalia Mæhle
Utgiver: Ruralis – Institutt for rural- og regionalforskning
Utgiversted: Trondheim
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Short summary
This report presents a main deliverable of work package 3 in the Coolcrowd project, an international research project funded by the Research Council of Norway. The aim of the project is to develop a crowdfunding program that would enable travelers to offset their GHG (greenhouse gas) emissions locally by supporting Norwegian farmers who want to adopt more climate friendly practices. The main objective of WP3 is to identify farmers' interest in participating in a locally crowdfunded climate program. The report analyzes the findings of a national survey investigating farmers' interest in climate change, particularly mitigation and a local crowdfunding program.

Key words
Crowdfunding, agriculture, climate change, business models

Coolcrowd partners

Preface

This report was written as part of the project "Coolcrowd: Investigating the concept of local climate crowdfunding for Norway". Coolcrowd is an international research project led by Ruralis. It includes five national research partners: University of Oslo (UiO), Western Norway University of Applied Sciences (HVL), Norwegian School of Economics (NHH), BI Norwegian Business School and NORSØK (Norwegian Centre for Organic Agriculture). Internationally the project collaborates with Eindhoven University of Technology (TU/e), the University of Western Australia (UWA) and the Centre for Sustainability (CSAFE) at the University of Otago. The project is financed by the Research Council of Norway (KLIMAFORSK program, project number 268223).

This report presents one of the deliverables of work package 3, which investigates farmers' willingness to participate in a local crowdfunding program that can assist farmers financially in adopting climate measures. This document serves as public report for agricultural stakeholders interested in climate change mitigation and alternative financing schemes, particularly crowdfunding, at the same time providing relevant knowledge for work package 4, which investigates the public's willingness to pay for local climate crowdfunding.

In Coolcrowd, local climate crowdfunding is considered as a potential additional source of finance for Norwegian farmers enabling the private sector to contribute to local food security and sustainable agriculture. We want to stress that local crowdfunding would provide additional capital to existing support schemes that are available to farmers through the agricultural agreement ('jordbruksavtale') rather than replacing it.

We would like to thank Dr. Ingvar Kvande from NORSØK for valuable inputs to the report. The report has been internally quality checked by Dr. Robert Burton.

More information on the project can be found at www.coolcrowd.no.

Pia Piroschka Otte and Alexander Zahl-Thanem

Trondheim, 15.05.2019

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Executive summary

This report builds on the *Coolcrowd* research project, an international three-year research project financed by the Research Council of Norway (project number 268223). The aim of the project is to develop a crowdfunding program that would enable travelers to offset their emissions locally by supporting Norwegian farmers who want to adopt more climate friendly practices. Conventional carbon offset programs support projects in distant countries where people are unable to ascertain their impact. Climate research has shown that locality becomes an important factor for enabling climate friendly practices (Stoknes, 2014; Nisbeth, 2009). Coolcrowd builds on this claim by testing the feasibility of a local crowdfunding program.

Crowdfunding can be defined as obtaining funding from a large audience, in which each backer provides a relatively small amount, instead of raising large sums from a small number of investors (Belleflamme et al., 2014). Crowdfunding involves three important players: the entrepreneur (who seeks funding and sets up the campaign), the backer/funder (who contributes with small amounts of money) and the crowdfunding platform (where the campaign is posted and which connects the entrepreneur and backer). We can distinguish four different types of crowdfunding:

- Donation- based: Backers donate money to support a certain cause without expecting anything in return.
- Reward-based: Backers receive non-monetary rewards or products in return for their financial contribution
- Lending-based: A type of peer-to-peer loan, where backers expect to receive fixed periodic income as well as repayment.
- Equity-based: Backers receive equity in the venture they support

Crowdfunding has seen an exponential growth in recent years. However, Norway has still an unexploited potential compared to other Nordic countries. Furthermore, crowdfunding has a high potential for financing sustainable, climate projects that lack financial resources.

Objectives:

This report presents the results from a national survey with Norwegian farmers to identify their interest in participating in a locally crowdfunded climate program. Through an iterative process we have identified five business model attributes as relevant for the supply side (farmers) for implementing local crowdfunding.

1.) *Crowdfunding type*: donation, reward, loan, equity

2.) *Co-finance*: Co-finance of the crowdfunded amount through additional sources, which can include farmers' own savings, bank loan, or existing governmental support schemes
3.) *Trusted platform*: Identification of the platform farmers trust that could administer the crowdfunding campaign and assist with GHG emission calculations. We can distinguish between farmers' organizations, agricultural advisory organizations, crowdfunding platforms, banks and research institutes.
4.) *Degree of collaboration*: Some climate mitigation measures are very suitable for collaboration between farmers. This can also reduce financial and social risks.
5.) *Types of backers*: These can be individuals and/or companies who want to become more climate friendly and look for new ways to offset their emissions.

Method:

A random sample of farmers was drawn from the population using the Register of Producers at the Norwegian Agricultural Authority. 2000 questionnaires were sent out to a representative sample of farmers by mail, a total of 465 respondents completed the questionnaire with an overall response rate of 23.3 percent. The questionnaire was divided into socio-economic background, knowledge and interest in crowdfunding, perceptions and knowledge of climate change, interest in different climate mitigation measures.

We included 7 climate measures that we defined as relevant or easy to crowdfund. These capture: 1) wood barns, 2) installation of ceiling panels on barns, 3) solar panels on barns, 4) biogas production from animal manure, 5) precision GPS guidance systems for tractors, 6) drag hose with dribble bars for manure spraying, 7) supplying biochar to soils.

Results:

- Results indicate that only 20 percent of the farmers had prior knowledge of the term crowdfunding. There were no significant differences between production types, age groups and educational level.
- Due to the limited knowledge on crowdfunding a high percentage of farmers answered survey statements with "don't know".
- Organic farmers (including farmers who are under a conversion-program to become organic farmers) tend to agree more with the statement that climate crowdfunding is attractive than conventional farmers.

- Farmers who feel responsible for reducing GHG emissions are more interested in a local crowdfunding program.
- 43 percent of farmers agree with the statement that crowdfunding of climate measures is only relevant if it does not lead to new regulations and inspections on the farm.
- 49 percent agree with the statement that they do not want to be presented publicly as a recipient of a crowdfunding campaign.
- 39 percent agree with the statement that crowdfunding is to time-consuming.
- Many farmers would prefer to receive financial support through a crowdfunding fund rather than carrying out their own campaign.
- Farmers tend towards donation-based crowdfunding but there is a high uncertainty since many ticked the "don't know" category. There is also interest in a reward-based system where open farm visits are the most attractive form or reward for farmers to offer.
- 66 percent perceive external financial contribution as important for implementing climate measures.
- 57 percent of the farmers agree with the statement that co-financing from governmental authorities would increase the likelihood that they participate in a crowdfunding campaign.
- Farmers express significantly greater trust in agricultural advisory services and farmers' organizations compared to crowdfunding platforms, banks and research institutes.
- A substantially greater number of farmers think that is acceptable to receive money from Norwegian companies than private people.
- Farmers expressing positive attitudes towards crowdfunding are more positive towards collaboration with other farmers.
- Farmers are interested in investing in solar panels as a preferred climate measure.

Conclusion and recommendations:

- Overall, the survey results indicate that there is generally a high level of uncertainty and lack of knowledge on crowdfunding among farmers.
- A large number of farmers do not want to be presented publicly as a recipient of a crowdfunding campaign. Notably, it was not specified in the survey what such a public presentation would look like. Thus, this potential socio-cultural constraint may need more consideration in further research.
- Many climate measures such as solar panels and drag hose with dribble bars for manure spraying can be shared among farmers and thus it needs to be

investigated further in which way farmers could imagine to run a collaborative crowdfunding campaign that would also reduce financial and social risks, and time concerns.

- High levels of trust among farmers in agricultural advisory organizations to run a crowdfunding platform and interest in governmental co-financing should find consideration in the further concept development.
- We encourage more dissemination activities to raise awareness on crowdfunding among Norwegian farmers. This could lead to increased interest among farmers. Furthermore, it could reduce the fear that a locally crowdfunded climate scheme would be negatively perceived by others in their neighborhood.

Sammendrag

Denne rapporten er basert på forskningsprosjektet *Coolcrowd*, som er et internasjonalt treårig forskningsprosjekt finansiert av Forskningsrådet (Prosjektnummer 268223). Målet med prosjektet er å utvikle et lokalt folkefinansieringsprogram som vil gjøre det mulig å støtte norske bønder som ønsker å omstille seg til en mer klimavennlig praksis. Tradisjonelle klimakvoter støtter gjerne prosjekter i andre land der man ikke i samme grad har mulighet til å få innblikk i hva egne bidrag fører til. Tidligere forskning viser at lokal nærhet er en viktig faktor som muliggjør klimavennlig praksis (Stoknes, 2014; Nisbeth, 2009). Coolcrowd bygger på denne påstanden ved at prosjektet vil undersøke gjennomførbarheten for ulike lokale folkefinansieringsprogram.

Crowdfunding (også kjent som folkefinansiering) kan beskrives som en finansieringskilde der man får økonomisk bidrag fra et stort publikum, hvor den enkelte bidragsyter ofte gir et relativt lite bidrag. Dette skiller seg fra andre finansieringsmodeller hvor et lite antall investorer bidrar med store summer (Belleflamme et al., 2014). Crowdfunding involverer tre viktige aktører: *entreprenøren* (som søker finansiering og setter opp kampanjen), *bidragsytere* (som bidrar med økonomisk insentiver) og *drivere av crowdfunding-plattformer* (der kampanjen er lagt ut og som knytter entreprenøren(e) og bidragsytere sammen).

Videre kan vi kan skille mellom fire forskjellige typer crowdfunding:

- Donasjonsbasert: Bidragsytere bidrar økonomisk for å støtte en bestemt sak, uten å forvente noe tilbake.
- Belønningsbasert: Bidragsytere mottar belønninger eller produkter som takk for deres økonomiske bidrag.
- Utlånsbasert: Et lån, hvor bidragsytere forventer en tilbakebetaling (inkludert rente).
- Aksje-basert: Bidragsytere mottar aksjer i det selskapet de støtter.

Selv om crowdfunding har blitt stadig mer kjent og utbredt de siste årene, har Norge fortsatt uutnyttet potensiale sammenlignet med andre nordiske land. Crowdfunding har et stort potensiale for finansiering av bærekraftige klimaprosjekter som mangler økonomiske ressurser.

Mål:

Denne rapporten presenterer resultater fra en representativ nasjonal undersøkelse av norske gårdbrukere, hvor målet blant annet er å identifisere deres interesse for å delta

i lokale folkefinansierte klimaprogram. Prosjektgruppen har tidligere identifisert fem faktorer som er sentrale for gode forretningsmodeller:

1.) *Crowdfunding type*: Donasjon, belønning, lån, og egenkapital.

2.) *Samfinansiering*: Finansiering utover bidrag fra crowdfunding, noe som kan inkludere eksisterende statlige støtteordninger, eller bøndenes egen kapital eller lån.

3.) *Plattformer bønder kan stole på*: Identifisering av plattformer bønder har tillit til med tanke på administrering av crowdfunding-kampanjer. Vi kan skille mellom bondeorganisasjoner, landbruksrådgivende organisasjoner, crowdfunding-plattformer, banker og forskningsinstitutter.

4.) *Samarbeidsgrad*: Noen klimatiltak er godt egnet for samarbeid mellom bønder. Dette kan også redusere økonomiske og sosiale risikoer.

5.) *Typer av bidragsytere*: Disse kan være enkeltpersoner og / eller selskaper som vil bli mer klimavennlige og se etter nye måter å kompensere for sine utslipp.

Metode:

Et tilfeldig utvalg av gårdbrukere ble trukket fra Produsentregisteret, som i dette henseende er samsvarende med Landbruksregisteret, og innebærer et register over alle registrerte landbruksforetak som driver landbruksdrift og som søker om produksjonstilskudd til et gårdsbruk. Totalt ble 2000 spørreskjemaer sendt ut postalt til et tilfeldig utvalg av norske gårdbrukere, og av disse fullførte 465 respondenter spørreskjemaet, noe som gir en responsrate på 23,3 prosent. Spørreskjemaet inneholder spørsmål om gårdbrukerens bakgrunn, interesse og kunnskap om crowdfunding, oppfatninger og kunnskap om klimaendringer, og interesse for ulike klimatiltak.

I tillegg inkluderte syv klimatiltak som vi definerte som relevante for crowdfunding, som gårdbrukerne ble bedt om å ta stilling til. Dette inkluderer: 1) bruk av tre i fjøs i stedet for stål og betong, 2) takplater på fjøset som slipper lys gjennom, 3) solceller på fjøs/hustaket, 4) biogassproduksjon fra husdyrgjødsel, 5) presisjonskjøringsutstyr basert på GPS, 6) Slepeslange med stripespreder, og 7) nedgraving av biokull i jorda som lagrer karbon.

Resultater:

- Kun 20 prosent av gårdbrukerne hadde tidligere kjennskap om begrepet crowdfunding/folkefinansiering. Det var ingen forskjeller mellom ulike produksjonstyper, aldersgrupper eller utdanningsnivå.

- På grunn av den begrensede kunnskapen og usikkerheten knyttet til crowdfunding/folkefinansiering, svarer en relativt stor prosentandel gårdbrukere «vet ikke» på enkelte spørsmål.
- Økologiske bønder (inkludert bønder under omlegging) er i større grad enig i at crowdfunding høres ut som en attraktiv løsning, sammenlignet med konvensjonelle bønder.
- Gårdbrukere som føler seg ansvarlige for å redusere drivhusgassutslippene, er mer interessert i et lokale crowdfunding-program.
- 43 prosent av gårdbrukerne er enige i påstanden om at crowdfunding bare er relevant hvis det ikke fører til nye forskrifter eller inspeksjoner på gården.
- 49 prosent er enige i påstanden om at de ikke vil presenteres som offentlig mottakere av en crowdfunding-kampanje.
- 39 prosent er enig i påstanden om at crowdfunding er *for* tidkrevende.
- Mange gårdbrukere gir uttrykk for at de foretrekker å motta økonomisk støtte gjennom et crowdfunding-fond i stedet for å gjennomføre sin egen kampanje.
- Flest gårdbrukere ser ut til å foretrekke donasjonsbasert crowdfunding. Likevel er det knytte stor usikkerhet til dette, ettersom en stor andel har krysset kategorien "vet ikke". Det er også interesse for et belønningsbasert system hos mange av gårdbrukerne, der åpne gårdsbesøk kan fungere som belønning til bidragsytere.
- 66 prosent oppfatter eksterne økonomiske bidrag som viktig for gjennomføringen av klimatiltak.
- 57 prosent av gårdbrukerne er enig i påstanden om at samfinansiering fra myndigheter øker sannsynligheten for at de deltar i en crowdfunding-kampanje.
- Gårdbrukerne uttrykker betydelig større tillit til landbruksrådgivning og bondeorganisasjoner sammenlignet med crowdfunding-plattformer, banker og forskningsinstitutter når det gjelder å sette opp og drive en crowdfunding-plattform for finansiering av klimatiltak.
- En vesentlig større andel gårdbrukerne synes det er greit å motta økonomisk støtte fra norske bedrifter sammenlignet med privatpersoner.
- Gårdbrukere som uttrykker positive holdninger til crowdfunding er mer positive til samarbeid med andre gårdbrukere enn de med mer negative holdninger til crowdfunding.
- Investering i solcellepaneler er tilsynelatende et foretrukket klimamål.

Konklusjon og anbefalinger:

- Samlet viser undersøkelsesresultatene at det generelt er høy grad av usikkerhet og mangel på kunnskap om crowdfunding blant gårdbrukere.
- Et stort antall bønder vil ikke bli presentert offentlig som mottaker av en crowdfunding-kampanje. Det er verdt å nevne seg at det i undersøkelsen ikke ble angitt hvordan en slik offentlig presentasjon ville se ut. Likevel er dette noe man bør ta i betraktning i videre forskning.
- Mange klimatiltak, som for eksempel solcellepaneler og slepeslange med stripespreder, kan deles mellom bønder og derfor må det undersøkes videre på hvilken måte gårdbrukere kan forestille seg å drive crowdfunding i samarbeid. Noe som kan redusere økonomiske og sosiale risikoer, i tillegg til bekymringer om tidsbruk.
- Gårdbrukeres høye tillit til landbruksrådgivende organisasjoner for å drive crowdfunding-plattformer, samt interesse for statlig medfinansiering, bør bli tatt hensyn til i videre konseptutvikling.
- Vi oppfordrer til mer formidling om Crowdfunding/folkefinansiering for å øke kunnskapen blant norske gårdbrukere. Dette kan føre til økt interesse blant bønder. Videre kan det potensielt redusere frykten for at et crowdfunding vil bli negativt oppfattet av andre i deres nabolag.

1 Introduction

This report builds on the Coolcrowd research project led by Ruralis. Coolcrowd is an international three-year research project financed by the KLIMAFORSK program of the Research Council of Norway.

The aim of the project is to develop a crowdfunding program that would enable travelers to offset their emissions locally by supporting Norwegian farmers who want to adopt more climate friendly practices (see Figure 1). Travelers can voluntary offset their emissions through so-called carbon-offset projects that aim to negate or neutralize CO_2 emissions in one place by avoiding the production of CO_2 emissions in another or by absorbing/sequestering the same amount of CO_2 as released (Taiyab, 2005:5). However, the uptake of these measures has been limited due to a lack of transparency and uncertainty. Conventional carbon offset programs support projects in distant countries where the consumer is unable to ascertain that they are having any impact – or whether they exist at all. Previous research in climate communication has shown that practices to mitigate climate change are often not undertaken because the impacts of climate change are distant in space and time (Stoknes, 2014; Nisbeth, 2009). Thus, locality become an important factor for enabling climate friendly practices (Stoknes, 2014).

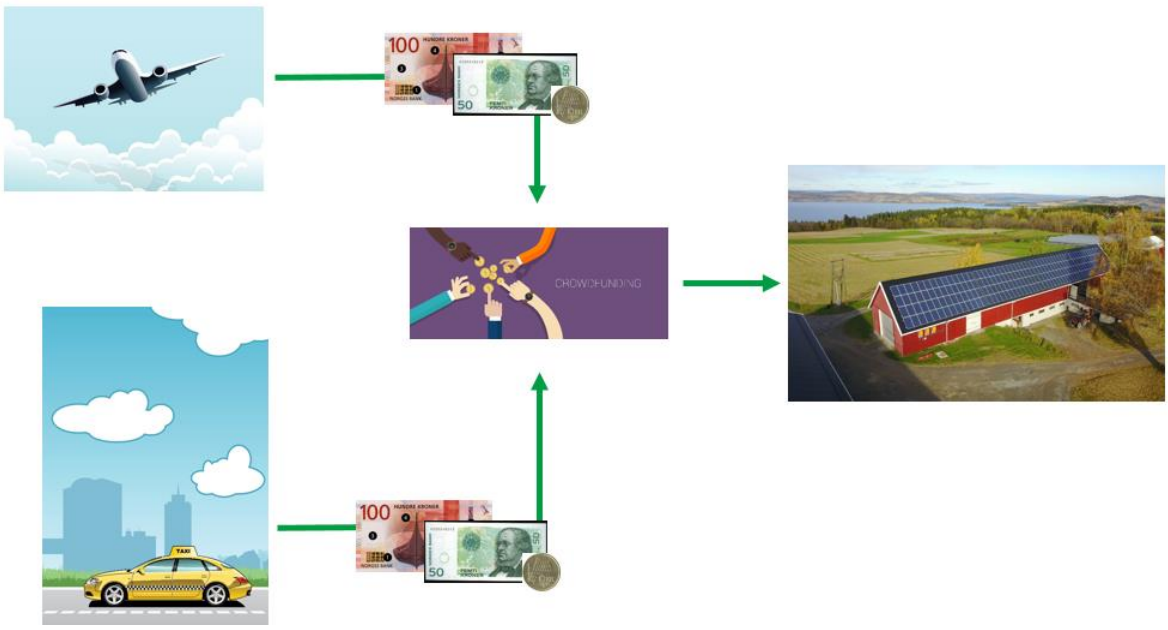

Figure 1: Local crowdfunding concept.

Source: Colourbox and bondevennen.no

Coolcrowd builds on this claim by testing the feasibility of a local crowdfunding program that can enable travelers to compensate for their emissions by paying local farmers who want to switch to more climate friendly practices. By allowing people to

fund investment in and interact with local famers, crowdfunding offers a real possibility of making climate reduction measures directly *visible* and *relevant* to their lives.

In addition, local crowdfunding of climate friendly agricultural practices can create multiple values besides its climate impact. It can also support local food production and contribute to rural development. The project presents a test of concept study following a design science approach, which is about connecting dispersed scientific knowledge to actionable tools and guidelines for practitioners (Burg et al., 2012).

Primary objective: To explore the potential of crowdfunding for climate-friendly agricultural projects in Norway as a novel socio-technical practice that promotes a rapid transition to a low-emission society.

Secondary objectives:

(i) To review existing crowdfunding approaches and analyzes how these might be applied in a Norwegian context (work package 2.1)

(ii) To explore legal and socio-cultural issues that may facilitate or inhibit the application of a crowdfunding approach to Norway (work package 2.2)

(iii) To develop alternative business models for a locally crowdfunded climate program (work package 2.3)

(iv) To explore the acceptability of the crowdfunding approach for Norwegian farmers and investigate optimal design from the perspective of the farm (work package 3)

(v) To establish the likely response of the general public to the concept of locally crowdfunded climate measures and identify optimal measures (work package 4)

(vi) To develop and recommend measures for the implementation of a crowdfunded approach in collaboration with relevant stakeholders (work package 5)

The project is divided into six work packages that address these objectives. Figure 2 provides an overview of the WP interactions. This report focuses on the work undertaken in *WP3 Farmer demand and design preferences*.

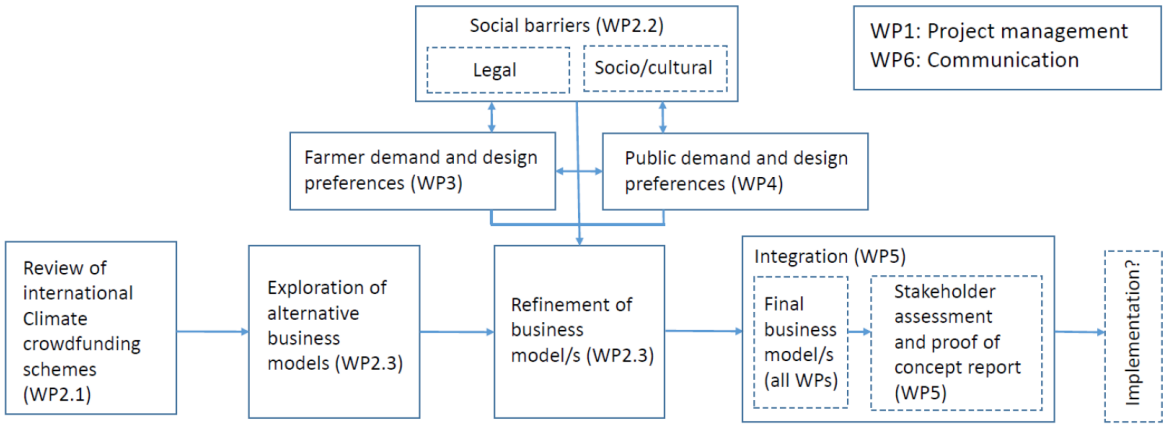

Figure 2: Work package interrelations in Coolcrowd

The main objective of WP3 is to identify farmers' interest in participating in a locally crowdfunded climate program, optimal design and preferred technologies or land management changes, and potential sociocultural and economic issues associated with adopting a publicly visible crowdfunding approach. This work presents a crucial part for designing suitable business models that can be implemented by the project's industry partners. The project follows an iterative process in line with the Design Science approach. WP3 applies a mixed method approach in its data collection consisting of focus group discussions, interviews and a survey with Norwegian farmers (see Figure 3). This report focuses on the quantitative part, in the form of a representative survey, addressing general trends and preferences of a local crowdfunding program among Norwegian farmers.

Figure 3: Flow chart data collection

2 Crowdfunding and business model design

2.1 Introduction to crowdfunding

Crowdfunding – obtaining funding from large audiences, in which each backer provides a relatively small amount, instead of raising large sums from a small number of large investors and backers (Belleflamme et al., 2014) – has become an important alternative source for project funding. Crowdfunding is not a new idea but has gained wide popularity through the use of the internet, which enables entrepreneurs to share their crowdfunding campaigns with a much broader audience. By enabling a wide range of people to network and pool their money together (Ordanini 2009 in Ordanini et al., 2011:444), crowdfunding represents an instrument that takes into account the local relevance aspect.

Crowdfunding normally involves three important players, such as the entrepreneur (who seeks finance and sets up the campaign), the backer or funder (who contributes with small amounts of money to the campaign) and a crowdfunding platform (where the campaign is posted and which connects the entrepreneurs and funders). Roles of the platform include relation mediator (intermediary between supply and demand sides), and social gatekeeper (Ordanini et al., 2011).

It is possible to distinguish between four crowdfunding models – donation-based, reward-based, equity-based, and lending-based crowdfunding (Mollick 2014; Ziegler et al., 2018). In donation-based crowdfunding, backers donate money to support a certain cause based on philanthropic or civic motivations without expecting anything in return. Reward-based crowdfunding offers backers various non-monetary rewards or products in exchange for their participation. The rewards can vary in their size depending on the amount contributed. Rewards can be products produced as a result of the project (pre-sale), merchandise products (e.g., t-shirts, cups) or experiences (e.g., farm visits, dinner with an entrepreneur). The lending model of crowdfunding represents a type of peer-to-peer loan, where backers expect to receive fixed periodic income as well as repayment. In equity-based crowdfunding, backers receive equity in the venture they support (Ahlers et al., 2015).

The important feature of crowdfunding is that through crowdfunding campaigns, the backer can make direct contact with the entrepreneurs. In terms of the Coolcrowd concept, it means that participants can directly contact local farmers through the online campaign, and thus local crowdfunding addresses the intangible trust issue experienced by conventional carbon credit systems where the direct beneficiaries are often unknown.

Crowdfunding has seen exponential growth in recent years and reached a volume of EUR 270 billion in 2016, growing 208% from EUR 130 billion in 2015 (Ziegler et al., 2018). We see crowdfunding growth also in Norway. The total volume of crowdfunding in 2018 was 205,2 million kroner, a 118% increase compared to 2017 (Shneor & Ziegler, 2019). The recent development in the market demonstrates that in 2018 loan-based crowdfunding for the first time became largest category of Norwegian crowdfunding. Reward crowdfunding is on decline while the donation approach continued to grow in 2018 (Shneor & Ziegler, 2019). There is also a dramatic growth in equity crowdfunding despite the regulatory challenges that make it difficult to establish in Norway. Overall, Norway has unexploited potential for crowdfunding compared to other Nordic countries (Ziegler et al., 2018), and crowdfunding is becoming an important capital acquisition method for entrepreneurs and project owners. It can particularly help to increase access to venture capital in the early stages of new start-ups (Shneor and Aas, 2016).

Moreover, crowdfunding is relevant for funding sustainable projects that otherwise lack of financial resources (Ortas et al., 2013). Sustainable projects have to balance economic, social and environmental goals, the so-called triple bottom line (Belz and Binder, 2017). That leads to higher risk perceptions among conventional investors, making it more challenging to acquire financing from traditional sources. Existing literature demonstrates that sustainable projects have successfully adopted crowdfunding. For instance, Lam and Law (2016) find that donation- and reward-based crowdfunding has been successfully used to provide initial capital for small-scale and remotely located sustainable energy and green innovation projects. However, they argue that it is best to combine crowdfunding with other sources of capital. At the same time, Hörisch (2015) shows that, contrary to prior empirical evidence (Bartenberger and Leitner, 2013), the environmental focus of a project does not seem to be positively correlated with the probability of successful funding. Nevertheless, these findings are based on a rather small number of projects (ten projects). Hörisch (2015) also finds that non-profit projects find it easier to collect funds, which suggests that sustainable projects might benefit from being recognized as non-profit. In contrast to Hörisch (2015), Calic and Mosakowski (2016) show that an environmental or prosocial orientation not only increases the probability of a project reaching its funding target, but also its chance of receiving funds in excess of the original goal. Vasileiadou et al., (2015) provide further support to this assumption by demonstrating that crowdfunding platforms fully dedicated to just renewable electricity initiatives fare better for renewable energy projects than platforms with broader orientations.

The concept of locally crowdfunding climate measures in agriculture extends the application of crowdfunding to the climate discourse.

2.2 Business model attributes for local crowdfunding

Farmers are key decision-makers and thus crucial stakeholders for determining the design and format of a local crowdfunding scheme. Through an iterative process in the project, consisting of workshops, focus group discussions with farmers, researchers and our industry partners we have identified five main business model attributes as relevant for the supply (farmer's) side. These can take different forms as illustrated in *Figure 4*.

1.) **Crowdfunding type:** This captures the different types of crowdfunding explained in section 2.1 (e.g., donation, reward, loan and equity based crowdfunding). Due to the lack of a legal framework for equity crowdfunding in Norway we excluded equity crowdfunding for the further concept development.
2.) **Co-finance:** Some of the mitigation measures in agriculture are very costly, which can make it difficult to finance them quickly through crowdfunding. Thus, an alternative approach is to crowdfund a share of the costs and cover the remaining part through additional funding from other sources. This can include the farmers' own savings, a combination with a bank loan or with existing support schemes such as those offered by governmental agencies (e.g., Innovation Norway and Enova).
3.) **Trusted platform**: Trust in a platform that administers the crowdfunding campaigns is a crucial factor for the adoption of a local crowdfunding program. Thus, we need to investigate which institutions farmers perceive as trusted entities that could host the crowdfunding campaign online, ensure a secure money transfer and assist with the carbon credit calculations. Here we divided the institutions into farmers' organizations (e.g. Norges Bondelag), agricultural advisory organizations (Norsk Landbruksrådgiving (NLR)), crowdfunding platforms (e.g. Bidra), banks and research institutes.
4.) **Degree of collaboration**: Some mitigation measures are very suitable for collaboration where farmers could share equipment or assist each other in the delivery of resources. Furthermore, a shared crowdfunding campaign can also reduce risks and responsibilities, which can enhance the uptake of mitigation measures and a local crowdfunding program. Hence, it is relevant to investigate whether or not farmers are interested in setting up crowdfunding campaigns jointly.

5.) **Type of backer**: Coolcrowd's original focus is on private people (travelers) as backers. However, companies that would like to improve their environmental/climate profile could also be potential backers and enable a more continuous money flow by for example introducing a company policy that requires each employee to offset their emissions from traveling.

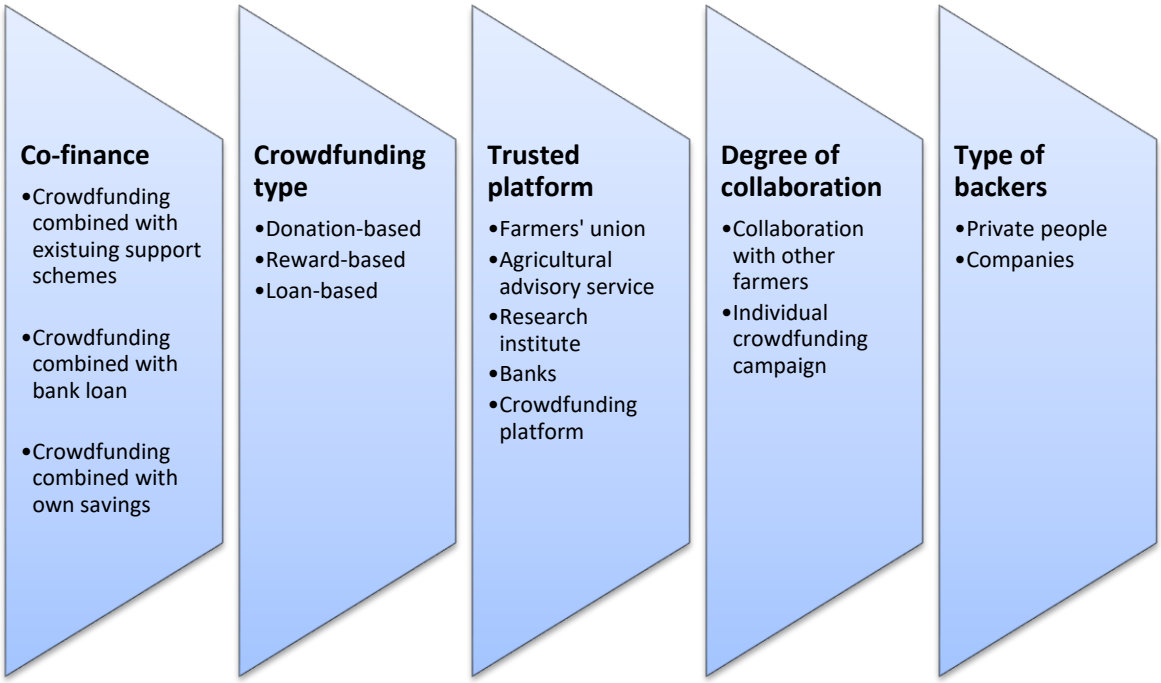

Figure 4: Business model attributes

3 Climate change and agriculture in Norway

3.1 GHG emissions from Norwegian agriculture

In 2016, 8.5% of Norway's GHG (greenhouse gas) emissions originated from agriculture, corresponding to 4.5 million tonnes of CO_2 eq (equivalents), and constituting 16.5% of emissions from sectors without emission allowances (transport, agriculture, heating of buildings, waste). Estimated emissions from agriculture have decreased by 6% since 1990 and increased by 0.6 % since 2015. The largest sources of GHGs within the agriculture sector are "enteric fermentation" (Methane = CH_4) and "agricultural soils" (Nitrous oxide = N_2O). In 2016, these sub-sectors represented 51% and 37% of the agriculture sector, respectively, while "manure management" represented 10% (Holmengen et al., 2018).

The main driver behind the emission trend in agriculture is the development in the number of animals for the significant animal groups. The main reasons for the decreasing trend in GHG emissions are the reduction of nitrogen content in the synthetic fertilizers used, use of more concentrate and more effective milk production which led to reduction of the number of dairy cows (ibid).

In addition to these emissions, emission related to agriculture are posted under other sectors. CO_2 emissions from cultivated and grazed agricultural areas are posted under LULUCF sector. In 2016 this constituted 2.2 million tonnes CO_2eq. From these 1.9 million tonnes CO_2eq were related to drainage of organic soils. In addition, GHG emissions related to the use of fossil fuel in agriculture was estimated to 346 000 tonnes CO_2eq and heating of agricultural buildings to 58 000 tonnes CO_2 eq (ibid). Also, GHG emissions from production of fertilizer, machinery and buildings and electricity use are not attributed to the agricultural sector. Norwegian farmers import feed, mainly concentrates, from many countries. GHG emissions from the feed production abroad is also not included in Norway's National inventory.

3.2 Climate policy and subsides in Norwegian agriculture

Norway has ambitious climate goals for all sectors – including agriculture. Several white papers address climate change and agriculture was for the first time stressed in the White Paper 39 to the Stortinget (2008-2009)[1] "Climate Challenges – Agriculture

[1] https://www.regjeringen.no/contentassets/1e463879f8fd48ca8acc2e6b4bceac52/no/pdfs/stm200820090039000dddpdfs.pdf

part of the Solution". Subsidies have been introduced that focus on the reduction of air related GHG emissions such as the environmentally friendly spread of manure and subsides for the supply of manure to biogas plants (Meld. St.11, 2016-2017). The Norwegian government identifies a need for environmental instruments in agriculture to be further developed to meet/address climate challenges. Furthermore, they advocate for synergy effects across climate and environmental initiatives (e.g. Climate measures can for example contribute to reduced water pollution) (ibid).

In 2015, the Ministry of Agriculture and Food appointed a working group consisting of representatives from industry, administration/management and environmental organizations to assess Norwegian climate policy in the agricultural sector. The investigation also included CO_2 storage potential in soils and CO_2 mitigation through forests.

The report argues that there is still significant potential for further emission cuts, with a possible 10-20 % emission reduction from agriculture within today's production level (Hohle et al., 2016)[2]. Furthermore, the report concluded that climate considerations should find greater importance in the development of agricultural policy, so that agriculture can to a greater extent help Norway to meet its climate targets. The working group argues for two main strategies for reducing greenhouse gas emissions from the agricultural sector: Changed composition of food consumption and reduced emissions within the production volume (optimize production). The working group concludes with 15 key climate measures, which can reduce GHG emissions and increase CO_2 absorption (ibid). However, they also point to the necessity of studying potential climate measures in order to identify the exact costs of different measures, their feasibility and potential support schemes (ibid).

Norwegian agriculture follows an agricultural policy model consisting of five pillars (Almås, 2016). These include 1) import tariffs that ensure that products that can be produced in Norway are protected through import fees; 2) the agricultural agreement (jordbruksavtale); 3) cooperative marked regulations around basic commodities such as diary production; 4) regulated market for farm properties; 5) geographically distributed production structure (Vik et al., forthcoming).

Issues related to climate adaptation and mitigation in agriculture are to some degree addressed in the agricultural agreement, which is negotiated every year in form of the 'jordbruksoppgjøret'. The 'jordbruksoppgjøret' consists of negotiations between the state and the two farmer unions representing all farmers in Norway (Norges Bondelag

[2] This includes emissions accounted in transport, construction and land planning.

and Norsk Bonde- og småbrukarlag). The negotiations are conducted on the basis of the Main Agreement for Agriculture ('hovedavtalen for jordbruket' from 1950). Negotiations between the state and the agricultural sector concern agricultural commodity prices, subsidies, and other industry regulations (Regjeringen, 2018).

In addition, climate negotiations for a voluntary climate agreement were initiated in autumn 2018. The government had previously proposed a target for climate cuts for agriculture corresponding to 5 million tonnes of CO_2 equivalents from 2021 to 2030 (Regjeringen, 2019).

In the government's offer to the farmers' unions for the agricultural agreement in 2019, the government states their willingness to negotiate a voluntary and binding climate agreement for agriculture (Statens tilbud, 2019). Furthermore, they suggest a reduction of emissions per unit produced, as well as to increase CO_2 uptake of soils (ibid:13). They offer an increased support to several climate initiatives with a strong focus on bioenergy (e.g., biogas, biochar) (ibid:89). The agreement is negotiated at the time of writing this report.

Innovation Norway and Enova are the two main governmental agencies that offer funding schemes that are among other sectors also relevant for agriculture. Farmers can apply for financial support that will cover part of the investment costs. However, none of the existing schemes covers the total costs. Innovation Norway supports profitable business development in Norway, which also concerns business development in agriculture (Innovation Norway, 2019). For farmers we can identify three relevant schemes offered by Innovation Norway that address climate measures. These include the bioenergy/renewable energy program (bionergiprogram[3]), the bioeconomy scheme (bioøkonomi-ordning) and the environmental technology scheme (miljøteknologi-ordning). For more details on the type of technologies supported and the share of financial support offered see

Table 1.

Enova's mission is to facilitate Norway's transition to a low-emission society. Enova provides financial support to companies and private people who want to invest in new climate friendly technologies (Enova, 2019). It includes financing from the early stage of pilot projects to commercialization. Many of their support schemes are related to private households but can be applied to agriculture (farm houses) as well.

[3] Recently changed to the name value creation program (Verdiskapingsprogrammet).

Table 1: Available funding program for climate measures in Norwegian agriculture

Program	**Technologies/type of project**	**Share of financial support (% of total investment) [(c)]**
Bioenergy program, (Innovation Norway) [(1)]	Reactor construction, pyrolysis systems, power/heating system, storage for fuel and substrates, equipment for the production of heat, electricity and biofuels	45% (max. 8 Mill)
Bioenergy program, (Innovation Norway) [(1)]	Pilot evaluation study	50% (50.000 NOK for pilot study, 150.000 NOK for pilot projects)
Renewable energy in agriculture, (Innovation Norway) [(1)]	Farm heating facilities (including heat recovery and solar energy) Greenhouses (including heat recovery and solar energy) Biogas, bio and power / heating systems, Tiled storage and drying facilities for fuel production for sale	35% to cover costs related to planning, building permits Support for pre-study that can result in a plant for heat sale 50 % maximum 50.000 NOK Pre-project if pre-study shows potential 50% maximum 150.000 NOK
Environmental technology scheme (Miljøteknologi-ordning) (focus on climate), (Innovation Norway) [(2), (a)]	Pilot and demonstration projects for new environmental-friendly solutions	25% of eligible additional costs for large companies, 35% for medium-sized businesses and 45% for small businesses
Environmental technology scheme (Miljøteknologi-ordning) (focus on climate), (Innovation Norway) [(2), (b)]	Demonstration units (focusing on technologies that are better for the environment than what the EU dictates	40% of eligible additional costs for large companies, 50% for medium-sized businesses and 60% for small businesses
Environmental technology scheme (Miljøteknologi-ordning) (focus on climate), (Innovation Norway) [(2), (b)]	Demonstration units (focusing on technologies that recycle or reuse of waste, or solutions that utilize waste streams in a new way)	35% of eligible additional costs for large companies, 45% for medium-sized businesses and 55% for small businesses
Bioeconomy scheme [(3)]	development projects in and across bio-resource value chains	25% of eligible additional costs for large companies, 35% for medium-sized businesses and 45% for small businesses

Biogas and bio fuel (Enova)[4]	Biogas and biofuel production based on domestic resources	45% for big companies, up to 50% for small companies
Electricity production from renewable energy (Enova)[5]	Renewable energy (solar and wind)	10.000 NOK for installation, 1250 NOK per kW installed effect up to 15kW. Up = 28.750 NOK
Upgrade of the building structure (Enova)[6]	Including energy measures in renovation (e.g., thermal insulation in exterior walls, ceilings, windows, exterior doors and foundation)	150.000 NOK
Removal of oil stove and tank (ENOVA)[7]	Replacement of oil stove/tank with heat pump, wood oven, pellet chimney	3000 NOK
Heating plants based on renewable energy (Enova)[8]	Heat plants based on e.g., wood chips, briquettes, pellets, solar thermal energy	45% maximum 1 Million NOK
Several small scale heat related technologies (Enova)	Air-to-water heat pump [9] Ventilation heat pump[10] Wood stove with back boiler[11] Pellet Burner with underfloor heating[12] Heat exchanger for waste water[13] Balanced ventilation[14]	10.000-20.000 NOK

*(1)https://www.innovasjonnorge.no/Bioenergi/, (2) https://www.innovasjonnorge.no/no/tjenester/innovasjon-og-utvikling/finansiering-for-innovasjon-og-utvikling/tilskudd-til-miljoteknologiprosjekter/; (3) https://www.innovasjonnorge.no/no/tjenester/innovasjon-og-utvikling/finansiering-for-innovasjon-og-utvikling/tilskudd-til-biookonomiprosjekter/ ; (4) https://www.enova.no/bedrift/biogass/ , (5) https://www.enova.no/privat/alle-energitiltak/solenergi/el-produksjon-/ , (6) https://www.enova.no/privat/alle-energitiltak/oppgradere-huset/oppgradering-av-bygningskroppen-/ (7) https://www.enova.no/privat/alle-energitiltak/fjerne-fossil-oppvarming/fjerning-av-oljekamin-og-tank/ , (8) https://www.enova.no/bedrift/bygg-og-eiendom/varmesentraler/ , (9) https://www.enova.no/privat/alle-energitiltak/varmepumper/luft-til-vann-varmepumpe/, (10) https://www.enova.no/privat/alle-energitiltak/varmepumper/avtrekksvarmepumpe-/ , (11) https://www.enova.no/privat/alle-energitiltak/biovarme/bio-ovn-med-vannkappe/ , (12) https://www.enova.no/privat/alle-energitiltak/biovarme/biokjel/, (13) https://www.enova.no/privat/alle-energitiltak/varmegjenvinning/varmegjenvinning-av-gravann-/, (14) https://www.enova.no/privat/alle-energitiltak/oppgradere-huset/balansert-ventilasjon/

(a) These address R&D projects. Applicants are normally the ones who develop new solutions. (b) These are investment support schemes where the applicant is normally the one who uses the new solution. (c) The maximum support possible. The exact support share/amount is assessed for each individual project. In case of the environmental technology scheme only a share of the additional extra costs is financed.

Besides these schemes, a subsidy for livestock manure has been established for biogas plants in the agricultural agreement. The subsidy rate has been increased from 60 to 70 NOK per tonne of delivered manure in the 2018-2019 agreement (Jordbruksavtale, 2018-2019).

3.3 Relevant climate measures for crowdfunding in Norwegian agriculture

We can identify a wide range of mitigation measures in agriculture. GHG emissions are released from different on farm practices/sources. We can divide between GHG emissions related to soils, building structure, transport and livestock (Figure 5). For each category we can identify different options of mitigation measures. A non-exhaustive list of these measures can be found in Hohle et al., (2016) and many suggestions for GHG mitigation relevant for Norwegian agriculture are presented (in Norwegian) on https://klimasmartlandbruk.no/100-losninger/.

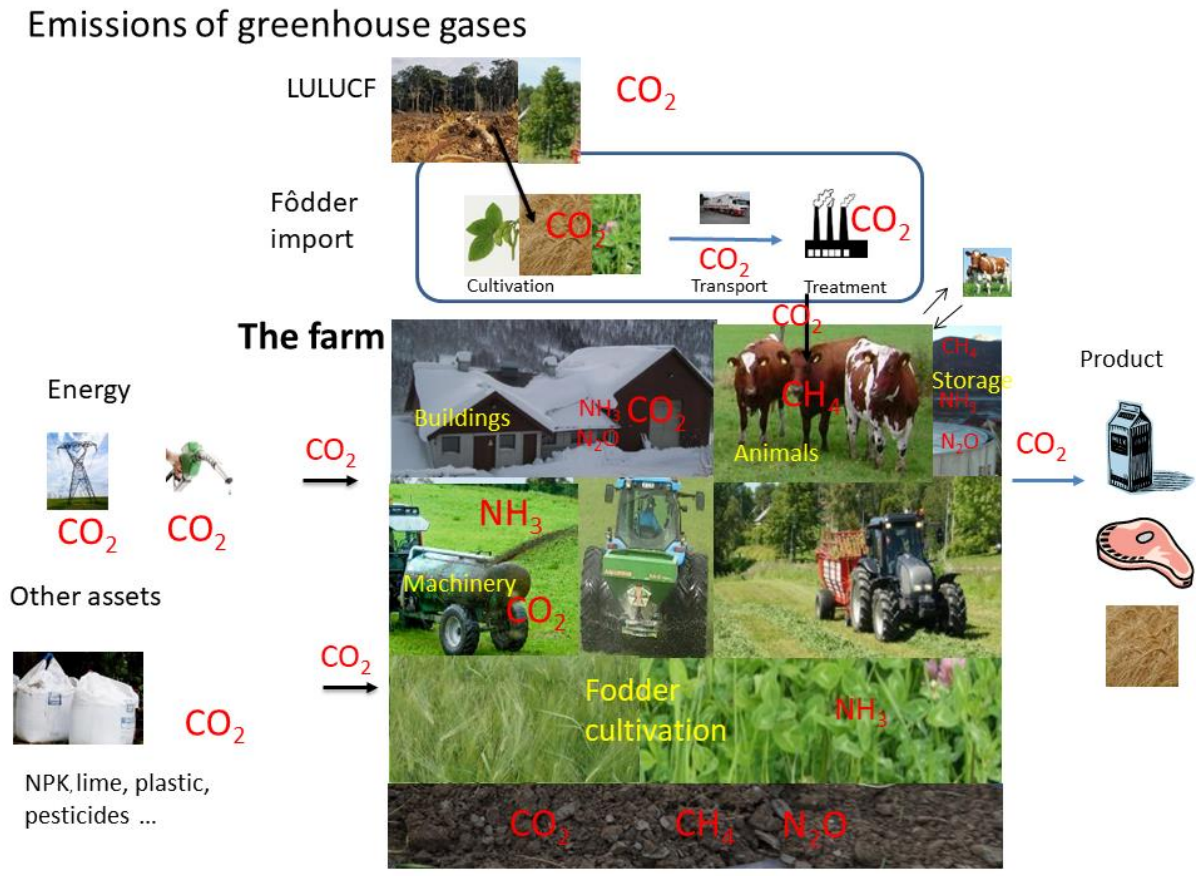

Figure 5: Main sources of greenhouse gas emissions from agricultural production.

Photo: Sissel Hansen

It is very difficult to state the exact emission reduction potential of each practice since there have been few measurements of GHG emissions from Norwegian agriculture

and potential sources are plentiful. It is the overall sum of these practices that enables us to make potentially significant reductions (Bonesmo et al., 2013). Good animal welfare, good agronomy combined with good utilization of the farm's own feed and livestock manure will ultimately lead to lower on-farm emissions (Hansen et al., 2018)[4].

However, a set of different farm practices is difficult to operationalize in a crowdfunding campaign and thus we need to choose measures that are relevant or easy to crowdfund. As a part of the survey design, we asked farmers about their interest in certain mitigation measures. This will help us in the development of possible business model scenarios, a major outcome of the project. To not overwhelm the respondents and risk a high rate of non-responses, we had to choose a limited number of measures from the original list for the survey. We chose mitigation practices based on the following selection criteria.

- **Concrete and tangible measures:** Crowdfunding campaigns are more successful if the offered product/campaign/service the entrepreneur aims to develop is very concrete and thus easy to grasp. Thus, we decided that climate measures in the form of technologies will be more relevant to crowdfund than a mix of changed agricultural practices, especially since many of these technologies require high initial start-up costs, which makes them very suitable for crowdfunding.
- **Practically feasible to implement:** It is important to choose mitigation options that are highly relevant for the Norwegian context since these can vary depending on factors such as climate, geography and farm size. This includes also the availability of this technology in Norway.
- **Need to show a clear mitigation benefit:** Some mitigation practices have a more uncertain GHG emission reduction potential than others and still require more documentation (Bardalen et al. 2018). Since we assume that numbers related to the amount of emission reduction can be important for the public, we preferably chose those technologies that show certain numbers and are officially approved. These practices can either aim towards reducing emissions or increasing carbon in soils.

[4] In 2017, the climate smart agriculture project (Klimasmart Landbruk) was initiated, which aims to develop a climate calculator for agriculture, a decision-support tool that can assist agricultural advisors and farmers to make good climate choices adapted to their farms and facilitate knowledge sharing in the sector. For more information see https://klimasmartlandbruk.no/

- **No legal-institutional impediments:** This is related to the practical feasibility of climate mitigation practices and requires the legal framework in place for implementing this technology/practice in the Norwegian context
- **No full subsidy:** There is no existing subsidy that could fully cover the practice change. This would certainly reduce the relevance for crowdfunding. However, partly financed mitigation measures can be included since these can provide higher credibility among farmers and investors as well.

Based on these considerations we chose the following 7 climate measures that were included in the survey:

1.) Use of wood for the barn's building structure instead of steel and concrete

The use of wood instead of steel and concrete for the barn's building structures reduces energy consumption levels and thus emissions (Hansen et al. 2018). Furthermore, timber locks up CO_2 (Brentnall, 2008) while concrete is a major GHG emitter. In addition, wood is a farmer's resource and can contribute to local value creation. The indoor environment is better. Noise and dust are to a large extent reduced. Another benefit of wood is that it regulates/stores heat and thus contributes to stable temperatures all around the year and good animal welfare (Bondevennen, 2017). Figure 6 shows a typical example for a Norwegian wood barn.

Figure 6: Wood barn.

Photo: Innovasjonnorge.no

For a larger Norwegian farm with 70 stalls (280 tonnes milk quota) the costs are very high with approximately 8-8.5 Million NOK (Bondevennen, 2017). We can roughly estimate 100 000 NOK per dairy cow. However, it is possible to build a wood barn for 65 dairy cows for 70.000 NOK per dairy cow (economies of scale) (Øyen, n.d.).

2.) Ceiling panels on the barn

Ceiling panels on the barn enable more sunshine coming through, which warms up the barn and thus reduces energy consumption levels. It also lightens up the stable, and thus improves animal welfare. This becomes particularly relevant for the short daylight time during winter when the cows are inside all day. We could not identify any fixed costs for ceiling panels due to many different available choices.

Figure 7: Ceiling panels on barn roof.

Photo: Sissel Hansen

3.) Solar panels on the barn or/and farmhouse

Solar panels on the barn's roof have a high efficiency potential and could be for many farmers a profitable investment. One of the reasons is that the roof surfaces are large and shade free (Solenergiforening, 2016). Solar panels can increase the share of

renewable energy consumption[5]. They can also increase grid independency. However, because the solar energy is not stored, the energy received by the solar panels must be used immediately or coupled to a battery. Batteries are expensive and have environmental challenges, thus development of solar panels must be coupled to the farms demand for electricity or a possibility to share surplus energy with the local electricity company. The latter is often not possible. An example of solar panels on a barn roof is presented in Figure 8.

The costs for a solar energy system depend on the size of the roof. It is estimated that solar panels for a barn roof start from 150 000 NOK upwards[6].

Figure 8: Solar panels on barn roof.

Photo: bondevennen.no

[5] Depending on the electricity market for calculating emissions. Considering the EU electricity market there is a high climate potential since solar energy can replace fossil fuel related energy production. In the Norwegian energy market the GHG emission reduction potential is lower due to the high share of hydropower.

[6] See for an example Eidsiva Energi https://www.eidsivaenergi.no/lev-energismart/solenergi/solcellepanel/ (Retrieved 19.04.2019).

4.) Biogas production from livestock manure

The production of biogas from animal manure leads to reduced emissions of methane and nitrous oxide from fertilizer storage, and reduced emissions of CO_2 if the biogas replaces fossil diesel or heating oil (Bardalen et al., 2018), but the costs are high for small farms (Lyng et al., 2019).

There has been a focus on biogas production since the White Paper Meld 21. (2011-2012). The government aims to contribute to the development of farm based biogas plants and larger co-treatment plants for livestock manure and waste. Biogas production has a high climate potential but is still infancy in Norway. Costs and benefits depend on several factors such as reduced storage time of livestock manure, degree of utilization, transport distance and the use of biogas and the bio residues. The distance between different farms and the biogas plant is found to be the most important cost factor for realizing large plants (Bardalen et al., 2018). For small farms, especially dairy cow manure farms the investment cost of a biogas plant is high (> 4 Million NOK). Coupled with a small energy demand relative to the energy production it is not straightforward to realize economically sound plants. Farm plants with a good match between energy demand and production and “mid-scale” biogas production with collaboration between farmers and an identified energy need in public buildings or industry in a regional setting would be highly relevant for a collaborative crowdfunding campaign. Figure 9 shows a biogas unit in agriculture.

Figure 9: Biogas production in agriculture.

Photo: Ruralis and norsklandbruk.no

5.) Precision GPS guidance system for tractors

Precision agriculture based on digital technologies such as GPS controlled fertilization and spraying have a high potential to reduce GHG emissions. Precision running equipment allows to program the tractor with GPS coordinates that guide the farmer to only spray/fertilize relevant areas/field patches instead of spraying the entire plot. This process can lead to increased efficiency, better utilization of input factors, reduced losses and can thus reduce GHG emissions in form of reduced nitrous oxides emissions (Bardalen et al., 2018). Prices vary from 10 000 – 30 000 NOK[7].

Figure 10: Precision running equipment.

Photo: www.deere.co.uk

6.) Drag hose with dribble bars for manure spraying

With a drag hose drag hose with dribble bars, the manure is transported through a hose connected with a tractor instead of being transported with a manure tanker (

Figure 11). This saves a lot of energy for transport of heavy manure. In addition, the energy used can be electrical energy and come from renewable sources. Most manure tankers are heavy and destroy soil structure. This leads to less utilization of applied manure, and increased emissions of the GHGs nitrous oxide and methane from soil.

[7] One example for a company selling precision GPS guidance systems in Norway. http://www.ivarsylte.no/gps/ (Retrieved 19.04.2019).

The Trailing Hose system is one of two banding techniques available. In a trailing hose system, manure is pumped from drag hose to a series of separate hanging hoses. The hoses are dragged along the surface or suspended just above the surface and lay manure in bands along the soil below the crop canopy. The result is reduced odour, reduced ammonia loss, and more uniform distribution of manure. Costs vary largely starting from 100 000 NOK but can be much higher with a larger farm size[8].

Figure 11: Drag hose with dribble bars for manure spraying.

Photo: nordnorge.nlr.no/fagartikler/14791/

7.) Supplying soils with biochar

Biochar is a type of char that can be produced from agricultural residues. It is produced under pyrolysis, a thermochemical process taking place without oxygen at temperatures above 300°C. In addition to biochar the process produced also syngas and heat, which can be utilized for energy consumption. We can identify different

[8] Here an overview of different equipment and prices http://www.agromiljo.no/finn.shtml (Retrieved 19.04.2019).

scales of biochar production from decentralized to centralized with different degrees of farmer involvement (Otte and Vik, 2017).

The climate potential is high but so far there have been only some pilot units in Norway (e.g., Sandnes kommune, Skjærgaarden gartneri). The Skjærgaarden pilot is presented in Figure 12. A recent report by NIBIO estimates that in order to reduce emissions from agriculture by 10% by 2030 we need 500-9000[9] extra pyrolysis units (Bardalen et al. 2018). This means that there is a huge potential for crowdfunding. A pyrolysis unit that produces 60 kilo of biochar per hour costs approximately 500.000 NOK[10].

Figure 12: Biochar unit Skjærgaarden Gartneri Norway.

Photo: Pia Otte

[9] Depending on the size of the system

[10] Information retrieved from Klimasmart landbruk: https://klimasmartlandbruk.no/100-losninger/biokull-binder-co2-og-forbedrer-jorda-article256-7.html (Retrieved 08.03.2019).

4 Methods

In this section, we will outline the methodological aspects of the survey, including sample selection, attrition and response rate.

4.1 Sample selection and survey design

The population of interest in this report is Norwegian farmers. A random sample of farmers was drawn from the population using the Register of Producers at the Norwegian Agricultural Authority, which is a register containing information about all farmers' applying for production subsidies in Norway. In the survey, farmers are defined as persons managing a farm with at least 0.5 ha of farmland, which excludes around 5 percent of the approximately 40 000 farms in Norway[11].

The survey was designed as a postal survey including nine pages on paper. The questionnaire was designed by researchers at Ruralis, in collaboration with external researchers involved in the Coolcrowd project. Sentio Research was responsible for the practical implementation of the data collection. The survey was sent out in mid-November 2018, with a reminder three weeks later. Respondents received an invitation letter in their mail, along with the questionnaire. In addition to the possibility of answering the questionnaire on paper, respondents also had the opportunity to answer online using a link to a webpage with a uniqe ID. Completed and returned questionnaires were automatically scanned and processed by Sentio Research.

4.2 Attrition and response rate

From the 2000 questionnaires that were sent out to a representative sample of farmers by mail, a total of 465 respondents completed the questionnaire (Table 2). Thus, the overall response rate of the survey is 23.3 percent. Out of the 465 respondents replaying, 70 responded used the web link in the invitation letter.

Table 2: Gross sample, net sample and response rate

Gross sample (n)	*Net sample (n)*	*Response rate (%)*
2000	465	23.3

As crowdfunding is a quite unfamiliar funding source for many farmers in Norway, a relatively low response rate was expected. However, as a low response rate increases

[11] This also excludes farms which is not sole proprietorship.

the risk of nonresponse bias, we have carried out an analysis to detect potential bias in the sample by comparing characteristics of the farmers, and their farms, with statistics from the population.

Table 3 shows the distribution of gender, age, production type, farm size and residency of farmers in the population and in the sample[12]. The confidence interval, which is estimated based on the standard errors (calculated from the sample mean, the standard deviation in the sample, and sample size) shows that almost all of the population means fall within the estimated confidence intervals. While the proportion of farmers from Aust-Agder and Troms are underrepresented in the sample, analysis showed no systematic skewness as far as the distribution of the variables included in the table was concerned. Thus, we consider the survey representative for the population of farmers in Norway.

[12] Population data are obtained from Statistics Norway (2017).

Table 3: Comparisons of variables in the survey with statistics for the population, obtained from Statistics Norway. In percent.

Variables	*Population mean*	*Survey mean*	*Survey Std.Err.*	*95 % confidence intervall*
Proportion of female farmers	15.8	15.3	1.67	[12.0 - 18.6]
Mean age	51.3	53.9	0.56	[52.8 - 55.0]
The proportion of farmers from different counties				
Østfold	5.4	6.5	1.14	[4.2 - 8.6]
Akershus	5.1	5.2	1.03	[3.1 - 7.2]
Hedmark	7.8	8.6	1.30	[6.0 - 11.1]
Oppland	11	13.3	1.57	[10.2 - 16.4]
Buskerud	5.3	5.8	1.09	[3.6 - 7.9]
Vestfold	3.4	4.3	0.94	[2.5 - 6.2]
Telemark	3.5	3.2	0.82	[1.6 - 4.8]
Aust-Agder	1.7	0.4	0.30	[-0.2 - 1.0]
Vest-Agder	2.7	2.6	0.74	[1.1 - 4.0]
Rogaland	10.4	9.0	1.33	[6.4 - 11.6]
Hordaland	7.7	9.0	1.33	[6.4 - 11.6]
Sogn og Fjordane	7.1	6.5	1.11	[4.2 - 8.6]
More og Romsdal	6.4	5.8	1.09	[3.7 - 7.9]
Trøndelag	14.4	14.4	1.63	[11.2 - 17.6]
Nordland	5.1	4.3	0.94	[2.5 - 6.2]
Troms	2.2	0.4	0.30	[-0.2 - 1.0]
Finnmark	0.7	0.7	0.37	[-0.1 - 1.4]
The proportion of farmers within different productions				
Grain	27.1	28.8	2.10	[24.7 - 32.9]
Sheep	35.5	34.2	2.22	[30.3 - 39.0]
Dairy	19.6	21.3	1.90	[17.5 - 25.0]
Pork	5.6	6.2	1.12	[4.0 - 8.4]
The proportion of farmers within different farm sizes				
<10 ha	27.7	28.1	2.09	[24.0 - 32.3]
10-49.9	60.8	59.3	2.29	[54.8 - 63.8]
=>50 ha	11.5	12.6	1.54	[9.5 - 15.6]

Note: Population data is gatered from Statistics Norway (2017).

5 Farmers' interest in crowdfunding

This section presents the results from the survey regarding farmers' interest in crowdfunding. This includes 1) farmers' prior knowledge of crowdfunding, 2) their interest in crowdfunding and 3) their willingness to participate in different types of crowdfunding (e.g., donation, reward and loan-based). We included statements related to potential socio-cultural barriers identified in WP2.2 to find out how relevant these become for farmers considering their interest in crowdfunding (see Hårstad, 2018). These include issues related to public visibility of farms in a crowdfunding campaign and neighbor's reputation.

In addition, we present the findings for the five business model attributes that we identified as crucial for the further design in section 2.2.

5.1 Prior knowledge of crowdfunding

In the survey, we provided farmers with a definition of crowdfunding and asked very generally whether they had heard about the term crowdfunding[13] prior to the study. The question was categorized as single "yes and "no" answer. We defined crowdfunding as "the collection of money to support initiatives by individuals or organizations. Crowdfunding campaigns are often set up through so-called crowdfunding platforms on the internet. An example of such a platform in Norway is Bidra.no (www.bidra.no)[14]." Figure 13 shows the distribution of this question.

[13] In Norwegian there are two terms for crowdfunding. In addition to the English word 'crowdfunding' there is the Norwegian translation 'folkefinansiering'. In order to avoid any misunderstandings we used both terms when introducing the concept for the first time in the survey.

[14] Translated from Norwegian "Crowdfunding», eller «folkefinansiering» som det heter på norsk, vil si at man samler sammen penger for å støtte tiltak hos privatpersoner eller organisasjoner. Crowdfunding-kampanjer settes ofte opp gjennom såkalte crowdfunding-plattformer på internett. Et eksempel på en slik plattform i Norge er bidra.no (www.bidra.no).»

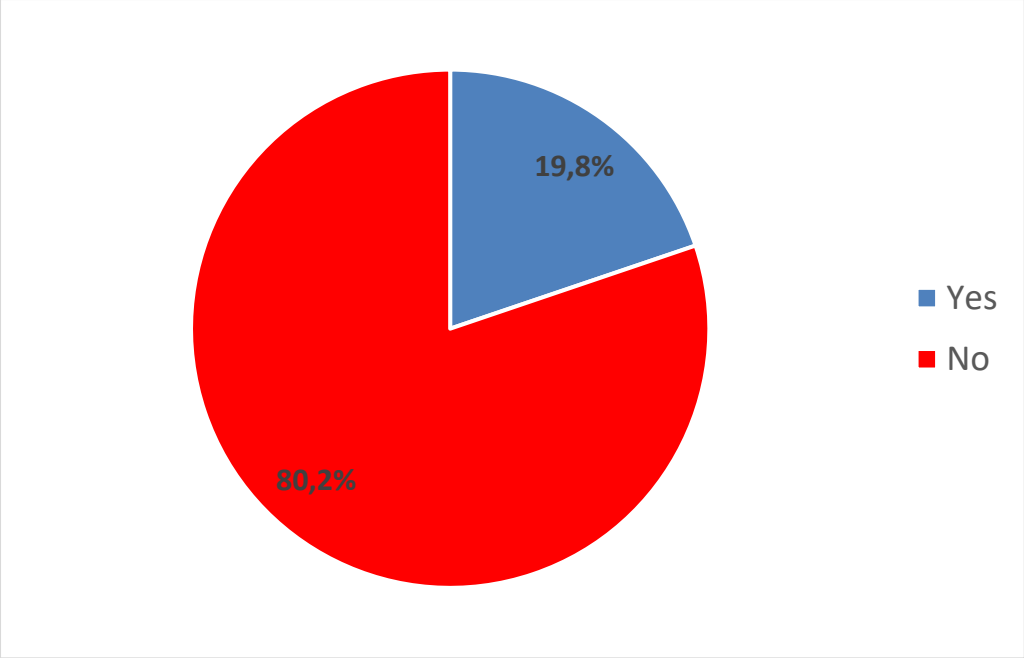

Figure 13: The proportion of farmers' stating they had prior knowledge of the term 'crowdfunding'

Only 20 percent of the farmers had prior knowledge of the term 'crowdfunding', indicating that crowdfunding for many farmers' is yet an unknown concept. This is also illustrated by the number of farmers stating that they have either conducted a crowdfunding campaign (< 1 percent) or given money to a crowdfunding campaign (5 percent) (Table 1 in the Appendix).

A logistic regression analysis (Table 2 in Appendix) show that farmers' below 40 years of age have a greater likelihood of having heard about the term 'crowdfunding', compared to farmers' who are 60 years or older. However, there is no significant difference between the age group below 40 years of age and farmers' in the age group 40-59 years of age regarding the likelihood of having heard about the term. Further, farmers with a university degree have a greater likelihood of having heard about the term compared to farmers without a university degree, and heavy users of social media (>2 hours per day) have a greater likelihood than farmers who spend no time on social media.

5.2 Farmers' attitudes and interest in crowdfunding

Several statements were included in the survey in order to measure the farmers' interest and attitudes toward crowdfunding. Figure 14 shows the distribution on the statement that crowdfunding sounds like an attractive solution for financing climate measures on individual farms.

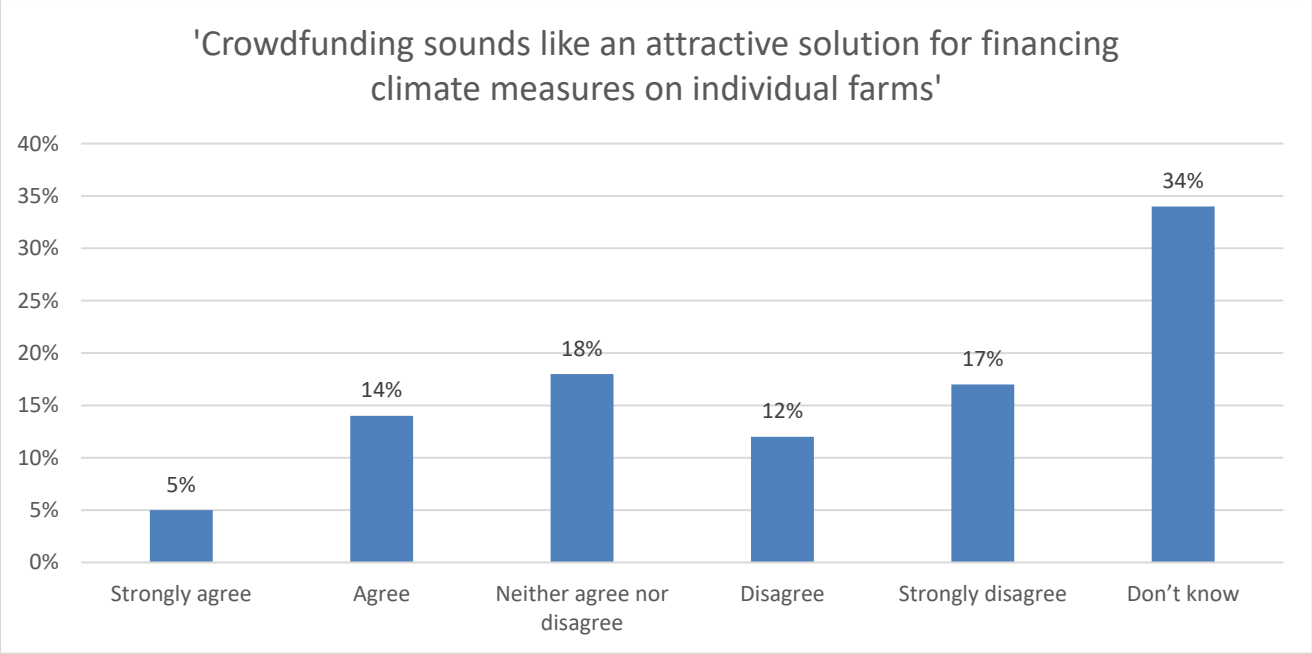

Figure 14: Farmers' response to a statement on whether they agree or disagree about crowdfunding sounding like an attractive solution for financing climate measures on individual farms

Around one-fifth (19 percent) agreed that crowdfunding sounds like an attractive solution for financing climate measures on the farm, while one-third (29 percent) disagreed with the statement. Further, 18 percent stated that they neither agreed nor disagreed with the statement. Although crowdfunding was presented in the invitation letter and in a text in the questionnaire, 34 percent of the farmers state that they 'don't know' whether crowdfunding sounds like an attractive solution. The figure and distribution of the question response raises two interesting questions: a) do the farmers answering 'don't know' differ from the farmers expressing an opinion, and b) what types of farmers agree that crowdfunding sounds like an attractive solution and who disagree with the statement?

Regarding the first question, although there can be a number of reasons for farmers giving a 'don't know' response, systematic differences between the farmers answering 'don't know' and farmers expressing an opinion can illustrate what factors determine the understanding of crowdfunding (or not). A logistic regression analysis (Table 3 in the Appendix) shows that the probability of answering 'don't know' is greater among farmers without a university level education compared to farmers with a higher edcuational level. Further, farmers who are 60 years or older have a greater likelihood of answering 'don't know' than farmers under 40 years of age. Thus, age and education represent two relevant aspects for identifying our target group that would be interested in a local crowdfunding scheme.

As for what type of farmers agree that crowdfunding sounds like an attractive solution, organic farmers (including farmers who are under a conversion-program to become organic farmers) tend to agree more with the statement than conventional farmers (Table 4 in the Appendix). However, there were no significant correlations between whether crowdfunding sounds like an attractive solution and the farmers' age, gender, educational level or production type. Nevertheless, farmers who believe that it is primarily their own responsibility as a farmer to reduce GHGs in agriculture express more positive attitudes toward crowdfunding compared to farmers who disagree that it is primarily their own responsibility to reduce GHGs in agriculture.

Figure 15 shows the farmers' answers on different statements about crowdfunding. For all statements, the relatively high proportion of farmers answering don't know' illustrates the uncertainty of crowdfunding among farmers.

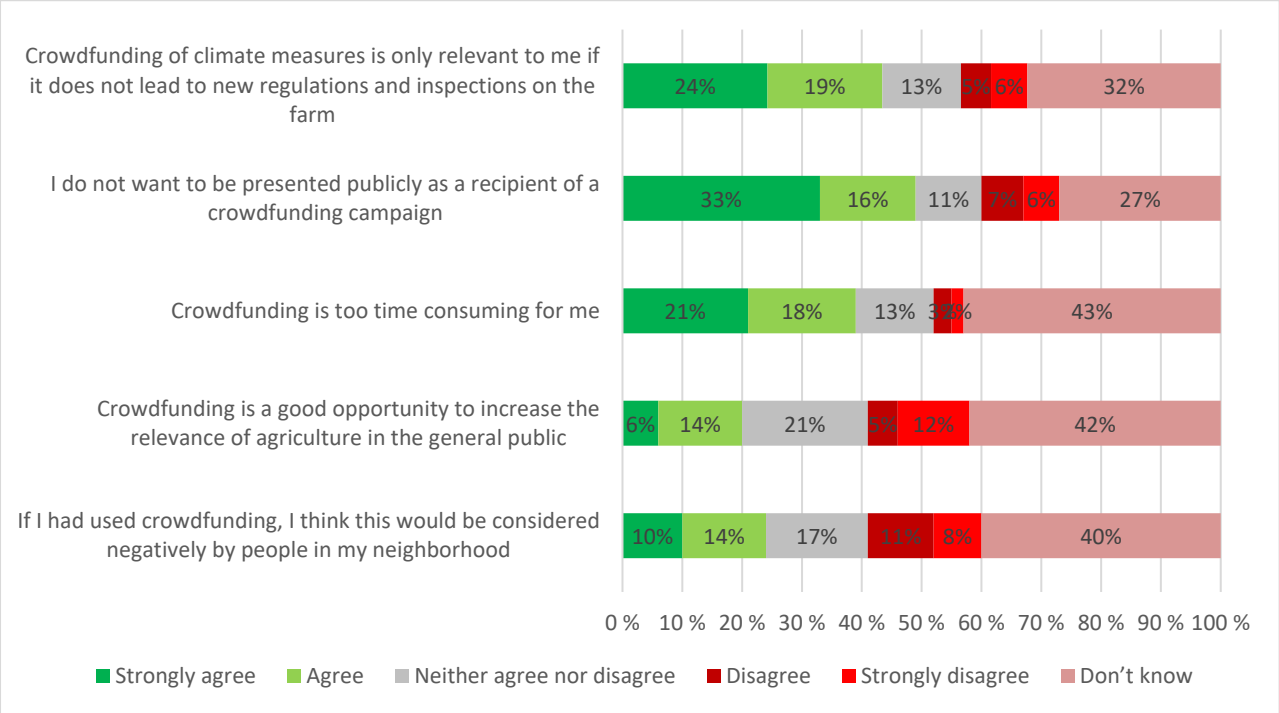

Figure 15: Statements about crowdfunding.

A high proportion of farmers (43 percent) agree with the statement that crowdfunding of climate measures is only relevant if it does not lead to new regulations and inspections on the farm. This illustrates a general skepticism against new regulations and inspections among many farmers, although one can argue that a certain level of regulations and inspections will be necessary in order to keep track of the emission reduction accounting. Further, the figure shows that about half of the farmers (49 percent) agree with the statement that they do not want to be presented publicly as

a recipient of a crowdfunding campaign. Notably, it is not specified what such a public presentation would look like.

Figure 15 shows that a high proportion of the farmers (39 percent) agree with the statement that crowdfunding is too time-consuming. Thus, time could be a barrier that hampers farmers' evaluation of crowdfunding as a financial model if farmers perceive crowdfunding as something they have to invest a lot of time in. A Pearson's correlation was computed to assess the relationship between the statement claiming crowdfunding is too time-consuming and the statement claiming crowdfunding sounds like an attractive solution for financing climate measures on individual farms. There was a significant correlation between the two variables ($r = -0.170$, $n=418$, $p < 0.001$), indicating that farmers' reporting that crowdfunding is too time-consuming for them, to a larger extent, disagree that crowdfunding seems like an attractive solution. This could indicate that a perception of crowdfunding as time-consuming may lead to crowdfunding being seen as a less attractive solution. However, interpretation of causality must be treated with caution.

Almost one-quarter of the farmers agree with the statement that a crowdfunding campaign would be considered negatively by people in their neighborhood, indicating that consideration of neighbors and reputation, in addition to time, may impact farmers' perception of crowdfunding. This is supported by a Pearson's correlation showing that there is a negative correlation between whether the farmers think crowdfunding would be considered negatively, and whether crowdfunding seems like an attractive solution ($r = -0.176$, $n=415$, $p < 0.001$).

5.3 Preferred model of crowdfunding

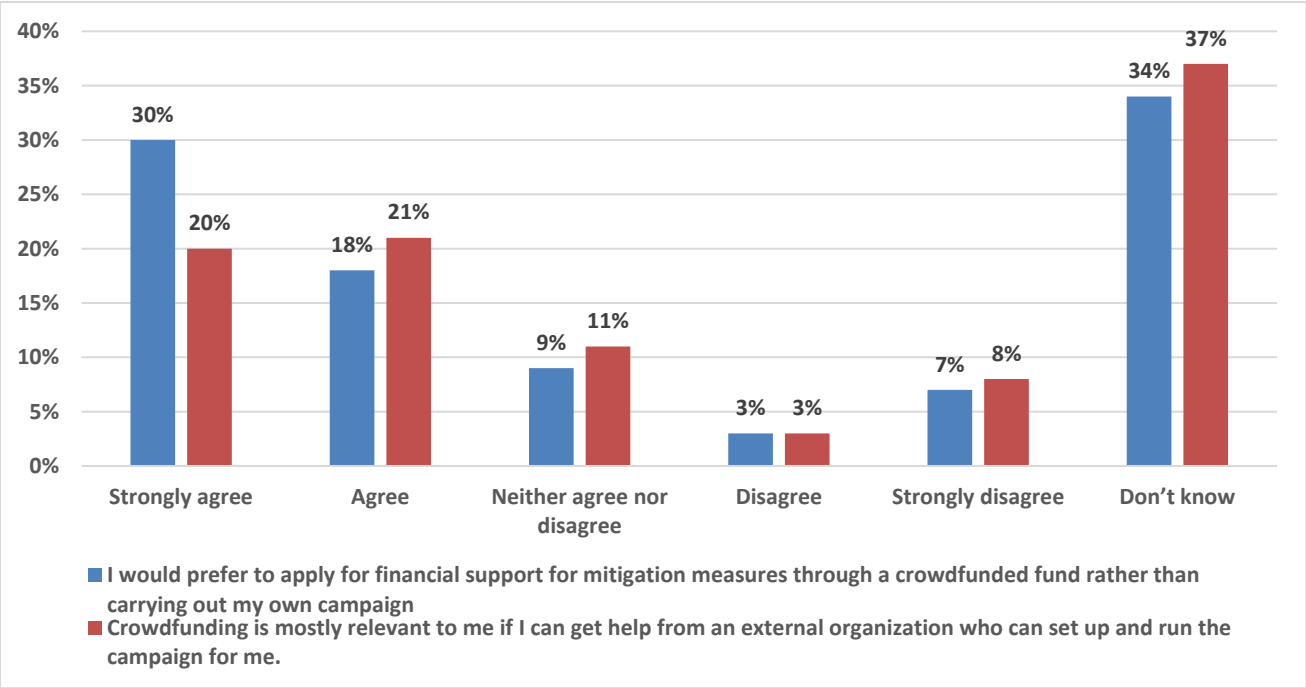

Figure 16: Statements about crowdfunding fund and external organization

Prior to the survey, we conducted a focus group with five Norwegian farmers to determine the business model attributes for the survey and to test the survey with farmers. During the discussion, the famers' group elaborated on an idea that would foresee the establishment of a general fund that could be crowdfunded by the public and where farmers could apply for funding. This would make individual farmers less publicly visible and could encourage also those farmers who do not want to be presented in a crowdfunding campaign to participate. However, at the same time it also becomes less transparent for the public to know where their funding goes to and thus might reduce interest among travelers.

Despite a relatively high proportion of farmers stating they don't know, Figure 16 shows a relatively clear tendency that many farmers would prefer to apply for financial support for mitigation measures through a crowdfunding fund rather than carrying out their own campaign. This also applies to the statement claiming that crowdfunding is mostly relevant if the farmers' get help from an external organization who can set up and run the campaign on the farmers' behalf.

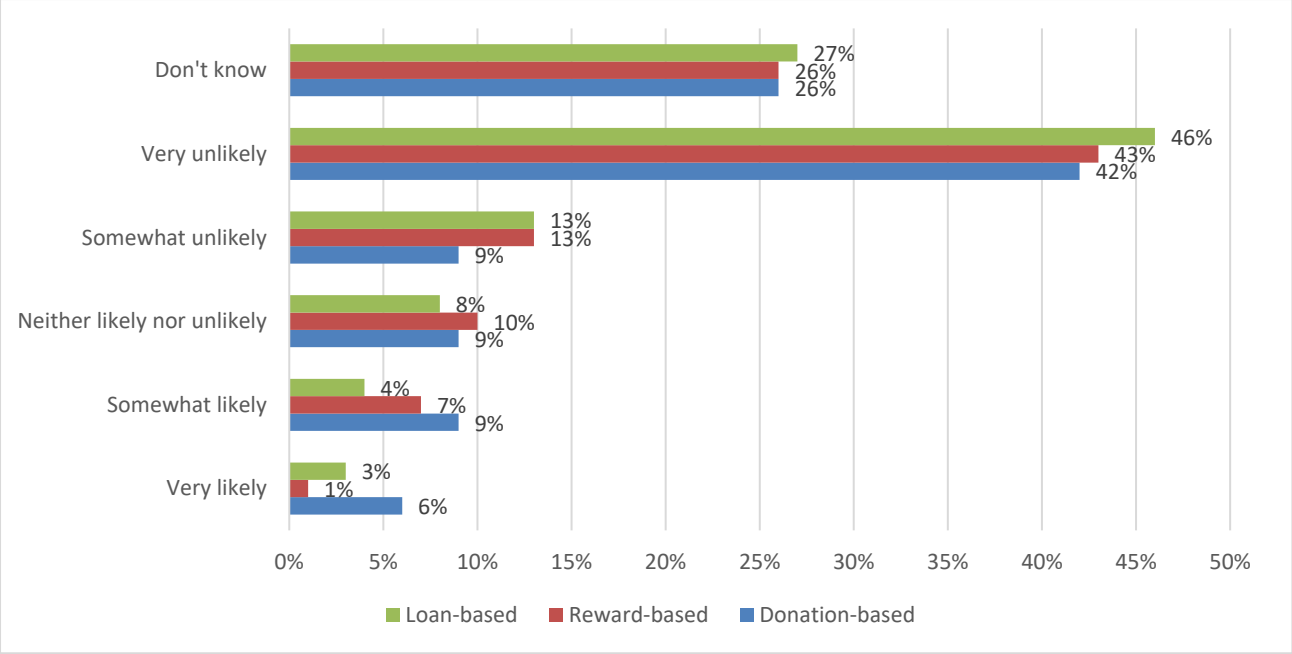

Figure 17: Likelihood of farmers using different types of crowdfunding if they were to conduct their own crowdfunding campaign. In percent

Concerning the different types of crowdfunding, despite almost one-third answering the category 'don't know', a greater proportion of farmers answer that donation-based type of crowdfunding is more likely to be used than reward- and loan-based crowdfunding. Although the interpretation of this must be done with caution, there is a suggestion that the donation-based type would be more likely to be used than reward or loan based. One explanation is that donation-based crowdfunding does not require any extra work for the farmer – in comparison to sending out rewards or applying for a loan, which requires a longer and closer contact with the backers (see Figure 17).

Further, we asked farmers about their preferences concerning potential rewards: '*Imagine that you are conducting your own reward-based crowdfunding campaign. To what extent would the following rewards be relevant to you to offer those who give money to your campaign?*' Figure 18 shows the proportion of farmers that to 'some extent' or 'to a great extent' respond that that a reward is relevant for them to offer.

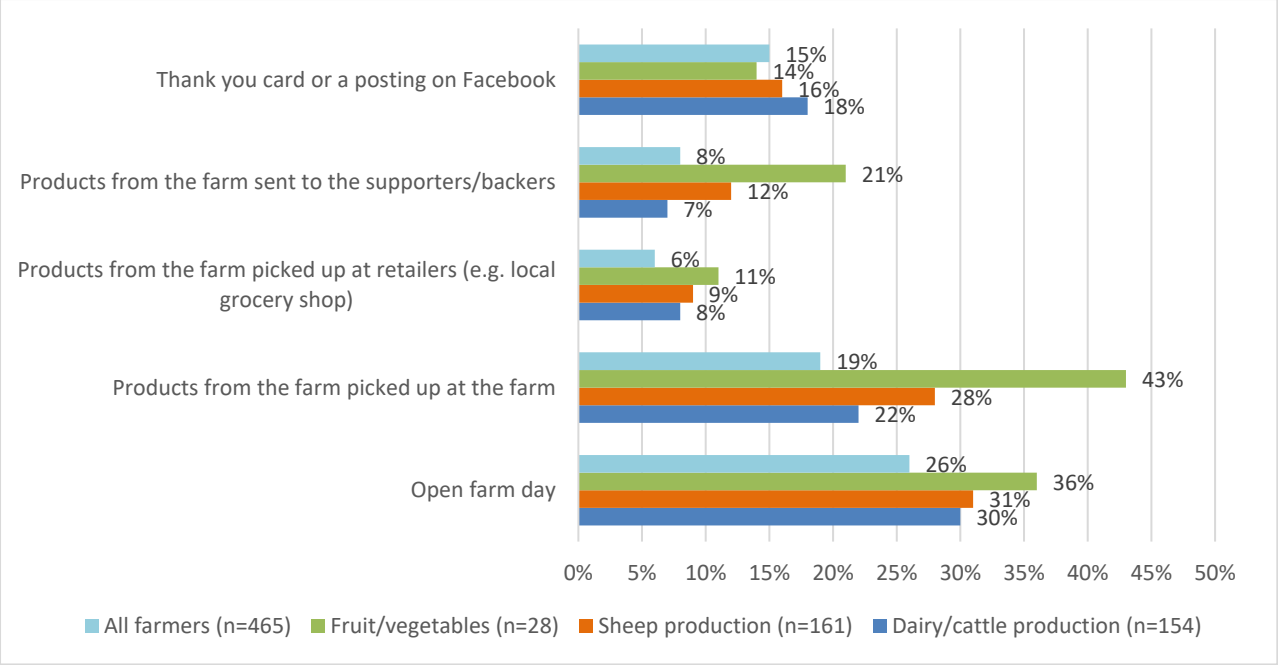

Figure 18: Farmers' potential rewards. Percent

Farmers were asked to indicate their preference for five different types of rewards that are very common in crowdfunding campaigns[15]. These include 1) a thank you card or posting on facebook, 2) products from the farm sent to supporters, 3) products from the farm picked up at retailers, 4) products from the farm picked up at the farm, and 5) an open farm day. Figure 18 shows that 'open farm day' is the most relevant reward for farmers in general to offer those who give money to the farmers' campaign. Additionally, products from the farm, which are picked up at the farm, seems to be relevant for many farmers (and to a larger extent than products from the farm picked up at retailers or sent by mail). This might be related again to the extra time, effort and workload involved in delivering local products to retailers or sending them directly to backers.

A 'thank you card' or a posting on Facebook is also relevant to almost one-third of the farmers, including farmers answering to some extent, to a great extent and to a very great extent. These are the tendencies for farmers within dairy/cattle production, sheep production, and producers of fruit/vegetables. For producers of fruit/vegetables, products picked up at the farm seem to be very relevant (note that producers of fruit/vegetables have a low 'n' in the sample, thus results in uncertainty

[15] Normally the type of reward varies according to the crowdfunded amount. The higher the amount invested the larger the reward. However, since the survey aimed to map the general interest at a more explorative stage we decided to only ask about the different types of rewards without ranking them according to the size of investment.

of the accuracy). For a full table showing all categories, see Appendix Table 5. One potential explanation is that producers of fruits and vegetables can easily offer their products at their farm without consulting the National Food Authority (Mattilsynet) for permission. Animal products, on the other hand, have strict regulations considering hygiene and food safety.

5.4 Interest in co-financing

We divided co-financing into three options 1) Co-financing from governmental authorities, 2) co-financing with own funds, and 3) co-financing with a bank loan. We asked the farmers to which degree they agree with each statement and its likelihood to increase interest in participating in a crowdfunding campaign.

Figure 19 shows that 57 percent of the farmers agree with the statement that co-financing from governmental authorities would increase the likelihood that they would participate in a crowdfunding campaign. Further, the figure shows that a relatively high proportion of the farmers (33 percent) are willing to invest their own capital in what is not covered by crowdfunding. A greater proportion of farmers disagree with the statement that they are willing to apply for a loan from a bank to cover what is not covered by crowdfunding, compared to the proportion of farmers who disagree with the statement that they are willing to use their own capital.

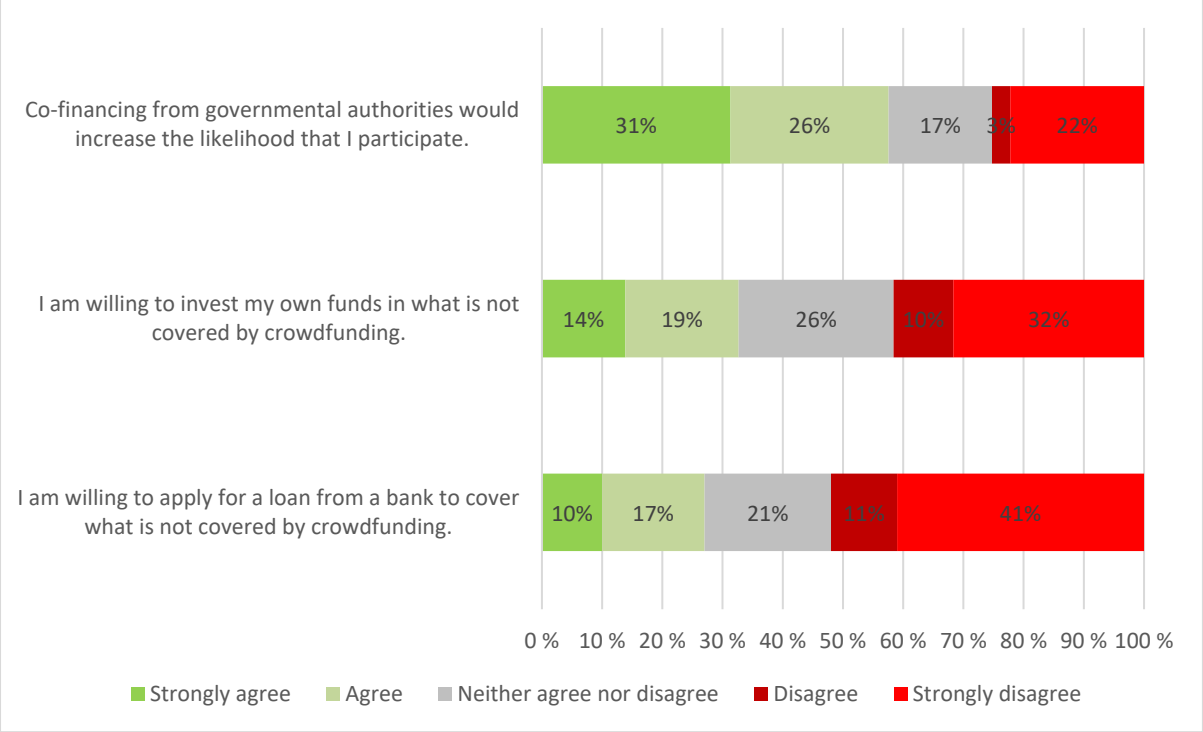

Figure 19: Statements about crowdfunding and financing of climate measures. In percent

5.5 Trusted partners to run a crowdfunding platform

Figure 20 shows farmers' trust toward different groups and organizations when it comes to setting up and running a crowdfunding platform for financing climate measures. The figure shows the farmers' mean score on the scale from 1 (no trust) to 7 (very high trust), among all farmers (blue) and among farmers' who agree that crowdfunding sounds like an attractive solution (red).

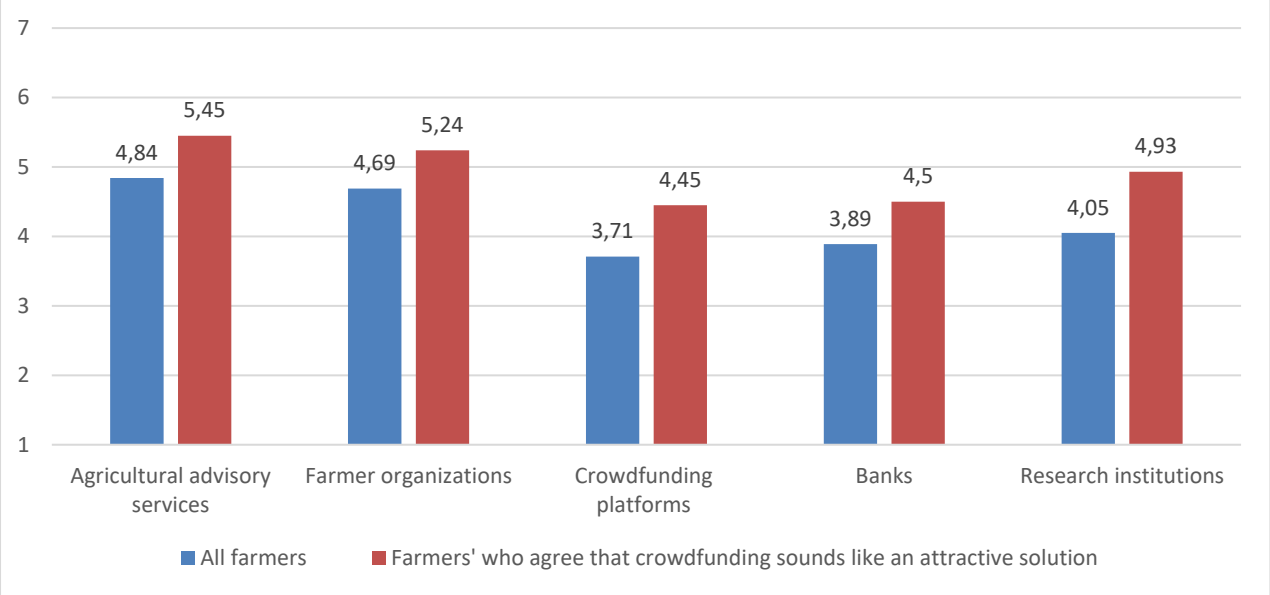

Figure 20: Farmers' trust toward different groups/organizations when it comes to setting up and running a crowdfunding platform for financing climate measures. The figure shows mean scores among all farmers (n=438), and among farmers' who agree that crowdfunding sounds like an attractive solution (n=84)[16].

In general, farmers express significantly greater trust in agricultural advisory services and farmers' organizations compared to crowdfunding platforms, banks, and research institutions. Farmers express the least trust to crowdfunding platforms. This might be due to the fact that many farmers have not heard of crowdfunding before and are not familiar with crowdfunding platforms.

Although a great number of farmers (39 percent) don't know whether they trust crowdfunding platforms, farmers place greater trust in farmers' organizations and

[16] In order to ensure statistical power, farmers' answering 'don't know' was recoded into category '4' (the mid category). Comparisons between a variable where 'don't know' category is included and a variable where the 'don't know' category is excluded, shows no statistically differences in mean comparisons test (t-test). The only exception was difference in trust toward agricultural advisory service, where excluding 'don't know' would have resulted in a significantly greater trust in agricultural advisory service. However, as the mean score difference was relatively marginal (0.24), we decided that recoding don't know into category '4' was the best option.

agricultural advisory services. Farmers who agree that crowdfunding sounds like an attractive solution follow the same pattern as the rest of the farmers, although they express more trust toward all organizations and groups overall.

5.6 Companies vs. private people as backers

Figure 21 shows the proportion of farmers stating it is accepted or not accepted to receive money from private people and Norwegian companies. As the figure shows, the number of farmers who think it is acceptable to receive money from Norwegian companies is substantially greater than those who believe it is acceptable to receive money from private citizens. One potential explanation might be that companies are more anonymous backers than private people.

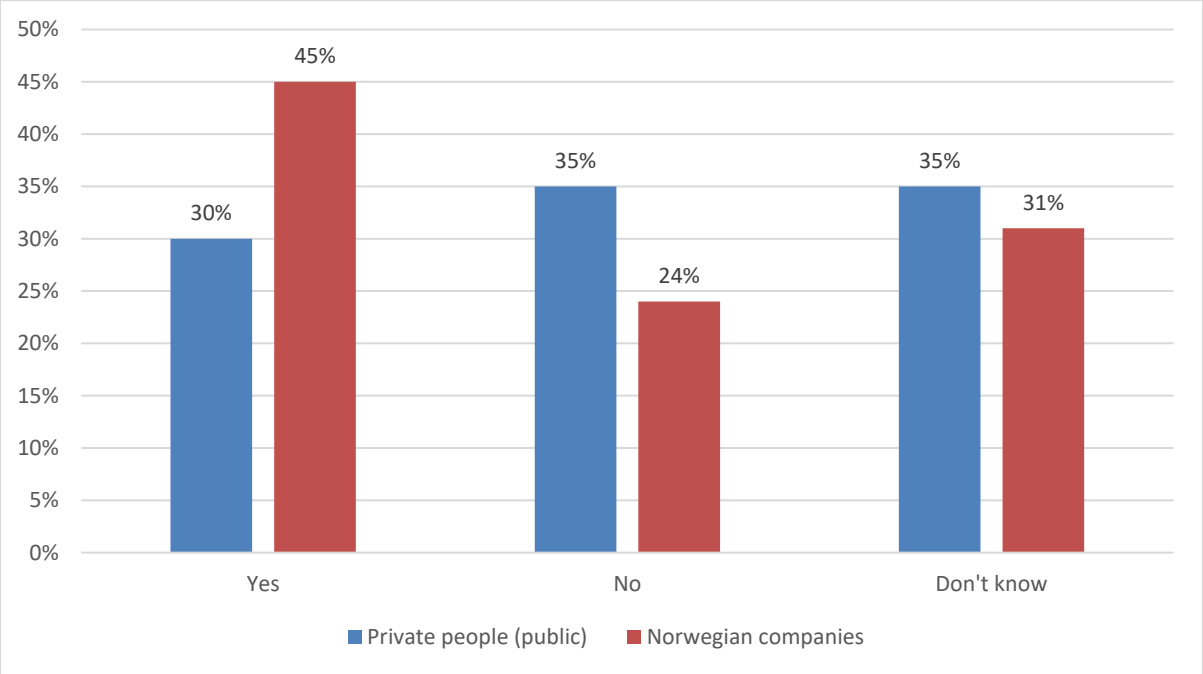

Figure 21: Proportion of farmers thinking it is accepted to receive money from private people and Norwegian companies. In percent.

5.7 Collaboration vs. Individual crowdfunding campaigns

Figure 22 shows that the farmers' willingness to collaborate with other farmers varies greatly. Around 18 percent of the farmers agree that they are willing to collaborate to start a crowdfunding campaign, while 29 percent disagree with the statement. Around one-fifth neither agree nor disagree, and 35 percent of the farmers 'don't know'.

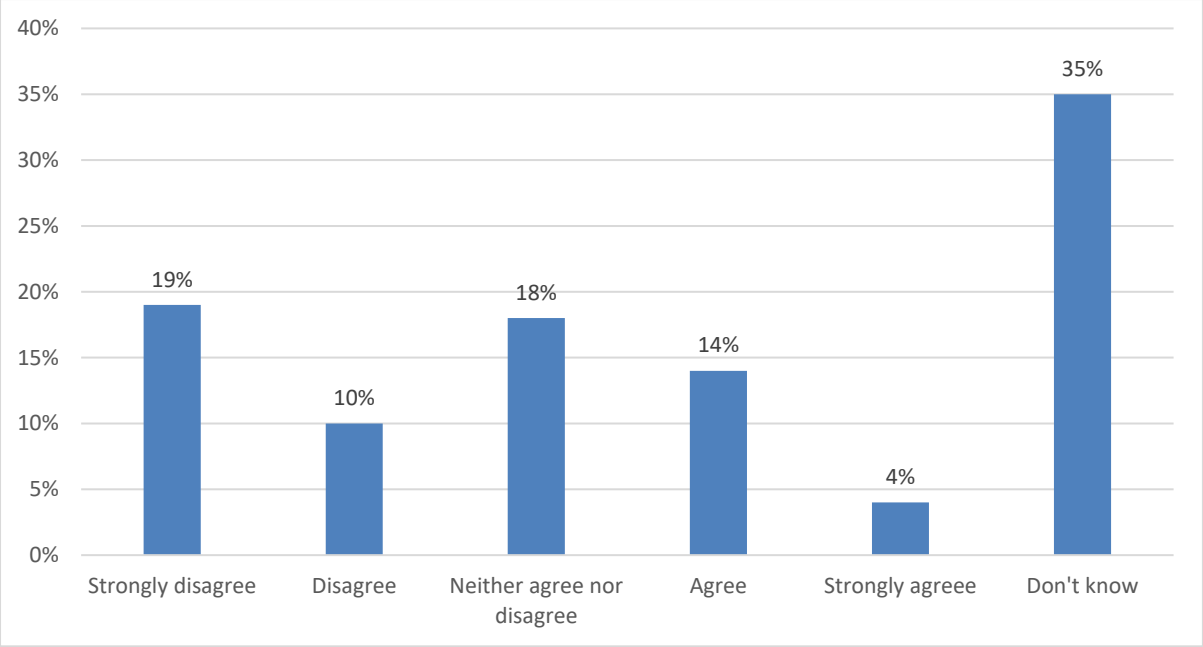

Figure 22: Willingness to collaborate with other farmers to start a crowdfunding campaign. Percent

Supplementary analysis reveals a positive correlation between willingness to collaborate with other farmers to start a crowdfunding campaign and stating that crowdfunding sounds like an attractive solution for financing climate measures on individual farms ($r = 0.307$, $n=413$, $p < 0.001$). This indicates that farmers' expressing positive attitudes toward crowdfunding are more positive toward collaboration with other farmers.

6 Farmers' knowledge and interest in climate measures

This report investigates the interest and willingness of farmers to participate in a crowdfunding campaign to finance climate measures in agriculture. However, in order to get a holistic understanding of the overall interest in crowdfunding we need to view crowdfunding in connection with farmers' climate perceptions and interest in climate measures, which will influence the overall interest in a local climate crowdfunding program.

Thus, in this section we present survey findings related to farmers' general perceptions of climate change (whether they think it is caused by natural process, human activity or both) and their interest in investing in the five earlier identified climate measures discussed in section 3.3.

6.1 Farmers' perceptions of climate change

In the survey, farmers were asked about their perception of the cause of climate change by the following question: 'Do you think climate change is caused by natural processes, human activity, or both?' Figure 23 shows the distribution on the question.

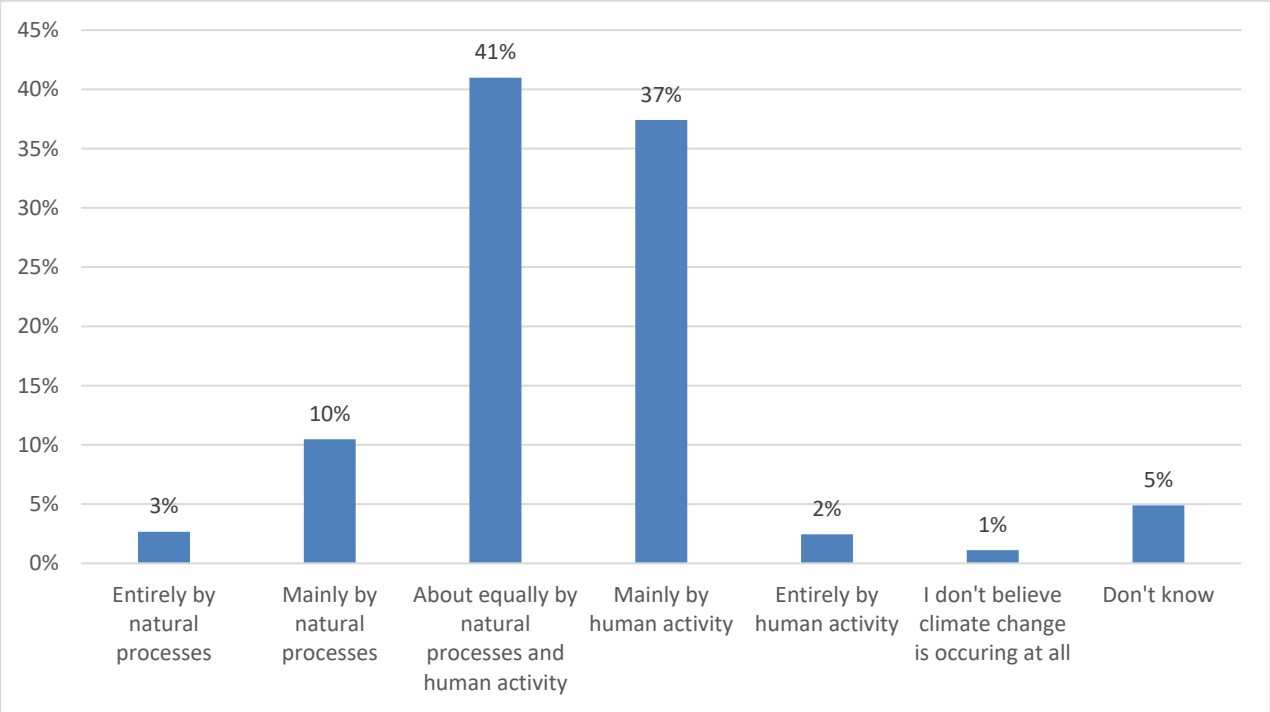

Figure 23: Beliefs about the causes of climate change. In percent

In this survey, 80.9 percent of the farmers believe climate change is at least partly caused by human activity. Compared to data from the European Social Survey, 87.8

percent of the Norwegian population think climate change is at least partly caused by human activity (European social survey, 2018). Even though the number is slightly lower than for the entire Norwegian population, a high number of farmers acknowledge (to a certain degree) people's responsibility for climate change, which is crucial for getting farmers involved in climate mitigation practices.

In order to get a better idea on which sectors farmers view as primary responsible for reducing GHG emissions we presented farmers with a number of statements that asked about ascribed levels of responsibility. We divided this into statements related to the transport, agriculture and government sectors' responsibility to reduce emissions.

Table 4 shows that six out of ten farmers agree that it is more important to reduce greenhouse gas emissions in other sectors than agriculture. In addition, over 50 percent of the farmers disagree with the statement that GHG emissions from Norwegian agriculture are far too high.

At the same time, 40 percent strongly agree and agree that it is primarily their own responsibility as a farmer to reduce GHGs in agriculture. Farmers' are more mixed regarding whether it is primarily the government's responsibility to reduce GHG in agriculture. However, 45 percent of the farmers agree that travelers are primarily responsible for reducing GHG emissions, and 32 percent agree that it is primarily the transport sector's responsibility. Further, the table shows that there is a relatively high belief that technology development will enable agriculture to handle challenges related to climate change.

Table 4: Statements about climate change and responsibility. In percent.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know	Total
It is more important to reduce greenhouse gas emissions in other sectors than agriculture.	34%	26%	24%	8%	4%	4%	100%
It is primarily the transport sector's responsibility to reduce GHG emissions.	9%	23%	36%	17%	11%	4%	100%
Technological development will enable agriculture to handle challenges related to climate change.	12%	36%	33%	7%	3%	9%	100%
There are too high emissions of GHG from Norwegian agriculture.	5%	11%	22%	33%	22%	7%	100%
Travelers are primarily responsible for reducing GHG emissions.	14%	31%	28%	14%	7%	5%	100%
It is primarily my responsibility as a farmer to reduce GHG in agriculture.	10%	30%	32%	14%	10%	4%	100%
It is primarily the government's responsibility to reduce GHG in agriculture.	7%	26%	40%	13%	9%	6%	100%

The results indicate that Norwegian farmers see a limited responsibility for reducing GHG emissions in their own sector, which could hamper the success of local crowdfunding. However, many climate measures include several co-benefits such as better animal welfare or higher soil fertility that could be of interest to farmers. Thus, the concept of local climate crowdfunding is not necessarily limited to the lower percentage of climate-concerned farmers, even if it is implemented under a climate frame. The results align with previous research that has emphasized the need for addressing co-benefits for widely implementing climate measures in agriculture (Otte and Vik, 2017; Kragt et al., 2017).

6.2 Farmers' knowledge of climate measures

In the survey, farmers were asked to which extent they generally know about climate measures in agriculture. Results are shown in Figure 24. One-third of the farmers state that they know about climate measures in the agriculture to a great extent or to a very great extent, while the majority report that they understand 'to some extent' climate measures in agriculture. 15 percent of the farmers reported that they know about climate measures in agriculture only to a small extent or know nothing. Although this is self-reported knowledge, the figure illustrates that there is a seemingly large variation in farmers' knowledge about climate measures in agriculture.

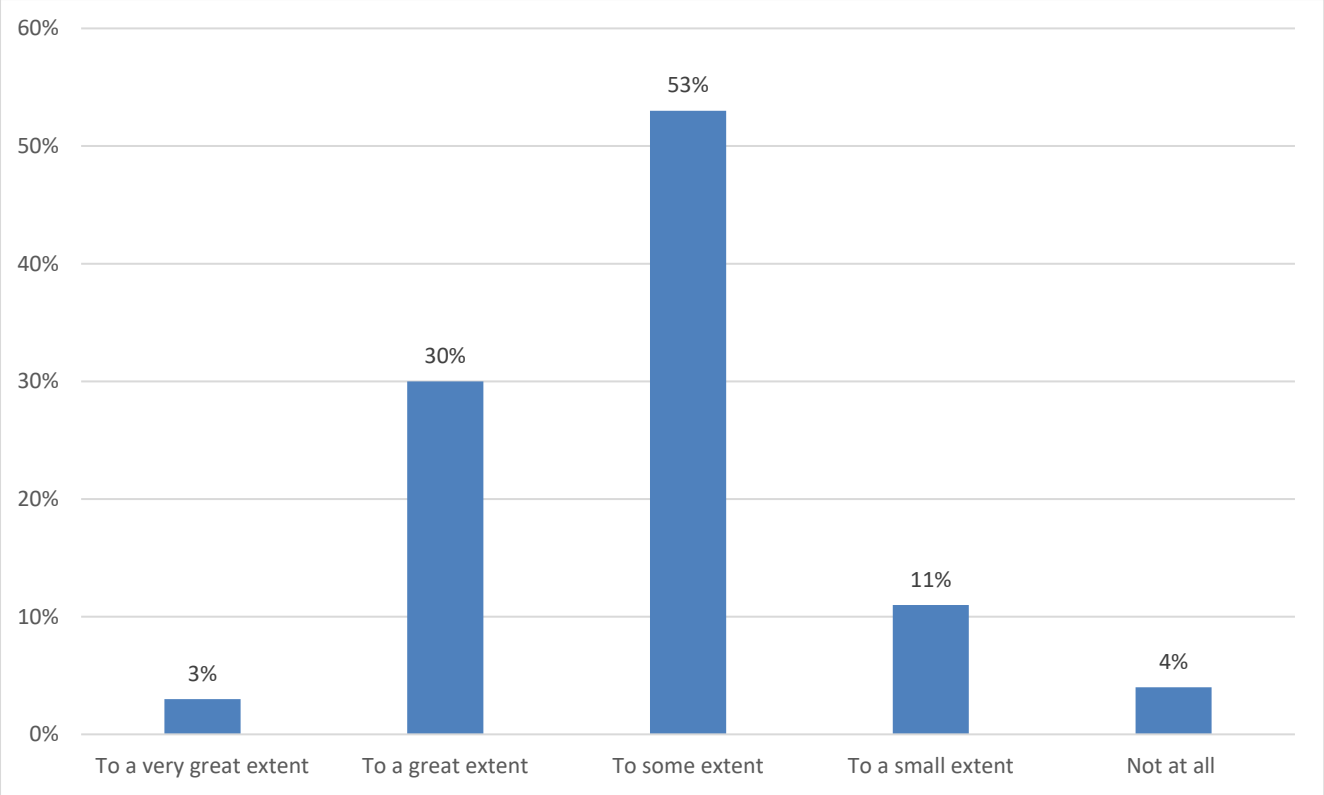

Figure 24: Farmers' knowledge about climate measures in agriculture

Table 5 shows to what extent farmers think different climate measures can reduce emissions from their farm. Here we provided a list of available climate measures that we identified as relevant for crowdfunding in section 3.3. The table shows that solar panels stand out as a climate measure that farmers' favor the most. Over one-third of the farmers think solar panels can reduce emissions from the farm to a great or to a very great extent. For other measures such as the use of wood in the barn instead of steel and concrete and ceiling panels on the barn, farmers' express more moderate believe that it will reduce emissions from their farm.

Table 5: The extent farmers think different climate measures can reduce emissions from their farm. In percent

	To a very great extent	To a great extent	To some extent	To a small extent	Not at all	Don't know	Not relevant	Total
Use of wood in the barn instead of steel and concrete	6%	7%	23%	20%	11%	7%	26%	100%
Ceiling panels on the barn that enable more sunshine coming through	3%	7%	24%	27%	14%	5%	21%	100%
Solar panels on the barn	12%	24%	26%	12%	7%	4%	14%	100%
Biogas production from livestock manure	3%	10%	15%	14%	18%	7%	32%	100%
Precision GPS guidance system	4%	10%	21%	22%	18%	5%	22%	100%
Drag hose with dribble bars for manure spraying	4%	13%	21%	15%	11%	4%	32%	100%
Supplying soils with biochar to increase carbon content	1%	4%	9%	13%	15%	30%	27%	100%

Figure 25 shows the proportion of farmers who have implemented climate measures on their farm.

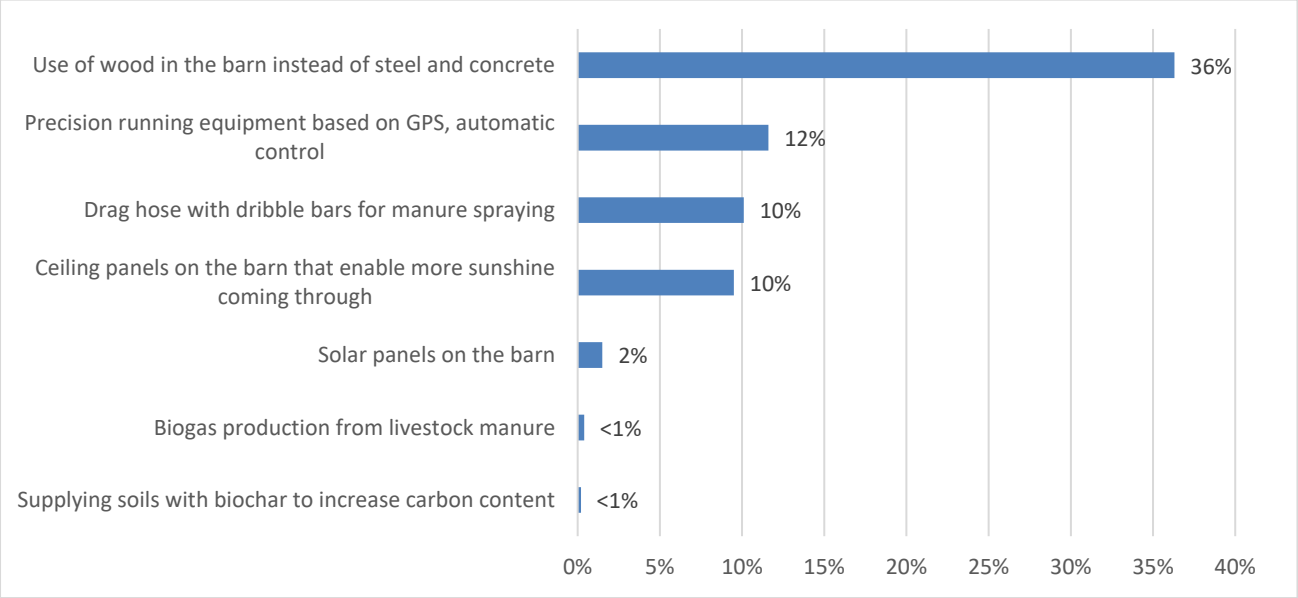

Figure 25: Climate measures already applied/implemented. In percent.

Over 36 percent of the farmers' report that they use wood in the barn instead of steel and concrete. However, it is doubtful that this has been implemented as a result of climate reasons for most farmers. Further, precision GPS guidance systems, drag hose

with dribble bars for manure spraying, and ceiling panels on the barn are other climate measures that roughly one-tenth of the farmers have implemented on their farm. Very few have implemented solar panels on the barn, produced biogas from livestock manure, or supplied soils with biochar to increase carbon content.

6.3 Farmers' preferred climate measures

Concerning climate measures farmers' report are somewhat likely or very likely to be carried out in the next 5 years, solar panels are one of the most likely to be implemented by the farmers in the survey (see Table 6). Use of wood in the barn, precision GPS guidance system and drag hose with dribble bars for manure spraying are also likely to be carried out by between 16 and 19 percent of the farmers. Biogas and biochar production are the least likely climate measures to be applied. This might be due to that they are realtively new tehcnologies and consequently have experienced limited implementation in Norway.

Table 6: The likelihood that farmers will carry out different mitigation practices in the next 5 years (n=450)

	Very likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Very unlikely	Don't know	Not relevant	Total
Use of wood in the barn instead of steel and concrete	11%	8%	8%	5%	23%	8%	36%	100%
Ceiling panels on the barn that enable more sunshine coming through	4%	7%	6%	11%	28%	8%	36%	100%
Solar panels on the barn	4%	18%	18%	10%	22%	9%	18%	100%
Biogas production from livestock manure	1%	2%	9%	13%	28%	9%	38%	100%
Precision GPS guidance system	7%	12%	11%	12%	27%	7%	23%	100%
Drag hose with dribble bars for manure spraying	6%	10%	9%	12%	18%	7%	38%	100%
Supplying soils with biochar to increase carbon content	0%	2%	7%	10%	30%	18%	33%	100%

Further, we asked farmers which factors they considered important for choosing climate measures for their farm. We listed here a wide range of factors to get a better idea on what matters for farmers. Farmers were presented with the following question: *Imagine that you would introduce one or more mitigation measures on your farm. How important will the following factors then be for implementation?* The distribution of the various factors are presented in Figure 26.

Figure 26: The importance of different factors for implementing mitigation measures on the farm

The figure shows that it is important for farmers that climate measures fit to the farm management, that the investment costs are low, and that the measure contributes to overall cost reduction – reflecting the relevancy of the prior mentioned co-benefit aspect. Additionally, that the measure does not lead to increased work effort on the farm, financial support from external sources, and accurate figures/numbers on how much the measure can reduce GHG emissions on the farm are other factors that are considered very important for many farmers.

For Coolcrowd the fact that famers perceive external financial contribution as important (66 percent state that this is either very or pretty important) provides a valid basis for implementing a local crowdfunding program. We can also see that 55 percent find it important to have someone to collaborate with. This has to be interpreted with caution since the survey did not state the type of collaboration but should be further explored in the following focus group/interviews in order to find out whether farmers would be more interested in collaborative crowdfunding campaigns that are set up with a group of farmers. Many of the climate measures such as solar panels and drag hose with dribble bars for manure spraying could be shared among farmers and such reduce costs, risks and some of the socio-cultural barriers including reputation and the law of Jante.

7 Implications for developing the concept of local crowdfunding

The overall aim of this report was to investigate the willingness of Norwegian farmers to participate in a local climate crowdfunding scheme. Based on the survey results we provide the following recommendations for the further business model development in the project. In order to develop an appropriate business model we need to identify our target group for local crowdfunding. From the supplier side we could see that the survey does not show any significant differences between production types, age groups and educational level. Nevertheless, organic farmers (including farmers who are under a conversion-program to become organic farmers) tend to agree more with the statement that climate crowdfunding sounds like an attractive solution for financing climate measures on individual farms than conventional farmers. Furthermore, farmers who feel responsible for reducing GHG emissions are more interested.

However, in order to gain a wider interest in local climate crowdfunding among a larger group of farmers who do not perceive it as their primary responsibility to reduce GHG emissions, it is important to investigate the potential co-benefits of different types of climate measures and emphasize these in the communication process with farmers. How far the climate argument is relevant in a crowdfunding campaign for both farmers and travelers would then need to be ascertained.

Considering the type of backers, farmers express high interest in including companies as backers. Thus, we advise conducting a focus group with larger Norwegian companies who could include the concept of local crowdfunding as part of their business strategy for compensating for their employees' travel related emissions. This may lead to much quicker and more stable fundraising. In addition, focusing on loan-based crowdfunding, companies might not only be interested in the concept for improving their environmental and climate profile but also because of potential green investment returns. For the farmers, companies might be a suitable group since they are more anonymous backers in comparison to individuals. Receiving a loan from individuals can be a limiting socio-cultural factor – particularly with regards to the lending model.

Furthermore, the survey results indicate that farmers' willingness to collaborate with other farmers varies greatly. However, further analysis showed that there is a positive correlation between willingness to collaborate with other farmers to start a crowdfunding campaign and stating that crowdfunding sounds like an attractive

solution for financing climate measures on individual farms. Thus, it should be investigated whether the public/travelers show any preferences here.

Farmers are very interested in solar panels as preferred climate measure. However, their climate impact depends on the scale of the electricity market we use for calculating the emission reduction potential (Norway - hydropower, Europe - coal). There are also other technologies that have a more certain climate impact (e.g., drag hose with dribble bars for manure spraying) and thus we recommend testing these two to see whether travelers have any preferences for financing certain technologies over others. Solar panels and drag hose with dribble bars for manure spraying present good examples here since they focus on very different GHG emission sources (soil, energy) and are not publicly known in the same way (solar panels as widely known technology in comparison to improved manure spraying which is known mostly to farmers). Comparing one technology that is easy to communicate to travelers with one that has a high potential but might be more difficult to communicate will help ascertain how important technological communication is in terms of attracting crowdfunding.

In addition, a large number of farmers do not want to be presented publicly as recipients of a crowdfunding campaign. Here, it was not specified what such a public presentation would look like. Thus, this aspect should find more consideration in further research to find out more about what these limitations entail. In order to overcome this problem, farmers are interested in setting up a locally crowdfunded fund, where farmers can apply for funding directly. This goes against the Coolcrowd concept since it loses part of the personal connection but it should be investigated further how much this matters for the public.

Considering the type of crowdfunding, farmers tend towards donation-based crowdfunding but there is a high uncertainty since many ticked the “don’t know” category. There is also interest in a reward-based system where open farm visits are the most attractive reward for farmers to offer. The provision of farm products that can be picked up at the farm is also of interest for farmers but it depends on the production type. Vegetable/fruit farmers are generally more interested due to easier conditions related to hygiene and food regulations. The findings are very mixed and thus we cannot narrow down to one or two crowdfunding models at this stage and thus advise further (qualitative) testing with travelers.

Furthermore, farmers show high levels of trust in agricultural advisory organizations to run a crowdfunding platform. There is also an interest in co-financing climate measures with governmental support. One approach could be to link up a local

crowdfunding program with existing governmental support schemes. This should find consideration in the further concept development and be tested with the public.

Overall, the survey results indicate that there is generally high uncertainty and lack of knowledge on crowdfunding among farmers that can limit the implementation of a local crowdfunding concept. Thus, we encourage more dissemination activities within the project in conjunction with our external stakeholder partners since this could actively contribute to more knowledge on crowdfunding. This could lead to increased interest among farmers, including older farmers who less frequently use social media and would avoid the risk of making crowdfunding only attractive for a certain social group. Furthermore, it can contribute to reduce farmers' fears that participating in a locally crowdfunded climate scheme would be negatively perceived in their neighborhood.

Literature

Ahlers, G. K., Cumming, D., Günther, C. and Schweizer, D. 2015. Signaling in equity crowdfunding, Entrepreneurship Theory and Practice, 39 (4), pp. 955-980.

Almås, R. 2016. Omstart Forslag til ein ny landbrukspolitikk. Snøfugl, Melhus.

Bardalen, et al., 2018. Utslippsreduksjoner i norsk jordbruk Kunnskapsstatus og tiltaksmuligheter, NIBIO Rapport 4:149.

Bartenberger, M. and Leitner, P. 2013. Crowdsourcing and crowdfunding: approaches to foster social innovation", available at: http://www.iadisportal.org/digital-library/mdownload/crowdsourcing-and-crowdfunding-approaches-to-foster-social-innovation (accessed 20 February 2019).

Belleflamme, P., Lambert, T. Schwienbacher, A. 2014. Crowdfunding: Tapping the right crowd. Journal of Business Venturing, 29(5), pp. 585-609.

Belz, F. M. and Binder, J. K. 2017. Sustainable entrepreneurship: A convergent process model, Business Strategy and the Environment, 26(1), pp. 1-17.

Bondevennen, 2017. Bygg i tre – en fordel for flere. https://www.bondevennen.no/aktuelt/bygg-i-tre-en-fordel-for-flere/# (Retrieved 08.03.2019).

Bonesmo, H., Beauchemin, K.A., Harstad, O.M., Skjelvåg, A.O., 2013. Greenhouse gas emission intensities of grass silage based dairy and beef production: A systems analysis of Norwegian farms. Livestock Science 152, pp. 239–252.

Brentnall, C. 2008. Timber, in: Michael Forsyth (ed.) Materials & skills for historic building conservation, Blackwell Publishing, Oxford.

Burg, van E., Jager de, S., Reymen, I., Cloodt, M., 2012. Design principles for corporate venture transition processes in established technology firms. R&D Management 42(5), pp. 455-472.

Calic, G. and Mosakowski, E. 2016. Kicking off social entrepreneurship: how a sustainability orientation influences crowdfunding success, Journal of Management Studies, 53(5), pp. 738-767.

Enova, 2019. Om Enova, https://www.enova.no/om-enova/ (Retrieved 08.03.2019).

European social survey 2018. European Attitudes to Climate Change and Energy. https://www.europeansocialsurvey.org/docs/findings/ESS8_toplines_issue_9_climatechange.pdf (Retrieved 12.04.2019).

Hansen, S. et al., 2018. Miljø-og klimavennlig melkeproduksjon Inspirasjon fra seks melkeproduksjonsbruk, NIBIO Rapport 4:16.

Hörisch, J. 2015. Crowdfunding for environmental ventures: an empirical analysis of the influence of environmental orientation on the success of crowdfunding initiatives", Journal of Cleaner Production, 107, pp. 636-645.

Hohle, E. E., Bardalen, A., Haugen J.M., Kvalevåg M., Øygarden, L., Hanssen-Bauer, I., Walland F., Brunvatne, J.O. 2016. Landbruk og klimaendringer. Report from Working Group, 19 February. Oslo: Ministry of Agriculture and Food.

Holmengen, N. (ed.) 2018. Greenhouse Gas Emissions 1990- 2016, National Inventory Report 2018. Rapport fra Miljødirektoratet, Oslo. M-985. http://tema.miljodirektoratet.no/Documents/publikasjoner/M985/M985.pdf

Hårstad, R.M.B. 2018. Socio-cultural factors: Opportunities and challenges for crowdfunding climate measures in Norwegian agriculture, Notat nr. 1/18, ISSN 1503-2027. https://ruralis.no/wp-content/uploads/2018/06/notat--wp-2-2-sociocultural-factors.pdf

Innovation Norway, 2019. Our mission. https://www.innovasjonnorge.no/en/start-page/our-mission/ (Retrieved 08.03.2019).

Jordbruksavtale, 2018-2019. https://www.regjeringen.no/contentassets/f52d24b151c64b8a96a073438b977bc5/revidert-jordbruksavtale-2018-2019.pdf

Kragt, M.E., Dumbrell, N.P., Blackmore, L., 2017. Motivations and barriers for Western Australian broad-acre farmers to adopt carbon farming, Environmental Science & Policy, 73, pp. 115-123.

Lam, P. T. and Law, A. O. 2016. Crowdfunding for renewable and sustainable energy projects: An exploratory case study approach, Renewable and Sustainable Energy Reviews, 60, pp. 11-20.

Lyng, K.A., Prestrud, K., Elstad Stensgård, A., 2019. EVALUERING AV PILOTORDNING FOR TILSKUDD TIL HUSDYRGJØDSEL TIL BIOGASSPRODUKSJON. https://www.ostfoldforskning.no/no/publikasjoner/Publication/?id=2491

Meld. St.11, 2016-2017. Endring og utvikling En fremtidsrettet jordbruksproduksjon. https://www.regjeringen.no/contentassets/37566c89c95f410e9bbec04265a7145f/no/pdfs/stm201620170011000dddpdfs.pdf

Meld. St.21, 2011-2012. Norsk klimapolitikk. https://www.regjeringen.no/contentassets/aa70cfe177d2433192570893d72b117a/no/pdfs/stm201120120021000dddpdfs.pdf

Mollick, E. 2014. The dynamics of crowdfunding: An exploratory study. Journal of Business Venturing, 29(1), pp. 1-16.

Nisbeth, M.C. 2009. Communicating Climate Change: Why Frames Matter for Public Engagement. Environment: Science and Policy for Sustainable Development. 51(2), 12-23.

Ordanini, A., Miceli, L., Pizzetti, M. and Parasuraman, A. 2011. Crowd-funding: transforming customers into investors through innovative service platforms, Journal of Service Management, 22(4), pp. 443-470.

Ortas, E., Burritt, R.L. and Moneva, J.M. 2013. Socially responsible investment and cleaner production in the Asia Pacific: Does it pay to be good?", Journal of Cleaner Production, 52, pp. 272-280.

Otte, P.P., Vik, J., 2017. Biochar systems: Developing a socio-technical system framework for biochar production in Norway. *Technology in Society*, 51, pp. 34-45.

Regjeringen, 2019. Svar på skriftlig spørsmål om kutt av CO_2-ekvivalenter i jordbrukssektoren. https://www.regjeringen.no/no/aktuelt/svar-pa-skriftlig-sporsmal-om-kutt-av-co2-ekvivalenter-i-jordbrukssektoren/id2615668/ (Retrieved 10.05.2019).

Regjeringen, 2018. Jordbruksoppgjøret. https://www.regjeringen.no/no/tema/mat-fiske-og-landbruk/jordbruk/innsikt/jordbruksoppgjoret/jordbruksoppgjoret/id2354585/ (Retrieved 16.04.2019).

Shneor, R., Aas, T.H. 2016. Folkefinansiering: Status og fremtidsutsikter. Praktisk økonomi og finans. ISSN: 1501-0074. 32 (1). s 43 - 51. doi:10.18261/issn.1504-2871-2016-01-06.

Shneor, R., Ziegler, T. 2019. Global status of crowdfunding: Insights from the Cambridge reports. Innlegg presentert ved Crowdfunding 2019 konferanse, Oslo.

Solenergiforening, Bruk av solenergi i det norske landbruket, https://norgesvel.no/getfile.php/131636-1501750234/NorgesVel/Bilder/Prosjekter/Fornybar%20energi%20og%20klima/Solguiden_landbruket_A5-3.pdf

Statens tilbud, 2019. Statens tilbud Jordbruksforhandlingene (07.05.2019). https://www.regjeringen.no/contentassets/af69c20a613a4e10b44bb24410aae7f7/jordbruksoppgjoret-statens-tilbud-070519.pdf

Statistics Norway 2017. Gardsbruk, jordbruksareal og husdyr. https://www.ssb.no/statbank/list/stjord (Retrieved 04.02.2019).

Stoknes, P. E., 2014. Rethinking climate communications and the psychological climate paradox. Energy Research & Social Science, 1, 161–170.

Taiyab, N., 2005. The market for voluntary carbon offsets: A new tool for sustainable development? Gatekeeper series 121, iied.

Vasileiadou, E., Huijben, J. Raven, R. 2015. Three is a crowd? Exploring the potential of crowdfunding for renewable energy in the Netherlands, Journal of Cleaner Production, 30, pp. 1-14.

Vik, Stræte, Hansen and Nærland (paper submitted): The political robot – The structural consequences of automated milking systems (AMS) in Norway.

Ziegler, T., Shneor, R., Garvey, K., Wenzlaff, K., Yerolemou, N., Rui, H., Zhang, B. 2018. Expanding Horizons: The 3rd European Alternative Finance Industry Report, Cambridge University Center for Alternative Finance, Cambridge, UK. https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2018-ccaf-exp-horizons.pdf

Øyen, O. (n.d.). Oppsummering av prosjekt«Landbruksbygg i Tre» Gode ideer og gode grunner til å bygge Trefjøs. https://landbruksbygg.nlr.no/media/ring/4200/Oppsummering-landbr.bygg%20Tre%2025.10.12.pdf

Appendix

Table 1: Farmers previous experience with crowdfunding

	Freq.	Percent
Yes, I have previously conducted my own crowdfunding campaign	3	0.7
Yes, I have previously given money to a crowdfunding campaign	22	4.7

Table 2: Logistic regression. Likelihood of having heard about the term 'crowdfunding' (n=419)

	Logit coef.	SE
Gender (women=1, men=0)	0.014	(0.344)
Age dummy (reference category: farmers < 40 years of age)		
40-59 years of age	-0.372	(0.354)
60 years or older	-1.754**	(0.465)
Education on university level (yes=1, no=0)	1.382**	(0.273)
Time spent on social media during a 'normal day' (reference category: no time)		
Less than one hour	0.294	(0.334)
Between one and two hours	0.580	(0.403)
More than two hours	1.480*	(0.690)
Constant	-1.642	(0.433)

*Note: Dependent variable: Prior knowledge about the term 'Crowdfunding' (Yes=1, No=0). *P < 0.05 and **P < 0.01 in two-tailed tests. SE, standard errors.*

Table 3: Logistic regression. Likelihood of answering don't know on whether Crowdfunding sounds like an attractive solution (n=411)

	Logit coef.	**SE**
Gender (women=1, men=0)	-0.531	(0.342)
Age dummy (reference category: farmers < 40 years of age)		
40-59 years of age	0.554	(0.374)
60 years or older	0.861*	(0.389)
Education on university level (yes=1, no=0)	-0.761**	(0.249)
Constant	-1.011	(0.351)

*Note: Dependent variable: Farmers' answering 'don't know' (=1) on the statement 'crowdfunding sounding like an attractive solution for financing climate measures on individual farms'. All other responses are coded 0. *P < 0.05 and **P < 0.01 in two-tailed tests. SE, standard errors.*

Additional information: Production type had no impact on whether farmers answered don't know.

Table 4: Multiple regression (OLS). Attitudes toward crowdfunding (n=272)

	Model 1: Coef. (SE)	**Model 2: Coef. (SE)**
Demographic variables		
Gender (women=1, men=0)	-0.238 (0.202)	-0.257 (0.199)
Age dummy (reference category: farmers < 40 years of age)		
40-59 years of age	0.112 (0.219)	0.106 (0.217)
60 years or older	0.065 (0.244)	-0.016 (0.243)
Education on university level (yes=1, no=0)	-0.171 (0.161)	-0.123 (0.160)
Organic farmer (yes=1, no=0)	0.652** (0.238)	0.646** (0.236)
Attitudes toward climate responsibility		
'It is primarily my responsibility as a farmer to reduce GHG in agriculture'. Scale from 1 (strongly disagree) to 5 (strongly agree).		0.193** (0.068)
Constant	2.557	1.995
R-squared	0.04	0.06

*Note: Dependent variable: Farmers' response to a statement on whether they agree or disagree about crowdfunding sounding like an attractive solution for financing climate measures on individual farms. Scale from 1 (strongly disagree) to 5 (strongly agree). Respondents answering don't know is dropped from the analysis. *P < 0.05 and **P < 0.01 in two-tailed tests. SE, standard errors.*

Table 5: Farmers' potential rewards. Percent.

	To a very great extent	To a great extent	To some extent	To a small extent	Not at all	Don't know
Open farm day	11	14	19	10	18	27
Products from the farm picked up at the farm	7	13	16	13	23	29
Products from the farm picked up at retailers (e.g. local grocery shop)	1	5	14	18	30	31
Products from the farm sent to the supporters/backers	2	7	11	19	32	30
Thank you card or a posting on Facebook	8	7	12	12	31	30

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Ruralis
Institute for Rural and Regional Research

Trondheim (hovedkontor):
Universitetssenteret Dragvoll
N-7491 Trondheim
73 82 01 60

Oslo:
Paleet, Karl Johans gate 41A (5 etg.)
N-0162 Oslo
913 32 277

post@ruralis.no
ruralis.no