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Animal Welfare and Economics in the Dairy Industry

Is cow-calf contact the future of Norwegian milk production?

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NORWEGIAN SCHOOL OF ECONOMICS

Abstract

In recent years, there has been an increased focus on animal welfare and sustainability in livestock production. In the case of dairy production, the practice of separating cow and calf at birth has been increasingly questioned by stakeholders. Early separation can be seen as a sacrifice of animals' naturalness in favor of human consumption, and thus associated with poor animal welfare. Today, only a minority of calves in milk production are allowed to have contact with their mother. To ensure sustainability of the dairy industry, listening to stakeholders' concerns is vital. Thus, knowledge of consequences and resources needed to succeed with animal welfare initiatives will be important for the industry.

The aim of this thesis is to investigate how prolonged cow and calf contact (CCC) can be a feasible option for Norwegian dairy farmers, viewed from an economic perspective. In order to investigate economic consequences of CCC, this study performs a lasso regression on production data from 94 farms. Survey data from 1 038 dairy farmers is used to find main barriers to adopting the CCC-practice, and a SEM is conducted to explain the level of perceived barriers.

Our findings indicate that CCC-farmers have a lower quota filling than farms without CCC, resulting in a lower income from milk. For a farmer with an average herd size of 30 cows, the decreased milk yield corresponds to the yearly production of one dairy cow. Additionally, CCC requires changes in the cow barn, which may result in additional investments for the farmer. Findings also suggest positive economic consequences, such as increased income from calves and decreased workload for the farmer. Non-monetary consequences of CCC are increased wellbeing and flexibility for the farmer. Thus, there are various factors affecting the economic success of the production system. Related to perceived barriers, the results show that poorer financial performance, the cow barn layout and increased workload are the main barriers to adopt the CCC-practice. Findings also suggest that the level of perceived barriers can be affected by the beliefs and values of the farmer. The findings highlight important challenges to be solved for facilitating increased animal welfare in the dairy industry.

Acknowledgements

This thesis has studied the economic consequences of cow and calf contact (CCC) in dairy farming, as well as examined the barriers to implementing such a practice. In regards to the increased focus on animal welfare, it has been motivating to research such a relevant topic. Economic consequences have to a small extent been covered in previous literature about CCC, thus we hope our thesis could contribute to the research field.

First, we would like to thank our supervisor Øivind Anti Nilsen, who has made this master thesis possible by putting us in touch with people in the industry. He has provided good and constructive feedback along the way.

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All data material used in this thesis is obtained through the SUCCEED research project, project no. 310728, funded by *Forskningsmidlene for jordbruk og matindustri (FFL/JA)*.

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Contents

List of Figures

List of Tables

1 Introduction

1.1 Motivation

Separation of cow and calf at birth has been a common practice in dairy farming worldwide. Unlike other domestic animals such as horses, sheep and pigs, the dairy cow is one of few animals that are hindered from staying together with their offspring. Under natural circumstances, the calf suckles the mother recurrently throughout the day, until the age of between 7 and 14 months (Vaarst et al., 2020). The main reason for separating cow and calf early, is for the farmer to control the amount of milk given to the calf, to maximize milk production to the dairy processors (Flower and Weary, 2003). If cow and calf are kept together, the calf drinks much more due to the free access, which in turn results in less saleable milk.

In recent years, there has been an increased focus and awareness about animal welfare in society. In Norway, we have seen the closure of the fur industry, as well as other animal welfare initiatives in agriculture. The former, especially, is a result of great consumer power and public pressure through animal welfare alliances (Norwegian Animal Protection Alliance, 2019). Nowadays we see that the practice of separating cow and calf is increasingly questioned by the public due to animal welfare concerns. Studies demonstrate that people are not aware of the practice of separation, and they do not seem to support the practice when they are informed about it (Hötzel et al., 2017; Busch et al., 2017). The topic has also received attention in Norwegian media[1,2].

For the long-term sustainability of the dairy industry, cattle housing requires a holistic approach that incorporates the interests from three main stakeholder groups: *the industry*, *the public*, and *the animals themselves* (Beaver et al., 2020). Providing cow and calf contact (CCC) may be required to meet demands from stakeholders, as well as possible future legal requirements for animal welfare from authorities. In recent years, several regulations of animal welfare have been adopted, such as the loose-housing requirement in Norway which prohibits tie-stalls from 2034.

[1]https://tv.nrk.no/serie/nytt-paa-nytt/2022/MUHH44000222/avspiller
[2]https://www.nrk.no/mr/forskar-pa-a-la-ku-og-kalv-vere-saman-1.15577609

Knowledge of consequences and resources needed to succeed with the practice will be important for the industry. This study collects data from 1 038 Norwegian dairy farmers. Contrary to earlier studies this study provides a broader insight to the topic of cow and calf rearing. Many of the solutions developed by animal welfare scientists are not adapted in practice because they do not adequately address perceived barriers within the public and by livestock producers (Weary et al., 2015). By studying both farmers with and without allowance of CCC, this thesis gives an understanding of which obstacles must be overcome to successfully implement the CCC practice.

1.2 Problem Formulation

The aim of the research is to investigate the consequences of practicing CCC on Norwegian dairy farms. In particular, it is desired to examine the economic consequences, and whether it is profitable to practice CCC. Another aim of the research is to examine non-CCC farmers' attitudes and barriers related to the topic. It will be just as important and interesting to examine the group that practice CCC as those who do not, in order to better understand the topic.

Based on the background provided in the previous section, this study has the following research question:

What are the socioeconomic consequences of, and barriers to, implementing cow and calf contact in the Norwegian dairy industry?

To answer the research question, the first thing we want to investigate is dairy farmers' experienced consequences of implementing the practice. Furthermore, we will shed light on dairy farmers' main barriers to adopting such a practice, and explore what can explain the level of perceived barriers.

1.3 Outline

This chapter has provided a brief introduction to the topic and presented the research question. Chapter 2 provides information about Norwegian agriculture and dairy farming, as well as political regulations. Chapter 3 covers relevant literature on animal welfare and economics in general, as well covering existing literature about CCC. In chapter 4, the data used in this study will be introduced, followed by statistical methods in Chapter 5. Chapter 6 is presenting empirical results and discussion of findings, before the conclusion in Chapter 7. Note that a glossary list, as well as a list of acronyms and abbreviations can be found after the conclusion.

2 Background

2.1 Norwegian Agriculture

Norwegian agricultural and food policy has four overriding goals: food security, agriculture across the country, increased value added and sustainable agriculture with lower greenhouse gas emissions (Regjeringen, 2016).

Norwegian agriculture has continuously adjusted over the past 150 years. Agriculture in Norway is strongly affected by the country's geographical location and natural conditions (Syverud et al., 2021). Geographical location sets an important restriction in Norwegian agriculture, with only about three percent agricultural area. As a result, most of the agricultural area is used for grass production, which can grow in higher-layer areas and far to the north (Syverud et al., 2021). Technological development, national and international politics, as well as economic conditions play an important role in Norwegian agriculture (Knutsen, 2021). Britt et al. (2018) claim agriculture to be further modernized within 2067, with integrated sensors, robotics and automation to replace much of the manual labor. There are already examples of this, such as the milking robot that has become widespread in the Norwegian dairy industry in the 2000s.

2.2 Norwegian Milk Production

Figure 2.1 illustrates a decline in the number of dairy farmers in Norway between 1998 and 2021. As of 2021, there are 6 925 milk producers in Norway, which represents a decrease of 70 percent since 1998. While the number of dairy farms has decreased, the size of them has increased. In 2021, more than 80 percent of the dairy farms had more than 15 cows, compared to approximately 40 percent in 1998 (Statistics Norway, 2022). This trend demonstrates a transition towards larger farms with more than 30 cows.

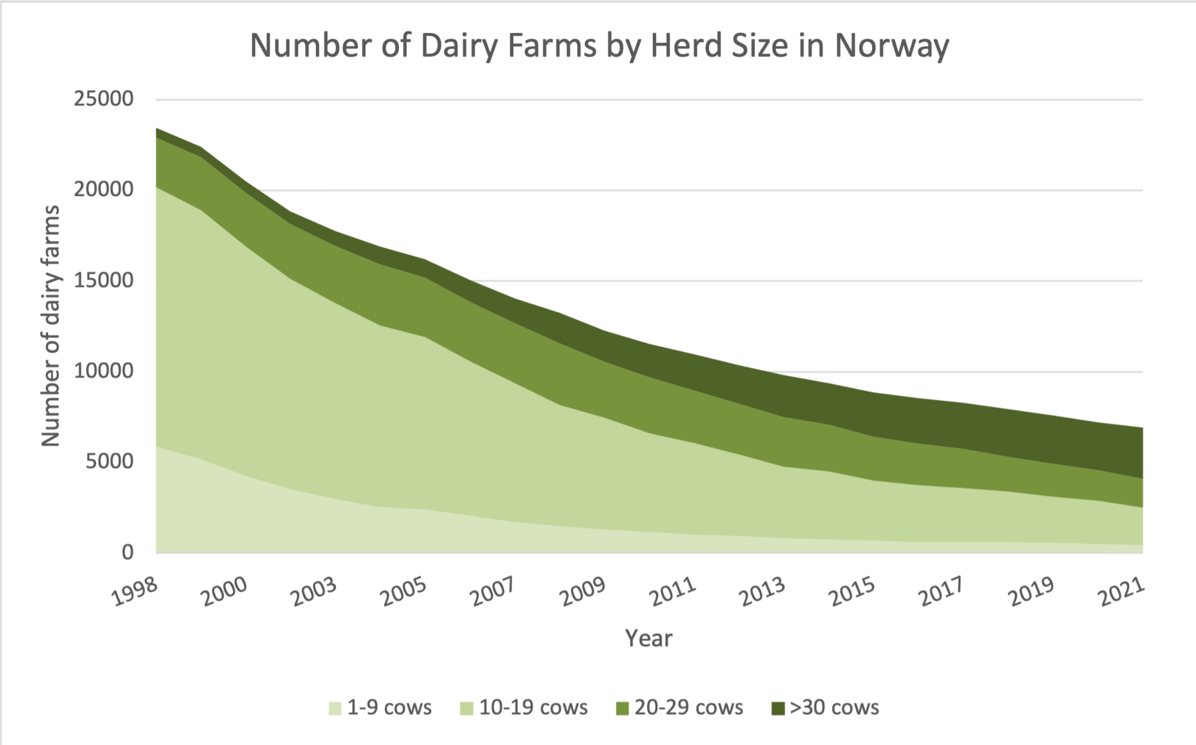

Figure 2.1: Number of dairy farms by herd size in Norway

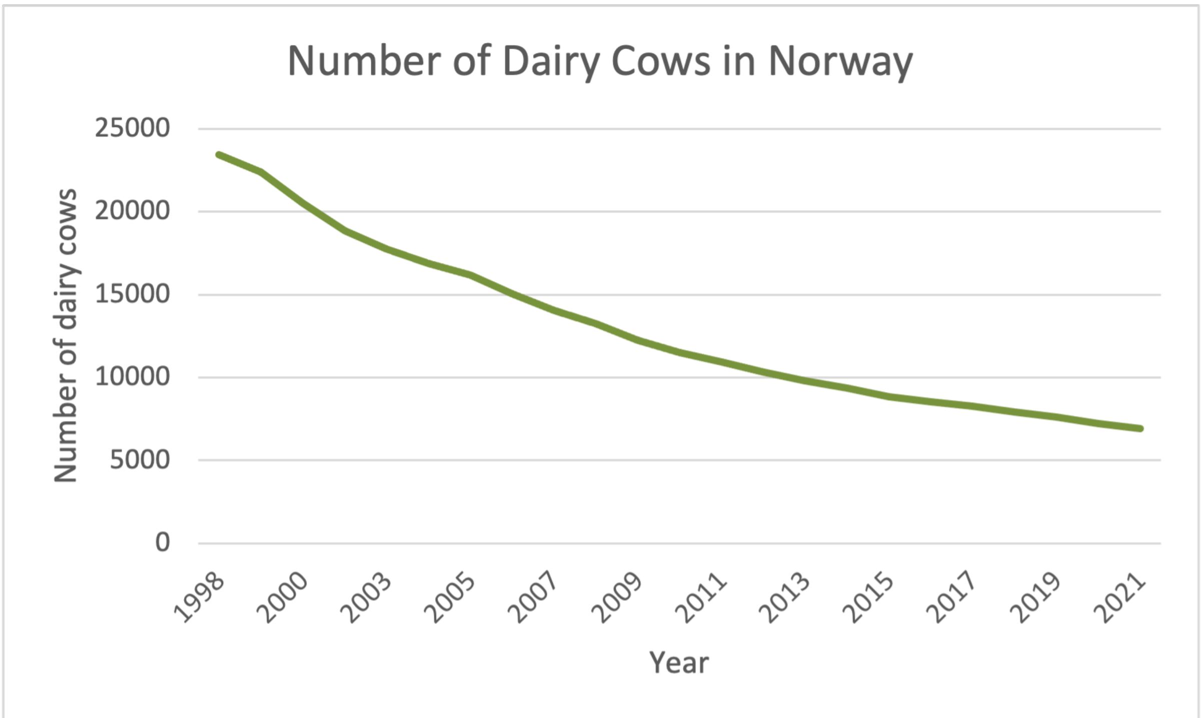

Figure 2.2: Number of dairy cows in Norway

Figure 2.2 shows a decline in the numbers of dairy cows in Norway. This indicates that the reduced number of dairy farms is greater than the increase in herd size per farm, leading to a decreasing number of cows.

In the modern dairy industry cows are producing milk for about 300 days a year with an average production of 25-30 kg per day, resulting in about 8 000 kg each year (TINE SA, 2022a). For the cow to be able to produce milk continuously, the cow must give birth to a calf roughly once a year (Opplysningskontoret for Meieriprodukter, 2022b). The average life expectancy of a cow is 5.7 years (Opplysningskontoret for Meieriprodukter, 2022a), compared to a natural life expectancy of approximately 20 years (De Vries and Marcondes, 2020).

As mentioned earlier, separation of cow and calf after birth is a common practice in the dairy industry. In organic production, the farmer is required to keep cow and calf together for at least 3 days, equivalent to the colostrum period. When the calf is separated from the dam, the calf is fed manually using a nipple feeder (bottle or buckets) or by automatic milk feeders, either by fresh milk or milk replacement. A third alternative is to use a foster cow. A foster cow is usually not producing milk for sale, and can nurse 2-4 calves simultaneously (Johnsen et al., 2016).

2.3 Political Regulations in Norwegian Dairy Farming

The Government presents its goals for agriculture through reports to the Norwegian Parliament. This, combined with laws, regulations and pricing systems, provides a national framework for agriculture (Knutsen, 2021). The two most important regulations are quotas and subsidies, which provides a major legal impact on the dairy industry.

2.3.1 Quotas

A quota is a right to produce a given amount of milk, during a certain period (Norwegian Agriculture Agency, 2022b). The production of milk in Norway has been regulated by milk quotas per producer since the 1980s (Statistics Norway, 2015). The purpose of the quota scheme is to adjust the production to the market demand, as well as to take care of rural- and structural[3] considerations (Norwegian Agriculture Agency, 2022b).

[3]Structural considerations means to facilitate farms with dairy production of various sizes.

In the quota scheme for milk, there are two main types of quotas: the base quota and the disposable quota (Norwegian Agriculture Agency, 2022b). The base quota is the quota that has been allocated and/or purchased for an agricultural property. Disposable quota is the total quantity an enterprise can produce during a year without being charged an overproduction tax. All enterprises that own a base quota will have their disposable quota calculated as a basis for production on the agricultural properties. The disposable quota can not be greater than the production ceiling, which in 2021 was 963 000 liters of milk, corresponding to the production of 120 dairy cows. It is possible to buy, sell and rent quotas, with some restrictions. For farms that exceed the disposable quota, an overproduction fee per liter of milk must be paid. In the event of overproduction at the national level, the Government can choose not to resell milk quotas that have been sold to the Government earlier. In the event of underproduction, the Government can increase the supply by adjusting all the available quotas proportionally (Norwegian Agriculture Agency, 2022b).

2.3.2 Subsidies

Statistics from OECD show that Norway is at the top when it comes to agricultural support, only exceeded by Switzerland and Iceland (OECD, 2022). The purpose of agricultural subsidies is to contribute to an active and sustainable agriculture. A second purpose, is subsidies for relief so that farmers who work with livestock have the opportunity to take time off by hiring help (Norwegian Agriculture Agency, 2022a). Every year, the Norwegian agricultural sector is supported with production subsidies, such as livestock subsidy for each animal and area subsidy for fodder production or production of other edible plants (Forskrift om produksjonstilskudd og avløsertilskudd i jordbruket, 2014, § 3-5). In addition, the farmer receives a price subsidy for milk, meat, eggs and wool, which is paid together with settlement for delivered goods (Norwegian Agriculture Agency, 2022d). Further, the subsidies vary between different geographical areas, with a main purpose of equalizing revenues linked to geographical differences in production costs and revenue opportunities (Norwegian Agriculture Agency, 2022c; Pristilskuddforskriften, 2008, § 1). Another subsidy is the subsidy for organic farms. Farms with organic production receive extra subsidies for the organic animals as well as an area subsidy for organic land (Forskrift om produksjonstilskudd og avløsertilskudd i jordbruket, 2014).

Subsidies contribute to cover costs in production and sales, so that customers can buy the subsidized product at a lower price than the actual production costs (Gaasland, 2020). This contributes to abnormally high production and consumption of these products, of which Norwegian taxpayers contribute to finance. Combined dairy farming, with both milk and beef production, has a subsidy share of the production value of 36 percent. This is low compared to for instance sheep, with a subsidy share of 76 percent. Still, it is high compared to e.g. tomatoes and poultry which are only subsidized by 5 percent of its production value (Gaasland, 2020).

The amount of subsidies is determined according to The Agricultural Agreement, which is an annual agreement made between the state and the two agricultural organizations; the Norwegian Agrarian Association[4] and the Norwegian Farmers and Smallholders Union[5] (Bratberg, 2018). The amount is negotiated each spring, and is regulated through the Main Agreement for Agriculture of 1992 (Knutsen, 2021). The agricultural negotiations this year ended the 16th of May, and resulted in a total subsidy budgeted to about 18 452 million NOK for 2022, and 23 957 million NOK for 2023 (Regjeringen, 2022). These budgets are record high, to compensate for a cost increase in input factors such as fertilizers, building materials and electricity.

In addition to subsidies, Norwegian agriculture is highly protected from international competition through trade barriers, where meat, dairy products, grain and eggs have the highest tax rate (Regjeringen, 2020). However, exceptions from the trade barriers are made and are regulated through international trade agreements, such as the World Trade Organization (WTO) and European Economic Area (EEA) agreement (Syverud et al., 2021).

[4] Norsk Bondelag
[5] Norsk Bonde- og Småbrukarlag

3 Relevant Literature

In the following sub-chapters, relevant findings from previous research of animal welfare and CCC are presented.

3.1 Animal Welfare and Economics

Animal welfare is a term that, among other things, describe three ethical concerns regarding the quality of life of animals: (1) the animal should live natural lives with development and use their natural adaptations and capabilities, (2) the animal should feel well by being free from fear and pain, and (3) the animal should function well with good health, growth, and normal physical and behavioral functioning (Fraser et al., 1997). In the dairy industry, violation of one or more of the three above-mentioned concerns is usually a problem. Nevertheless, the level of animal welfare on farms varies due to animal welfare being a complicated and multidimensional concept (von Keyserlingk et al., 2012; Fraser, 1995). Different management conditions among dairy farms makes it even more complex (De Vries et al., 2015).

Management conditions may include herd- and housing characteristics, feeding, milking and other management practices (De Vries et al., 2015). In dairy, there are two main types of cow housing: free-stall housing and tie-stall housing. In Norway, it is legally established that all cattle should be housed in free-stalls within 2034 (Forskrift om hold av storfe, 2004). This can be viewed as an important animal welfare initiative, as the tie-stall deprives the animals of the opportunity for natural behavior and movement. Popescu et al. (2014) studied the effects of cow housing on animal welfare. They found significant differences between free-stall and tie-stall housing, with the free-stall system as more advantageous when it came to feeding, housing and behavior of the dairy cow. The result shows that the animal welfare of dairy cows is greatly influenced by the housing system. Other important aspects related to management conditions affecting the quality of animal welfare are new technologies such as automated feeders and Automatic Milking System (AMS). These may represent opportunities to improve animal welfare by allowing the cow to eat and be milked when needed, as well as more flexibility for the farmer (Beaver et al., 2020; Cogato et al., 2021).

Management decisions that affect animal welfare also have an impact on the economic performance of the farm. The relation between animal welfare and economics can be discussed within various fields. Four main fields are public economics, welfare economics, consumer economics and production economics (Lusk and Norwood, 2011). *Public economics* studies how animal welfare is a public good that can lead to market failure, e.g. inefficient distribution of goods and services. *Welfare economics* considers both human and animal welfare when analyzing the effects of different initiatives or regulations. *Consumer economics* is typically concerned with consumers' willingness to pay for improved animal welfare. *Production economics* studies the relation between animal welfare, productivity and profitability at the farm level (Lusk and Norwood, 2011). Production economics will be the main focus in this thesis.

To illustrate how animal welfare is related to productivity and profitability, a theoretical framework suggested by Henningsen et al. (2017) will be used. Figure 3.1 illustrates the role of animal welfare in the production process.

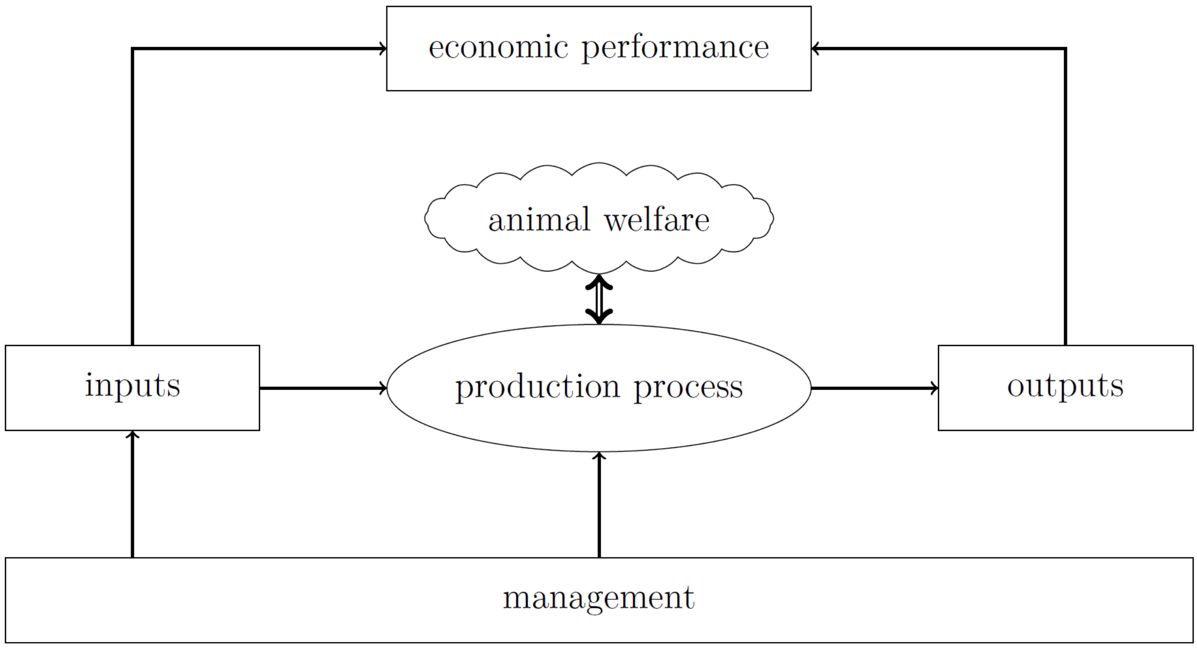

Figure 3.1: Role of animal welfare in the production process (Henningsen et al., 2016)

Prior to the production process, the farmer makes decisions regarding input factors like labor and feed, as well as herd and housing characteristics, feeding, and prioritization of time spent on different tasks. Animal health and wellbeing will affect their productive performance, which determines the quality of the production process (Henningsen et al., 2017). The model also indicates that the production process itself determines the level of animal welfare. This is in line with The Farm Animal Welfare Committee (2011) who argue that animal welfare can be seen as an externality resulting from the production process. As an instance, poor animal welfare could lead to increased animal morbidity and require a larger quantity of veterinary products and services, contributing to poorer financial performance.

Now that we have established animal welfare in the context of the production process, it can be useful to further investigate the relationship between the level of animal welfare and economic performance, as shown in figure 3.2.

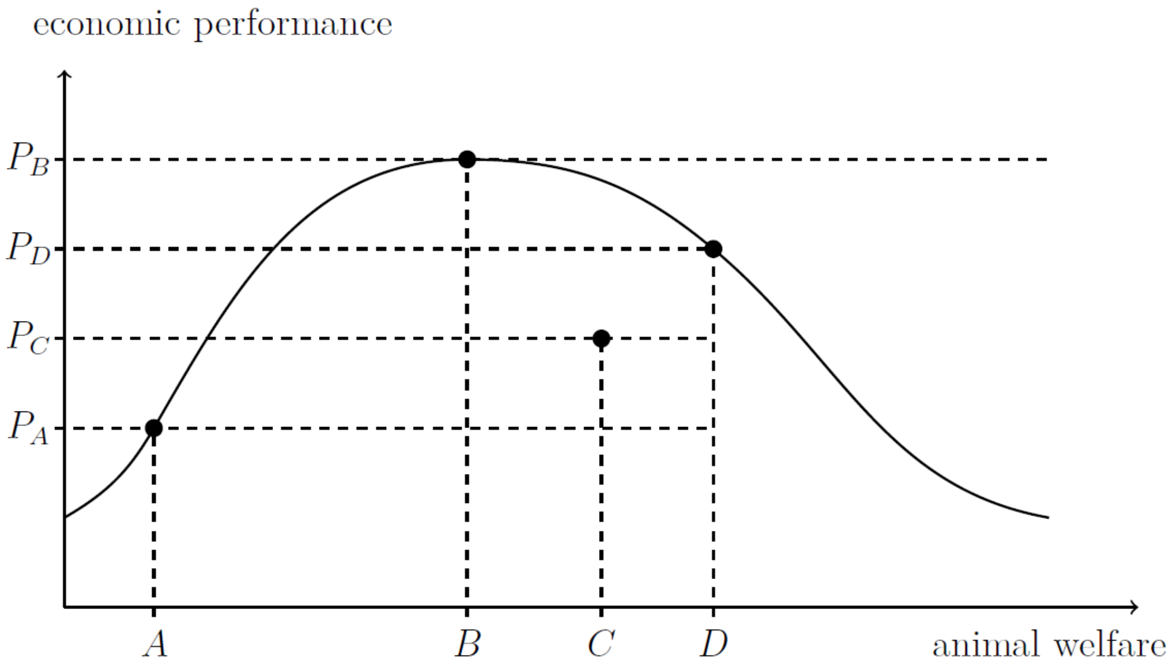

Figure 3.2: Relationship between animal welfare and economic performance (Henningsen et al., 2017)

The figure illustrates that with a low level of animal welfare, A, the potential of economic performance is also very low. Animal welfare at level B provides the greatest potential of economic performance. In many cases, insufficient management may hinder the farmer from reaching the economic potential associated with the level of animal welfare, resulting in low economic performance (C) (Henningsen et al., 2017). Point D illustrates a case where increased level of animal welfare has led to a decreasing economic performance. As an instance, increased space allowance could lead to improved animal health, wellbeing and productivity. However, increased space allowance can be costly, and the improved animal productivity might not cover the associated costs. A recent study by Ahmed et al. (2021) found that increased space allowance will decrease short run profit per animal in cow-calf operations. In such cases, the farmer is faced with a trade-off between animal wellbeing and profitability (Lusk and Norwood, 2011). Hence, this model implies that a farmer whose goal is to maximize economic performance, will choose animal welfare at level B, and has no economic incentives to exceed this level of animal welfare. As Fernandes et al. (2021, p. 10) argues, it is likely "that major changes in animal husbandry systems could be positive for animal welfare, but result in unprofitable systems of animal production". In this case, if society is in favor of such systems, the livestock systems would have to be subsidized for the business to be profitable.

3.2 Studies on Effects of Cow and Calf Contact (CCC)

There are various studies on the effects of cow and calf contact. Asheim et al. (2016) studied the economic effects on suckling and milk feeding to calves in Norwegian, organic dual-purpose dairy and beef farming. They found that suckling up to 7 weeks resulted in the best farm profit compared to no suckling, suckling for 3 days and 13 weeks. Consequences such as better calf growth and lower incidence of sick cows and calves, seemed to compensate for investments and the increased number of cows needed to produce the milk quota. They also found a reduction in cows treated for disease. Suckling also resulted in time savings for the farmer, because suckling was less time consuming when it came to feeding the calves. Another important finding was that calving in May in general was profitable since cheap pasture feed can replace some concentrates.

In a literature review examining the effects of prolonged cow-calf contact, Meagher et al. (2019) found that in many studies, suckling often did not reduce milk yield in the long term, and that calf growth most often improved by allowing CCC. When it comes to behavior of the calves, very few long term studies are performed, but in studies where effects have been found, they have been positive. On the other hand, they conclude that early separation, within 24 hours postpartum, can reduce acute distress responses of cows and calves. Nevertheless, prolonged contact may provide long-term benefits for calf growth and behavioral development (Meagher et al., 2019).

Viewing more recent studies, it appears to be a consensus when it comes to the effect on milk yield and calf growth. Barth (2020) performed a set of studies focusing on milk yield and composition in German farms, where 87 cows with calf contact and 89 control cows were included in total. The results showed that the group with calf contact had significantly lower milk yield during the contact period. A study from Slovakia (Broucek et al., 2020) examined the effects of different rearing during the milk-feeding period on the growth of dairy calves. Broucek et al. (2020) found that feeding methods had a significant impact on later performance of calves. In this study, 105 calves were assigned to one of three treatments: single (restricted) suckling, multiple (unrestricted) suckling and artificially rearing in hutches. The results showed that calves in the multiple suckling-group had the highest average increase in weight at 180 days and 360 days old, while the artificially rearing group had the lowest.

Johnsen et al. (2021) studied the performance of cow and calf with a cow-driven CCC system using smart gates to allow the cow to visit her calf. Group 1 had free access, during the suckling period of 31 days, while group 2 had restricted access to the calves based on previous activity in the AMS. The cow access was gradually decreased and the results show that the CCC system led to higher calf growth. The milk yield of cows during nursing varied a lot and increased after separation. However, the low sample size limits interpretation and generalization of the results. Similarly, Kisac et al. (2011) found that prolonged suckling resulted in a higher live weight of the calves at the age of 90 days, but reduced milk production of mothers when comparing suckling for 7 days, 14 days and 21 days. Therefore, they conclude that the farmer must decide either on 1) the higher milk production of mothers or 2) increased body weight of calves, lower consumption of milk replacer and a chance of higher milk production in adulthood.

3.3 Framework of Socioeconomic Consequences of CCC

Knierim et al. (2020) made a framework for the socioeconomic evaluation of rearing systems of dairy calves with and without cow contact. The framework shown in figure 3.3 consists of seven main categories; *income milk*, *income calves*, *other income*, *direct costs*, *labor costs*, *building costs* and *non-monetary effects*. They found a very high variation in farming systems with a similarly high number of interacting factors. Therefore, the study results vary a lot in extent and partly also in direction. However, some findings are clear, such as the reduced amount of saleable milk during the suckling period, and increased growth rates of dam rearing calves.

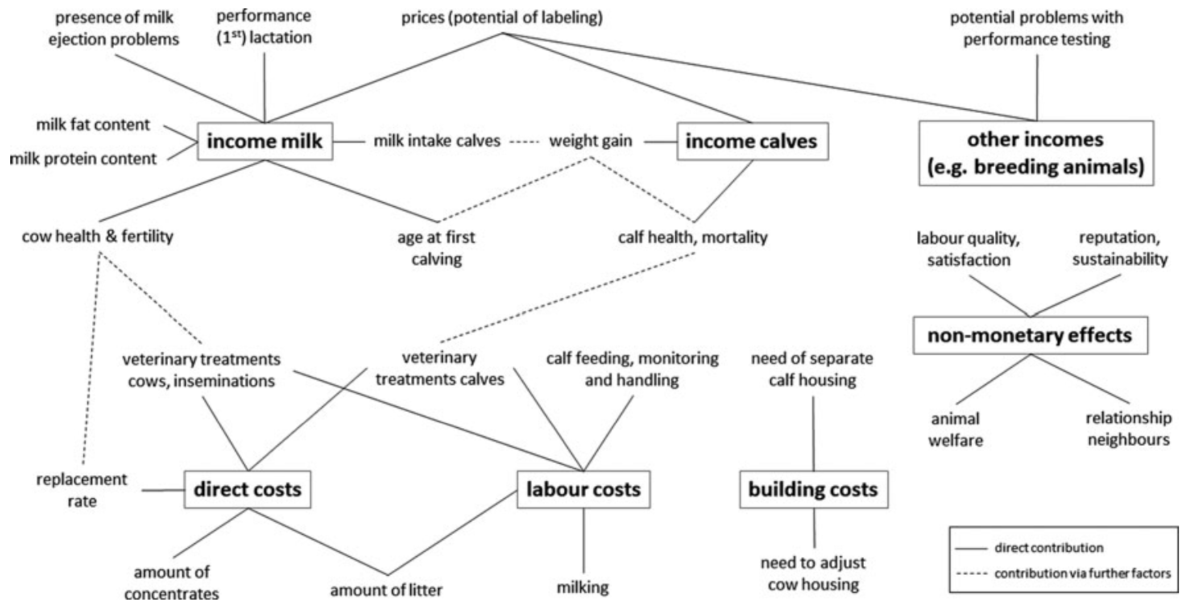

Figure 3.3: Framework for the socioeconomic evaluation of rearing systems of dairy calves with or without cow contact (Knierim et al., 2020)

Income milk is affected by a number of factors such as milk intake by calves and the quality of the milk. Milk fat- and protein content are two measures of milk quality which may cause a reduction in the price paid to the farmer, if the milk does not meet the requirements. In order to get the best possible profitability in milk production, it is important that the composition of the milk corresponds to the demand in the market. The farmer can affect the content of fat and protein in the milk in several ways, where targeted feeding is one example (TINE SA, 2022b). Thus, the farmer may increase income from milk by increasing the quality. Milk ejection problems, bad health and fertility also affect the income from milk as it can reduce the milk yield. The other important income in dairy farming is income from calves. Bull calves, which can not be dairy cows in later years, are slaughtered for veal. The better the weight gain of the calf, the faster they can be slaughtered, and the more feeding costs (and other variable costs) the farmer saves. Knierim et al. (2020) also discuss the opportunity of labeling milk from CCC-farms. The milk price could be higher if a label includes the aspect of contact between cow and calf. Unfortunately, there are very few examples of this.

The framework divides the economic costs into three main groups. Direct costs include costs for concentrates and veterinary treatments. These are assumed to be slightly reduced when practicing CCC. Labor costs are also assumed to be reduced in a CCC-driven system, but are depending a lot on the management system of the farm, including calf feeding method and milking system. CCC also requires some adjustment in the barn, which may cause increased building costs. Finally, the framework includes non-monetary effects such as labor quality, reputation and animal welfare, which must also be taken into consideration besides the financial terms.

As presented above, there are various factors to consider. However, other studies have found the most important factors when it comes to revenue efficiency. Hansen et al. (2019) performed a study to explore efficiency drivers among 212 Norwegian dairy farms. Important factors related to income from milk were found to be age of first calving and a high milk yield. Another income-related factor was quality payment, which is a payment depending on the quality of milk measured in protein and fat content, and bacteria and somatic cell counts. A relative measure of milk yield called quota filling, consisting of the yearly milk yield divided by disposable quota, was also found to be a significant efficiency driver. Associated with income calves, beef production per cow was found as the most important efficiency driver. When it comes to direct costs, main drivers were low insemination costs and a low share of concentrate out of total feed.

3.4 Farmers Perceptions of CCC and Considerations for Future Milk Production

Perceptions of CCC vary among farmers, and there is little research on the topic. Vaarst et al. (2020) performed a study based on interviews of Norwegian, French and Dutch farmers with experience in dam-rearing systems. They analyzed and discussed experiences and arguments on CCC from the perspectives of cows, calves, farmers and the management system. From the perspective of the farmer, having calm and confident animals and the beauty of seeing cow and calf together were in favor of the practice. More work, difficulties with keeping an eye on the calves (especially on pasture) and lower income from milk were disadvantages. Another study performed in Canada by Ritter et al. (2020) found that farmers generally did not see the practice of early cow-calf separation as a problem that had to be addressed in future dairy farming. Neave et al. (2022) studied New Zealand dairy farmers' perspectives on practicing cow-calf contact in a pasture based-system, and identified three major concerns. First, farmers were concerned about the animal welfare, mainly due to the risk of mastitis, risk of inadequate feeding of colostrum to the calf, increased stress at separation and lack of shelter for the calf. Second, farmers were concerned about increased labor and stress on staff. Third, required changes on the farming system, like infrastructure and herd management were also seen as barriers to adopting such a practice.

Beaver et al. (2020, p.5751) claims that "the future of dairy cattle housing requires a holistic approach that incorporates input from three key stakeholder groups: the industry, the public, and the animals themselves". Further, they argue that the long-term sustainability of the dairy industry will depend on the extent to which housing systems reflect public concerns and the animals' priorities. From the perspectives of farmers, Ritter et al. (2020) found that cow comfort, employee management, responsible health management and the use of advanced technologies were seen as future must-haves. Achieving public trust was mentioned as another important factor. When assessing animal welfare in the context of societal issues, McGlone (2001) argues that sustainable agricultural systems have to be in harmony with the animals, the workers and the community, while at the same time be efficient and economically competitive.

4 Data Material

All data material used in this thesis are obtained through the SUCCEED[6] research project, project no. 310728, funded by *Forskningsmidlene for jordbruk og matindustri (FFL/JA)*[7]. Ruralis have been responsible for the processing of personal data.

4.1 Data Collection

To meet the aim of this thesis, we need data containing information regarding financial performance at farm level, as well as dairy farmers' perceptions on the topic. Financial data is hard to obtain as most farmers are organized as one-man businesses where financial statements are usually not publicly available [8]. Therefore, our financial data is limited to survey and production data.

Dataset I contains production data from the National Dairy Herd Recording System (NDHRS) from 2019 and 2020 for 38 CCC herds matched with control herds. This dataset makes it possible to investigate whether existing CCC farmers differ from non-CCC farms. Production data contains milk production outputs such as milk delivered, milk quality and animal health measures.

Dataset II consists of data from a survey answered by Norwegian Dairy farmers in 2022. The responses are merged with descriptive information of the farm, such as herd size, quota size and management system retrieved from the NDHRS and Norwegian Agricultural Producer Register (NAPR)[9].

In addition, we have access to interview data from 13 CCC-farms, conducted by Norsøk and Ruralis as part of the SUCCEED research project in 2020-2021.

[6]Sustainable systems with cow-calf contact for higher welfare in dairy production

[7]https://www.landbruksdirektoratet.no/nb/prosjektmidler/forskningsmidlene-for-jordbruk-og-matindustri

[8]One-man businesses with assets of less than 20 MNOK and less than 20 man-years on average are not required to submit financial statements to The Brønnøysund Register Centre (Regnskapsloven, 1999)

[9]NAPR is the register of all primary producers and agricultural properties that get production subsidies in Norway

4.2 Production Data

The first dataset analyzed in this thesis includes NDHRS data on 94 herds in total, whereas 38 of these practice CCC. The herds are selected based on a survey distributed by the Norwegian Veterinary Institute in October 2020 to recruit farms practicing CCC. Thus, the data material available for matching with control herds is all herds that responded to the survey and agreed to participate and share data from the NDHRS.

To be able to investigate potential differences in performance between herds with and without CCC, the CCC herds are matched with control herds using four criteria: *county*, *barn type*, *milking system* and *herd size*. The final dataset consists of 38 CCC herds and 56 control herds. A list of variables and descriptive statistics can be found in Appendix, table A4.1.

4.3 Survey Data

The second dataset of this thesis is composed of data from a survey completed by Norwegian dairy farmers in 2022. All questions included in the survey are presented in Appendix chapter A6. The survey is designed in collaboration with TINE, Norsøk and Ruralis as part of the SUCCEED research project. The purpose of the survey is to examine Norwegian Dairy farmers' opinions and experiences when it comes to cow and calf contact, and to detect the number of farmers practicing the rearing system today. A second purpose is to investigate the farmers' barriers to implement such a practice.

A questionnaire is chosen as a collection method due to the possibility to collect larger quantities of data, and the desire for a broader focus in the research. A web questionnaire is most appropriate considering that the NAPR have emails registered for the vast majority of farmers in Norway. The questionnaire is made in the digital survey tool named SurveyXact. The survey is predetermined to be distributed through email to a subset of Norwegian Dairy farmers, and the email addresses are ordered from Landbrukets Dataflyt[10], which holds the NAPR.

995 respondents fully completed the survey, and 81 respondents partially answered. Out of these 81 respondents, only 43 responded to a sufficiently large number of questions.

[10]https://www2.landbruketsdataflyt.no/

The response rate is calculated to 38.4%. Details regarding distribution of respondents can be found in the Appendix section A2.

4.3.1 Survey Design

Questions are developed based on in-depth interviews conducted by the SUCCEED research project in the winter of 2020/2021 (Johanssen and Sørheim, 2021). The questionnaire includes a variation of question types. The first part of the survey consists of relevant background questions such as gender, age, education and management system. A logical order and simple questions in the beginning are emphasized to prevent the respondents from leaving the survey at the outset. Following the background questions, respondents are asked about financial performance in 2021. This part includes questions about revenue, past and future investments and working hours. The third part of the survey contains statements about rearing systems and other factors related to being a dairy farmer, such as values and beliefs. Through a question about current practice the respondents are redirected to different sets of questions based on the practice of the farm. Since the aim of the research is to investigate CCC, farmers that keep cow and calf together for more than 14 days are asked questions about needed adjustments, investments and consequences of having CCC. The respondents who are not practicing CCC receive statements to uncover attitudes and barriers, but also questions about what potential adjustments and investments if CCC for more than 14 days had become a regulatory requirement.

All statements have seven possible answers, using Likert scales ranging from 1-7, with 1 = Strongly disagree to 7 = Strongly agree or 1 = Not important to 7 = Very important. The seven-point scale is chosen out of consideration for the respondents and their ability to respond. It is important to have enough points to separate the respondents' answers, while more than seven possible answers may increase the chance of getting arbitrary answers, resulting in poorer data quality (Kho, 2018). List and category questions (Saunders et al., 2019) are frequently used on remaining questions, in addition to a small number of open questions. A comment box is included at the end of the survey to let respondents add their additional comments to the topic. This gives the respondent the opportunity to elaborate and explain their answers, which can make valuable contributions for the researchers to understand the topic.

To refine the questionnaire and to assess the questions' validity and the likely reliability (Saunders et al., 2019), the survey is pilot tested on dairy farmers and others with farm experience. The pilot testers ensured that the questions were understandable, with meaningful answer alternatives, in addition to assessing whether the questions were possible to answer for a farmer. The pilot testers also contributed with time estimates for how long the questionnaire took to complete.

4.3.2 Sampling

The sampling frame encompasses Norwegian dairy farmers that are listed in the NAPR. We choose to exclude farmers registered with less than 10 dairy cows and less than five acres of land. This selection is due to the target group of this study being dairy farmers engaged in milk production for a living, and not those who engage in milk production only for private consumption or small niche production. These run their farm on a different basis and are therefore considered irrelevant cases in this study. After the initial adjustments the sampling frame consists of 6 486 Norwegian dairy farmers.

Based on initial surveys within the SUCCEED research project, females and organic farmers seem to be overrepresented among dairy farmers practicing cow-calf contact. Therefore, with one of the main objectives being investigating the consequences of CCC it is desirable to ensure that females and organic farmers are represented proportionally within the selected sample. Stratified random sampling with proportional allocation is a technique that can be used in such cases. Stratified sample can be defined as "A probability sample in which population units are partitioned into strata, and then a probability sample of units is taken from each stratum" (Lohr, 2022, p. 65). Stratification often increases precision, as elements in the same stratum tend to be more similar than randomly selected elements from the whole population (Lohr, 2022). Three relevant characteristics are chosen for this sample: 1) county, to ensure a fair geographical distribution of the sample, 2) females and 3) organic farmers, to ensure that a corresponding proportion to the total population of these two groups are given a chance to answer the survey. Thus, each county will contain four different strata: female or male, combined with organic or conventional as shown below. For instance, in county 1 (Rogaland) we have:

n_{1mo} Rogaland - male - organic

n_{1fo} Rogaland - female - organic

n_{1mc} Rogaland - male - conventional

n_{1fc} Rogaland - female - conventional

As there are ten counties (Oslo is excluded), the sample will be divided into 40 different strata in total. The stratified sampling is conducted by randomly selecting units within each county, according to the correct proportion of each stratum which can be found in Appendix section A1.

When choosing the sample size, we must consider 1) the confidence we need to have in our data, 2) the margin of error that we can tolerate, 3) the types of analyses we are going to undertake, and 4) the size of the target population (Saunders et al., 2019, p. 279). In business research, a confidence level of 5 percent is often considered sufficient, and the margin of error is normally set to 3 percent (Saunders et al., 2019; Lohr, 2022).

Given the above mentioned precision criteria, the minimum required sample size is 1 067 for any large population (see appendix section A1 for further calculations). Taking the total population size (6 486) into account, the sample can be reduced to 917. Further, as we know, stratified random samples tend to have lower variance than a simple random sample. This means that the minimum sample size required to reach the desired precision is probably even lower than our estimates. However, as we are collecting data through a survey, the sample size is highly dependent on the response rate. Thus, we choose to set the minimum sample size to 1 067 when estimating the actual sample size required. Earlier surveys have obtained response rates ranging from 38 to 42 percent (Hårstad, 2019; Zahl-Thanem and Melås, 2020; Zahl-Thanem et al., 2018). We expect the response rate of this survey to be similar, and estimate our response rate to be 40 percent. We have:

$$n_{actual} = \frac{n}{re\%} = \frac{1067}{0.40} = 2\ 668 \approx 2\ 700$$

where n_{actual} is the actual sample size required, n is the minimum sample size and re% is the estimated response rate expressed as a percentage (Saunders et al., 2019). Thus, the actual sample size required is 2 700, which is the number of farmers that will receive the survey.

4.4 Preparing of the Datasets

Dataset I with herd record data is collected and matched by researchers in the SUCCEED project. Thus, little preparation is required. However, to be able to conduct the regression analysis, smaller adjustments are needed. For instance, some of the variables are measured at different scales and do not contribute equally to the analysis. This can cause biased estimates. Thus the variables are standardized using the scale()-function in R. The dataset also has some incomplete cases ($n = 16$) which are deleted. The number of complete observations are 94, comprising 38 CCC herds and 56 control herds.

Dataset II with survey data from 1 038 respondents are merged with data from the NDHRS and the NAPR of all primary producers and agricultural properties in Norway. Additional variables are also created. An important factor for evaluating revenue efficiency in dairy production is quota filling (Hansen et al., 2019), which is not included in the dataset originally. Therefore, a new variable called quota filling is created using quota and volume for 2021.

A number of recodings are also required in the survey data prior to the analysis. First, responses with "Don't know" are coded as item non-response (N/A). Item non-response occurs when some measurements are present for the observation unit, but at least one item is missing (Lohr, 2022). A number of statement variables are reverse coded. Reverse coding is necessary for negatively worded questionnaire items to ensure that high values became positive for all items (Saunders et al., 2019). Statements that refer to barriers are reversed such that the higher value indicates lower barriers. Further, a number of categorical variables are recoded as dichotomous variables. A dichotomous variable is a variable taking only two values, and can be created from categorical variables by separating values based on some criteria (Saunders et al., 2019). For instance, the background variable that concerns whether farms operate with "conventional", "organic" or "under conversion" is recoded to a dichotomous variable, taking 1 if the farm is organic, and 0 otherwise.

5 Statistical Methods

5.1 Lasso Regression

The production data in dataset I includes a large number of variables/predictors (p=26) and a relatively small number of observations (n=94). In cases with a high number of variables, shrinkage methods can be helpful by identifying a smaller subset of the most important predictors (Hastie et al., 2015). Therefore, this thesis will apply shrinkage methods for the regression analysis. The idea of shrinkage methods is to remove "variables that are of little use to predict or explain variation in the response variable" (Hansen, 2020, p.15). A common method for shrinkage is *the lasso*, which will be explained below.

Lasso is an extension of linear regression with the OLS estimator (James et al., 2013). First, we present the OLS estimator which is obtained by minimizing the residual sum of squares (RSS)

$$Minimize : RSS = \sum_{i=1}^{n}(y_i - \beta_0 - \sum_{i=1}^{n} \beta_j x_{ij})^2 \tag{5.1}$$

Where y_i is the response variable, or dependent variable with n observations, and x_{ij} is the independent variables or predictors with the value, j, according to the ith value of y. β_0 represent the intercept and β_j are the coefficients, which are set to minimize the RSS.

Lasso regression estimator adds a penalty term at the end:

$$Minimize : RSS + \lambda \sum_{j=1}^{p} |\beta_j| \tag{5.2}$$

The difference between the OLS and lasso lies in the second term, $\lambda \sum_{j=1}^{p} |\beta_j|$, which is called a *shrinkage penalty* and has the effect of shrinking the estimates of the β_j (James et al., 2013). The lambda determines the amount of shrinkage, and $\lambda = 0$ yields the OLS estimate (Hansen, 2020). Selecting a good value for λ is critical, and cross-validation provides a simple way of solving this. When the λ is sufficiently large, the lasso penalty will force some of the coefficient estimates β to be equal to zero and thus omit variables that are highly correlated. This means that the lasso performs variable selection (James et al., 2013).

Lasso is also a statistical learning method. The basic goal is to train a model on a subset of the data to obtain the best possible estimate of the relationship between the response variable and the explanatory variables (James et al., 2013). To estimate the goodness of fit, we use the predict()-function in R which finds the probability of the model making the correct classification. Lasso has one main limitation. If there exists high pairwise correlations, the lasso tends to arbitrarily select one of them (Zou and Hastie, 2005). This can cause influential variables to be excluded from the regression model, which is important to bear in mind when interpreting the results.

5.2 Handling Missing Data

The survey data (Dataset II) has some missing data due to item non-response. The distribution of missing data can be found in Appendix section A3. When cases have missing data, there are certain alternative ways to solve the problem. The preferred approach depends on the types of missing data, and we usually consider three types (Lohr, 2022, p.321):

The first type is *Missing Completely at Random (MCAR)*. If the probability of not responding is not depending on any other variables of the dataset or the survey design, the non-responses are MCAR. The second type is *Missing at Random Given Covariates (MAR)* or missing conditionally at random. If the probability of responding depends on other observed variables (x_i) in the dataset, but not on the missing data variable itself (y_i), the data are MAR. The third type of missing data is *Missing Not at Random (MNAR)*. If the probability of responding depends on the missing value data themselves (y_i), which is (obviously) unobserved for non-respondents, the non-response is not missing at random. Determining the type of missing data can be difficult and one can not know for sure whether the missing values are MCAR, MAR or MNAR (Lohr, 2022). In general, MAR is a more realistic assumption than MCAR (Lohr, 2022; Van Buuren, 2018). The researchers have found that some of the non-responses are related to other variables in the dataset, and non-responses are not considered to be related to the unobserved variable itself. Therefore, missing data are assumed to be MAR.

A frequently used method to handle missing data is listwise deletion, where only the complete cases are used for analyses (Kang, 2013). The use of listwise deletion in a dataset with many variables can dramatically reduce the total sample size (Baraldi and Enders, 2010), and can give biased estimates if the missing data are not MCAR (Jöreskog et al., 2016). As MCAR is often an unreasonable assumption in research, listwise deletion is typically not recommended (Kang, 2013). Studies have shown that when more than 10-15% of the data is missing, multiple imputation methods and maximum likelihood (ML) methods outperforms other methods (Watkins, 2018; Kang, 2013). In multiple imputation, missing values are substituted with an estimated value (Kang, 2013).

Given that the data are MAR, and the proportion of missing data is 10% or more, using a multiple imputation or ML estimation method is recommended (Baraldi and Enders, 2010; Buuren and Groothuis-Oudshoorn, 2011). In this case, where missing data is present in more than one variable, a multivariate imputation method is appropriate (Buuren and Groothuis-Oudshoorn, 2011). However, several methods may give good results, thus this thesis will test both a ML estimation method, named *Full Information Maximum Likelihood (FIML)* and a Multiple Imputation (MI) method, named *Multivariate Imputation by Chained Equations (MICE).*

FIML "is a type of Maximum Likelihood (ML) parameter estimation technique" (Beaujean, 2014, p.119). FIML finds the most likely parameter estimates for each observation, while the final parameter estimates are the ones that are most likely across all observations. Since FIML uses information from each observation, data do not need to be removed if it includes missing values (Beaujean, 2014).

MICE is an effective tool to deal with missing data (Wulff and Ejlskov, 2017). The method "fills in" missing values in the dataset through an iterative process. Each specified variable in the dataset is imputed using the other variables in the dataset. MICE provides flexibility and makes it possible to impute hundreds of variables in a dataset (Wulff and Ejlskov, 2017). As with other methods, MICE also has some drawbacks. Various researchers emphasize the disadvantage that MICE does not have the same theoretical justification as other imputation approaches (Wulff and Ejlskov, 2017; Azur et al., 2011). However, in practice, this does not seem to be an issue according to White et al. (2011). Other drawbacks only point to multiple imputation methods in general. One of them is the challenge of choosing an appropriate imputation model (Wulff and Ejlskov, 2017).

Even though FIML and MICE have some drawbacks, the traditional deletion methods give more disadvantages. Both FIML and MICE are tested on the dataset, which gave similar results. Due to technical advantages in R, MICE is used as the imputation method.

5.3 Exploratory Factor Analysis

To provide a better understanding of the perceived barriers of livestock producers, Weary et al. (2015) recommends applying social science research. Further, the dataset from the survey contains a high number of variables, from many similar questions. Thus, it is likely that some of the variables measure the same underlying construct. To analyze this, factor analysis can be applied. Factor analysis is a procedure used to identify the interrelationships among a large set of observed variables and divides these variables into a set of dimensions or *factors* that have common characteristics (Pett et al., 2003). Pett et al. (2003, p.2-3) explains a factor as "a linear combination or cluster of related observed variables that represents a specific underlying dimension of a construct, which is as distinct as possible from the other factors included in the solution."

The linear combination can be expressed as (Jöreskog et al., 2016, p.259):

$$x_i = \lambda_{i1}\ F_1 + \lambda_{i2}\ F_2 + \ \lambda_{ik}\ + \ldots + F_k + \delta_i\ \ ,\ i = 1, 2, \ldots,\ p \tag{5.3}$$

Where, x_i = the item or observed variable i,

$F_{1,2,\ldots,k}$ = the underlying latent factor 1, 2, ..., k

λ_{ik} = factor loading of item i on factor 1, 2, ..., k

δ_i = the unique part of item x_i, uncorrelated with F_1, F_2, ..., F_k

Exploratory Factor Analysis (EFA) is used when the researcher has limited knowledge about the construct of interest and does not know how many factors are necessary to explain the interrelationships between the set of variables (Pett et al., 2003, p.3). In contrast, *Confirmatory Factor Analysis (CFA)* is used when hypotheses of the underlying structure of the construct are present, and the techniques of factor analysis is applied to assess how the hypothesized set of factors fits the data (Pett et al., 2003, p.4). This thesis will use the EFA approach, followed by CFA in the SEM.

The initial step of an EFA is to present a Pearson correlation matrix of the relevant variables. There should be sufficiently strong correlations among the items, where a substantial number of correlations should exceed ±0.30 for EFA to be appropriate (Hair et al., 2010). The factorability of the correlation matrix should also be measured through statistical tests. Bartlett's test for sphericity should result in a statistically significant chi-square value (Watkins, 2018). For large sample sizes, results from the Bartlett's test should be complemented with the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy, preferably with at $KMO \geq 0.70$ (Watkins, 2018).

For the factor extraction, there are two main methods: principal components analysis and common factor analysis. Principal component analysis assumes that all of the variance in an item can be explained by the extracted factors, while common factor analysis extracts factors only based on the variance that the variables have in common (Pett et al., 2003). Both methods have their advantages and disadvantages, and both will be tested in this analysis.

The second step of the EFA is to determine how many factors to retain from the analysis. There is no unique way to do this, but methods can be used to give an indication (Jöreskog et al., 2016). Two common methods are the Kaiser rule that tells to extract the number of factors with an eigenvalue greater than one, and a scree plot where eigenvalues are plotted by rank and the number of factors to retain are indicated by a sharp bend on the curve (Jöreskog et al., 2016).

Initial results from an EFA are often difficult to interpret. Therefore, it is common to rotate the factors (Hair et al., 2010). There are two common methods of rotating the factors: oblique and orthogonal rotation. This analysis will use oblique rotation. As it allows correlation between the factors, it is usually the preferred technique (Watkins, 2018).

When the factors are rotated, the results must be evaluated and interpreted, and the factors refined if necessary. This stage requires a combination of applying objective criteria with subjective judgements. Objective criteria to follow are that factor loadings should be greater than 0.3, and preferably greater than 0.4. Furthermore, each variable should load substantially on only one factor (Hair et al., 2010). Finally, each factor should have at least three items (Fabrigar et al., 1999). In the subjective judgment, the researcher must evaluate each factor with regards to the conceptual foundation of the analysis, and ensure that factors are theoretically meaningful (Hair et al., 2010).

5.4 Structural Equation Modeling

The factors identified through the EFA can be used as predictors or outcome variables in further analysis, which is the goal of SEM (Jöreskog et al., 2016). "SEM uses various types of models to depict relationships among variables, with the same basic goal of providing a quantitative test of a theoretical model hypothesized by the researcher" (Schumacker and Lomax, 2010, p.2). SEM consists of two parts: the structural model and the latent variable model. The structural model identifies a regression-like relationship among the variables, while the latent variable model (LVM) forms the latent variables used in the structural model. The latter is also called CFA, whereas the factor in the factor analysis is synonymous with a latent variable (Beaujean, 2014).

To estimate the model, one can use several estimation methods. Since the SEM model includes ordinal data from the questionnaire, Diagonally Weighted Least Squares (DWLS) is chosen. DWLS has given good results in previous research and has become popular for factor analysis of ordinal data (Koğar and Koğar, 2015).

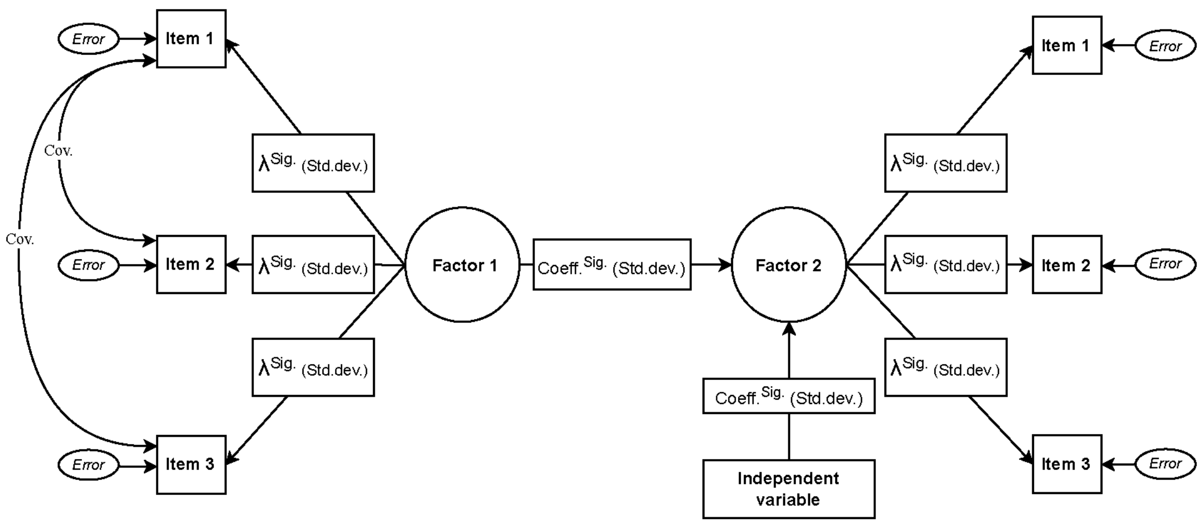

Figure 5.1: SEM Path diagram

Figure 5.1 shows a schematic representation of the SEM-model which is called a path diagram (Byrne, 2016). The rectangular boxes furthest to the left and right hand side of the figure represents observed variables which are part of a factor, also called items, while the circular boxes illustrate the latent variables, also called factors. The relationships between them are illustrated by single-headed arrows, whereas the double-headed arrows indicate covariances between variables (Beaujean, 2014), shown at the left hand side of the model. Observed variables that are not part of a factor, are presented as rectangular boxes named "independent variables". These are directly affecting a factor, illustrated by a one-headed arrow pointing towards the factor. The boxes between the items and factors, show the factor loadings, λ, with corresponding significance level and standard deviations. The boxes between the factors show coefficients with corresponding significance level and standard deviations. This also applies for the boxes between factors and independent variables. Measurement errors in observed variables are shown as circular boxes named "error".

To test how well the model reflects the underlying data, one has to study the model fit. There are many indices measuring model fit, both absolute and incremental (comparable) fit indices, all with their advantages and disadvantages. Therefore, it is reasonable to consider several measures before concluding about the model fit. Four widely respected and reported fit indices include Chi-Square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA) (Hooper et al., 2008). Details can be found in Appendix A5.

Due to the complexity of SEM, "it is not uncommon to find that the fit of a proposed model is poor" (Hooper et al., 2008, p.56). A way to improve the model is to allow for correlation of error terms. (Hooper et al., 2008). However, this should not be used with the only purpose of increasing the model fit and every correlation between error terms must be substantiated by theory (Jöreskog et al., 2016).

6 Empirical Results

This chapter will present the results from the analyzes, as well as a discussion about the findings. Firstly, results and discussion related to socioeconomic consequences of CCC will be presented, followed by a section about the barriers to implement the CCC-practice. Finally, implications of the findings, limitations and future research suggestions are discussed.

6.1 Prevalence of CCC and the General Economic Condition in Dairy Farming

To get an overview of the population, the prevalence of practicing CCC among Norwegian dairy farmers is estimated. CCC is in our study defined as keeping cow and calf together for more than 14 days, and there are 31 such farmers in our sample. To estimate the total number of population units having a specified characteristic in a stratified sample, the following formula can be used (Lohr, 2022, p.84-86):

$$\hat{t}_{str} = \sum_{h=1}^{H} N_h \hat{p}_h \tag{6.1}$$

Where $\hat{t}_{str}$ is the estimated population total for all strata, N_h is the number of population units in stratum h and $\hat{p}_h$ is the sample mean in stratum h. Substituting the number of population units for each of the 40 stratum, and the sample mean of CCC-farmers in each stratum according to the above formula, we have:

$$\hat{t}_{str} = \sum_{h=1}^{40} N_h \hat{p}_h = 179.2, \tag{6.2}$$

which implies that there are about 179 farmers practicing CCC in Norway. The overall population mean $\bar{y}_U$ is then calculated by dividing by the total population of dairy farmers:

$$\bar{y}_U = \frac{\hat{t}_{str}}{N} = \frac{179.2}{6485} = 2.76\% \tag{6.3}$$

Thus, the estimated proportion of dairy farmers practicing CCC in Norway is 2.76%. However, this proportion may be overestimated, as it is likely that a higher share of CCC farmers have responded to the survey, due to greater interest in the topic. Another indication of the excessively high estimate is that females are overrepresented in the sample, and the results also indicate that there is a higher share of female farmers practicing CCC. Overestimated or not, the prevalence of the practice among Norwegian farmers is considered small.

Further, it is interesting to investigate how many dairy farmers are considering implementing the CCC-practice. The proportion is estimated using the formulas outlined above,

$$\hat{t}_{str} = \sum_{h=1}^{40} N_h \hat{p}_h = 990.9, \tag{6.4}$$

$$\bar{y}_U = \frac{\hat{t}_{str}}{N} = \frac{990.9}{6485} = 15.3\% \tag{6.5}$$

The calculations indicate that there are 991 Norwegian dairy farmers (15.3%) wishing to implement the practice. Compared with the number of farmers practicing CCC today (179), one sees a notable difference. This may indicate that there are considerable barriers to implementing the practice. However, as with the proportion of CCC-farmers above, this number may also be overestimated. Nevertheless, it seems that there are more farmers wishing to keep cow and calf together than there are CCC-farmers today.

The survey also asked about past and future financial performance, as shown in figure 6.1. The results show that the majority of the farmers have experienced a negative change in financial performance the last five years, indicating that the economy of the dairy industry may be in a bad state. However, beliefs on the future suggest more optimism.

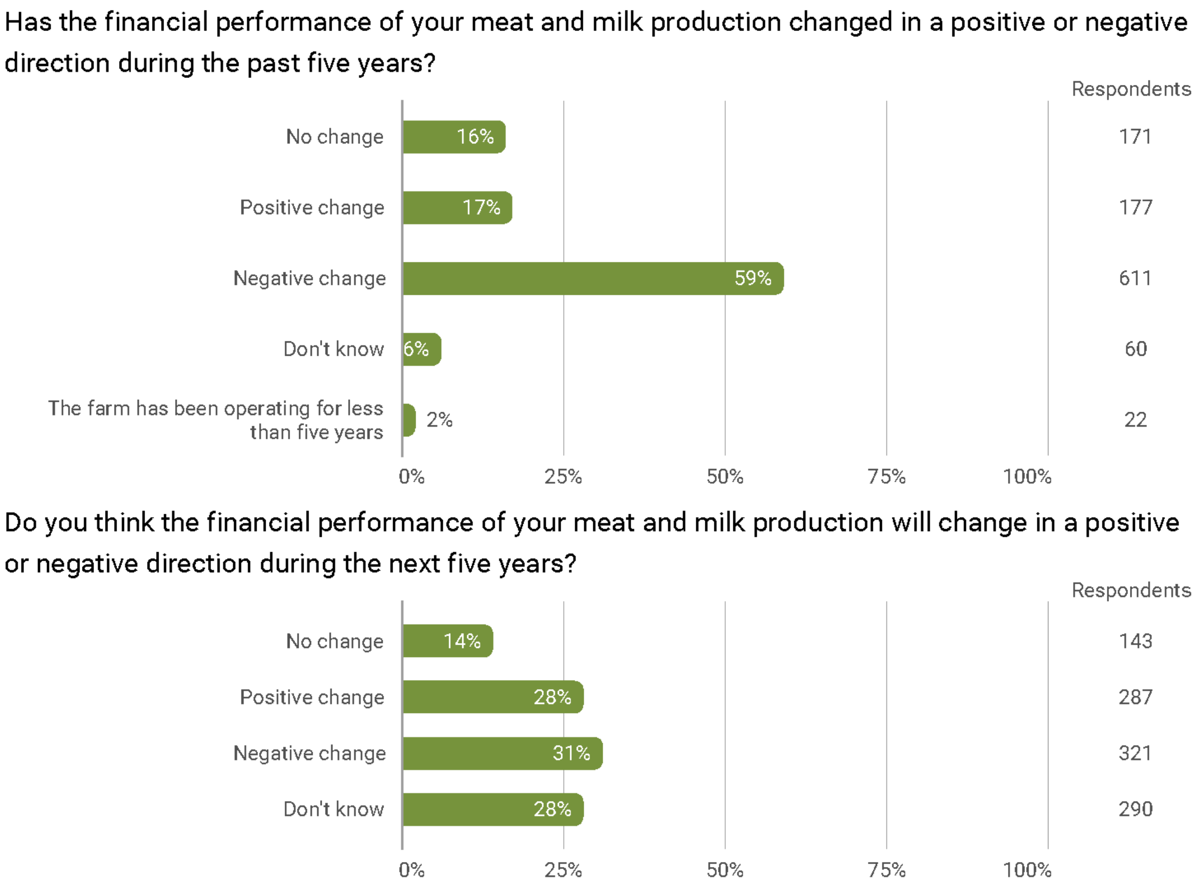

Figure 6.1: Past and future financial performance

6.2 Economic Consequences of CCC

The farmers practicing CCC (N=31) reported the following investments and adjustments, shown in figure 6.2.

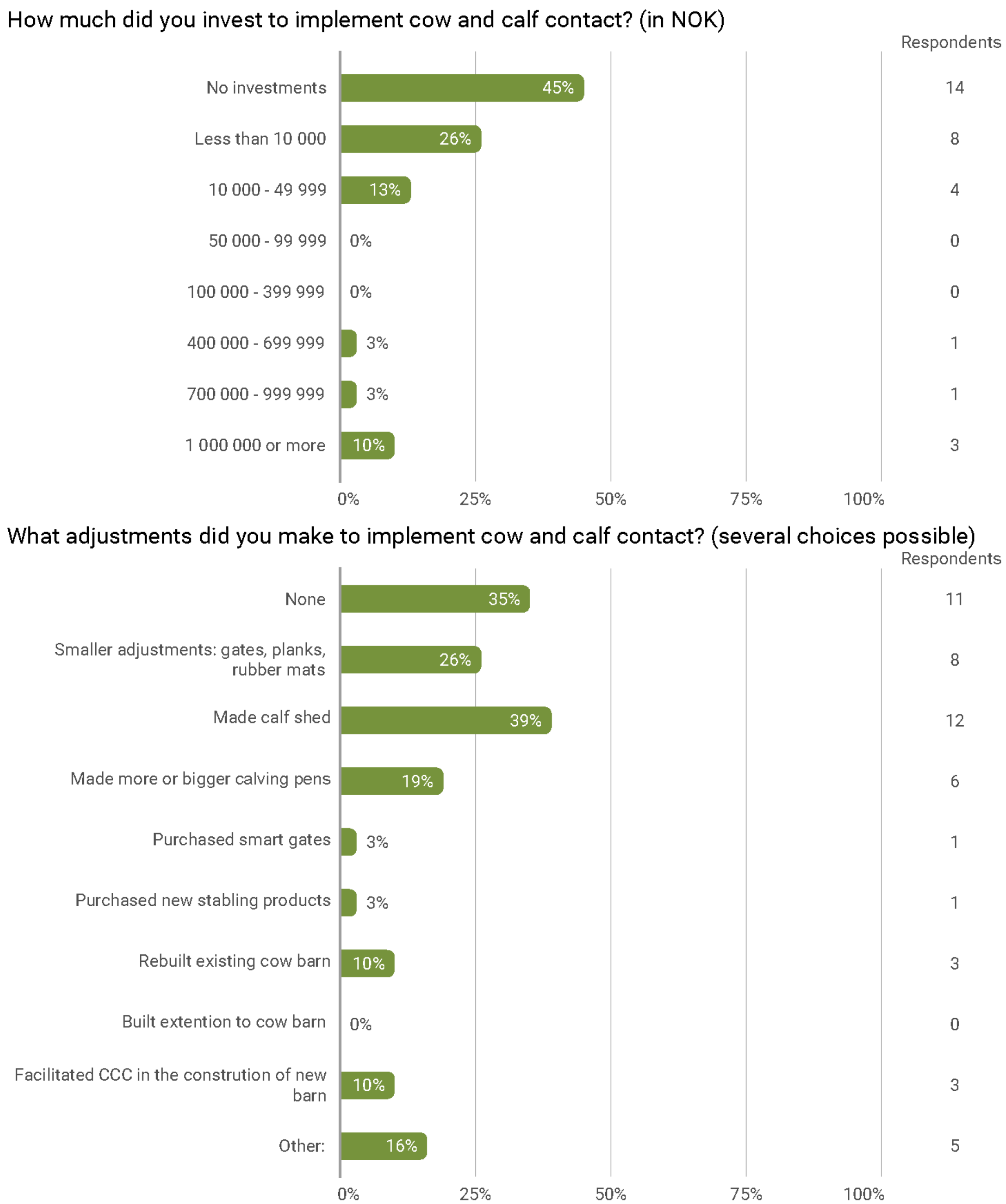

Figure 6.2: Farmers' reported investments and adjustments (N=31)

The first part of the figure shows the amount invested by the farmers to facilitate CCC. 45% of the farmers reported that they made no investments to implement cow and calf contact, while a few invested significantly more. This is related to the second part of the figure, which shows a few farmers that have rebuilt existing cow barn or facilitated CCC in the construction of a new barn. The most common adjustments are making calf shed, buying extra gates and establishing more calving pens. These are adaptations that cost little or nothing in most barns. The category "other" includes a comment box where the farmers have elaborated on the adjustments needed. One farmer switched to summer-calving outside, while another made adjustments in the barn using existing materials.

The farmers practicing CCC (N=31) also reported the following experienced consequences related to financial performance and work situation, shown in table 6.1 and 6.2

Table 6.1: Farmers' self-reported economic consequences of implementing CCC

Statistic	N	Mean	St. Dev.	Min	Median	Max
Increased calf growth (+)	30	6.43	1.22	1	7	7
Better calf health (+)	29	5.75	1.88	1	7	7
Decreased workload (+)	28	5.61	1.77	1	6	7
Unchanged or increased cow fertility (+)	26	5.50	1.94	1	6.5	7
Better cow health (+)	24	4.67	2.16	1	5	7
Lower quota filling (-)	27	5.07	1.86	1	5	7
Decreased income milk (-)	27	5.00	1.80	1	6	7
More dairy cows needed to fill quota (-)	26	4.92	2.04	1	5.5	7
Increased space requirement in barn (-)	28	3.86	1.96	1	4.5	7

The variables are measured on a scale from 1 to 7, where 1 is "Not at all" and 7 is "To a large extent". The upper part includes positive consequences of CCC, whereas the lower part are negative consequences. The most important positive consequences of CCC seem to be increased calf growth and better calf health, with a median answer of 7 and a mean of 6.43 and 5.75, respectively. The results also indicate consensus when it comes to decreased workload and unchanged or increased cow fertility. The latter can be interpreted in the following way: score 7 indicates that the farmer has experienced either no change or increased fertility, whereas score 1 indicates much worse cow fertility due to cow and calf contact. The main negative economic consequences are lower quota filling and decreased income from milk.

Table 6.2: Farmers' self-reported non-monetary consequences of implementing CCC

Statistic	N	Mean	St. Dev.	Min	Median	Max
Increased farmer wellbeing (+)	29	5.86	1.51	2	6	7
Better behavior of calf (+)	30	5.53	1.72	1	6	7
Increased workday flexibility (+)	29	4.97	1.96	1	6	7
Increased separation stress (-)	30	4.57	2.00	1	5	7
More accidents or reduced safety (-)	28	1.79	1.66	1	1	7

Most important positive non-monetary consequence of CCC is increased farmer wellbeing. When it comes to negative non-monetary consequences, several report separation stress to be a problem, while almost none have experienced more accidents or reduced safety due to CCC.

6.2.1 Lasso Regression

To investigate how the production of dairy farms practicing CCC differ from farms not allowing contact between cow and calf, a lasso regression is performed on the production data. The optimal lambda (0.1120) is found using cross-validation. All data are from 2019 unless otherwise specified.

Table 6.3: Results from the Lasso Regression (N=94)

Variable	**Beta**
Milk quota 2019	.
Birth year	0.004
Female	-0.070
Organic farm	0.299
Loose housing	.
Automatic milking system (AMS)	.
Production regions	.
Milk measurement controls	.
Number of milk samples for analysis	.
Approved for NDHRS	.
Kg milk per cow	.
Kg energy-corrected milk per cow	.
Number of dairy cows	.
Kg concentrates	.
KG other fodder	.
Cow fertility (FS index)	.
Age of first calving	.
Milk protein content	.
Milk fat content	.
Milk delivered	.
Quota filling	-0.128
Milk delivered 2020	.
Milk quota 2020	.
Delivery percentage 2020	.

The lasso performs variable selection, and thus indicates which variables are the most important for classifying whether a farmer practices CCC. The lasso model selects the variables *birth year*, *gender*, *organic farm* and *quota filling*. The magnitude of the coefficients indicates that being a male lowers the probability of being a CCC farmer, while being an organic farmer and being younger increases the probability of being a CCC farmer. When it comes to production related parameters, the results indicate that a higher quota filling lowers the probability of being a CCC farmer. In other words, the results imply that farmers practicing CCC will have a lower quota filling than a farmer not practicing CCC.

Using the predict()-function in R, we find that the estimated lasso model will correctly classify the observations (CCC or not) in 69.1% of the cases. It should be noted that the lasso regression is performed on a relatively small dataset. The lasso regression model, being a statistical learning method, is supposed to be trained on a subset of the data for obtaining the best possible estimate (James et al., 2013). Due to the limited number of observations, we are not able to run the model on a separate test set, which can cause the model fit to look better than what it actually is.

Based on both former studies and the survey performed in this thesis, one could expect that the lasso would have selected more than one variable measuring production outcomes. Findings show that keeping cow and calf together tend to reduce the amount of saleable milk per cow (KgMilk & KgEKM) (Meagher et al., 2019; Johnsen et al., 2021; Kisac et al., 2011; Broucek et al., 2020). These variables are not selected as important predictors in the lasso regression. A potential explanation could be the limited sample size. It could also be that quota filling is highly correlated with the two variables, causing the lasso penalty to omit them from the analyses. However, the correlation between quota filling and KgECM/KgMilk is 0.21, which is considered a low correlation. Thus, it is not likely to be the case here. Another limitation of the analysis is that the dataset is missing some production variables that could potentially be important predictors, such as the growth rate of calves. Thus, the results are not to be interpreted as a complete list of production variables predicting differences of rearing calves with their dam or not, but limited to the variables accessed through the dataset.

As quota filling is chosen as an important classifier in the lasso regression, we calculate the difference in quota filling between the two groups.

Table 6.4: Quota filling for CCC and non CCC -farms in 2019

CCC	N	Mean	St. Dev.	Min	Median	Max
CCC	38	0.903	0.120	0.556	0.941	1.071
Non CCC	56	0.937	0.099	0.580	0.964	1.073

The estimated difference in quota filling is 0.034 (=0.903-0.937). Given a total milk quota of 242 842 L, which is the mean of the sample and equivalent to a herd size of 30 dairy cows, the estimated loss in liters of milk per year is:

$$242\,842 * 0.034 = 8\,256.62 \text{ L},$$

which is approximately the yearly production of one dairy cow.

The loss in income per year can be estimated using the average income from milk subtracted costs of fodder per liter of milk, which is 3.37 NOK.

$$8256.62 \text{ L} * 3.37 \text{ NOK/L} = 27\ 822 \text{ NOK}.$$

This is the estimated difference in income after forage costs between a CCC farmer to a non-CCC farmer with the same herd and quota size.

The loss in milk yield of 8 256 L due to CCC can be interpreted as follows: With a herd size of 30 cows, practicing CCC will require one additional dairy cow in order to reach the same quota filling as a farm without CCC. Therefore, another way of estimating the loss associated with a lower quota filling, is to calculate the costs of having an additional dairy cow to fill the quota.

Variable costs per cow	27 029 NOK[11]
- Subsidies per cow	3 282 NOK[12]
- Value per calf	2 000 NOK[13]
= Net costs for one additional cow	21 747 NOK

Having one extra cow will lead to an increase of costs estimated to 27 029 NOK. Additionally, the farmer will receive extra subsidies and get an extra calf, which increases income with 5 282 NOK in total. Thus, a CCC-farmer with an average quota and herd size, will have to spend 21 747 NOK to reach the same quota filling as a non-CCC farmer. Additionally, an extra cow will require more space in the cow barn, which alternatively could have been used for other purposes. Due to limited data material, this analysis does not estimate potential positive economic consequences of CCC, which may reduce the net costs for an additional cow.

One of the most common positive consequences of CCC is increased calf growth. According to Grøndahl et al. (2007), mean daily growth rate is 1.2kg for calves allowed natural suckling up to 6-8 weeks of age. The average growth rate for calves with bucket feeding is 0.70-0.98 kg per day (Overrein et al., 2021). From an economic perspective, increased calf growth is beneficial. When calves have a higher growth rate, they can be slaughtered or inseminated at a lower age. Further, this analysis lack data on costs that can potentially

[11] Average variable cost from "TINE Mjølkonomi" of the financial year 2020 (B.G. Hansen - TINE SA, personal communication, May 13, 2022)

[12] Subsidies per cow by herd size between 15 and 30 cows in 2020 (Regjeringen, 2022)

[13] Sale of calves as livestock (E. Kluften - Nortura, personal communication, May 21, 2022)

be reduced due to practicing CCC, such as insemination costs and veterinary costs.

6.2.2 The Socioeconomic Consequences of Practicing CCC

The discussion of the presented results on economic consequences of CCC will be based on the framework by Knierim et al. (2020) presented in chapter 3.

Income milk

Our results indicate that CCC leads to a decreased income from milk, with an average answer of 5 and a median answer of 6, on a scale from 1 to 7, where 7 is "to a large extent". This is consistent with Knierim et al. (2020)s findings. Decreased income from milk is the most clear effect of CCC, since the calf drinks more milk when getting free access.

Due to decreased income from milk, which comes from less milk sold to dairy, an expected effect on CCC is lower quota filling. However, many farmers practicing CCC solve this by having an additional cow to compensate for the "lost milk". This may be the reason for the results showing a high degree of agreement on lower quota filling, but not a consensus. Nevertheless, a median answer of 5 out of 7 indicates that most dairy farmers practicing CCC experience a lower quota filling after implementing CCC. A study by Hansen et al. (2019) found that quota filling is an important driver of revenue efficiency in dairy farms, and that highly revenue efficient farms had a significantly higher quota filling than less revenue efficient farms. Thus, given that practicing CCC leads to a lower quota filling, the practice could have negative implications on the financial performance of the farm, estimated to a loss in milk income at 3.4% of the total milk quota. Knierim et al. (2020) also presents another potential of obtaining a higher milk price by labeling milk from cows with calf contact. This factor is not analyzed in this study. Currently, there are few examples of this type of labeling.

Income calves

Income from milk production does not only consist of milk sold to dairy, but also includes income from meat. When the cow gives birth to a male calf, the calf is sold for veal, usually slaughtered at 15-18 months of age (TYR, 2022). Increased calf growth is a positive consequence of CCC which leads to higher calves weights at weaning and later on (Knierim et al., 2020). Knierim et al. (2020) also claims this to be the most constant effect on CCC. The results from the survey show a clear agreement on this question, with a median answer of 7 and a mean of 6.43. The agreement is also present on the question about better calf health with a median of 7 and a mean of 5.61. From an economic point of view, better calf heath will reduce veterinary costs, as well as increasing the butcher price due to better quality of the animal. Increased calf growth also provides the opportunity to slaughter earlier, which provides savings in feed.

Direct costs

Knierim et al. (2020) found the advantage of increased cow health and fertility among cows that are allowed to spend time with their calves. The results from the survey also show an agreement among farmers who practice CCC about an unchanged or increased fertility on cows, but the question about better cow health is not that clear. On a scale from 1 to 7, the majority answer on the right hand side of the scale, with a median of 6.5 on cow fertility and a median of 5 on better cow health. Related to cow health, a widely used argument against CCC is the possibility of increased incidences of mastitis and the possibility for the calf to suckle other cows than the mother, leading to spread of mastitis. However, most of the farmers interviewed in the SUCCEED project experienced reduced veterinary costs and no mastitis problems. Increased fertility may lead to lower feeding costs per kilogram milk produced and lower insemination costs, due to earlier and more successful insemination of the cow. Further, good health and fertility can affect direct costs in terms of lower veterinary costs and replacement rate (Knierim et al., 2020). However, the results from the interviews show that most of the farmers experienced reduced veterinary costs, whereas one farmer experienced increased veterinary costs due to injuries and medication. One of the farmers interviewed previously had calves with bad health, resulting in veterinary costs at 10-20 000NOK per month when they were sick. After implementing CCC, the farm reduced the veterinary costs significantly, to costs only relating to dehorning of the calves. However, other studies, like Johnsen et al. (2016), have shown mixed effects on health and fertility.

The questionnaire did not include questions about treatment costs and calves concentrate feeding, which are assumed to be slightly reduced when practicing CCC (Knierim et al., 2020). As mentioned earlier, several CCC-farmers choose to have additional cows to be able to fill the milk quota. This could be a potential extension of the model, as Knierim et al. (2020) does not include this. An additional cow will increase direct costs in terms of increased feeding and a potential increase in treatment costs.

Labor costs

Results from the survey shows an agreement about decreased workload after implementing CCC, with a mean of 5.61 and a median of 6, out of 7. Results from the interviews from the SUCCEED project point at simplified calf care and less work with calf feeding as two major reasons (Johanssen and Sørheim, 2021). The animals manage on their own, without the need for the farmer having to help. The variable "better behavior of calves" is a question about behavior, learning and socialization of the calf. This may lead to reduced labor costs due to simpler calf monitoring and handling for the farmer. However, the potential reduction in labor demand will differ between farms depending on the existing management- and feeding system of the calves (Knierim et al., 2020).

Building costs

Allowing cow and calf contact means in most cases that the barn layout must change. The result from the question about increased space requirement in the barn is not that clear, with a mean of 3.86 and a median of 4.5. Some may argue that they do not need more space, but rather another exploitation than without CCC, while others have built a new cow barn or extensions to it, to enable CCC. Results from the interviews show that the vast majority have made calf sheds with separate provision of feed, water and protected lying places for the calves.

Non-monetary effects

Knierim et al. (2020) also include non-monetary effects in the framework. The consequences of CCC does not only depend on monetary costs and income, "but may be enhanced or constrained by non-monetary factors" (Knierim et al., 2020, p.131). For the farmer, our results show increased farmer wellbeing, with a mean of 5.86 and a median of 6. Results from the interviews can exemplify this. Most farmers state wellbeing and conscience as important reasons for practicing CCC. A farmer from the survey wrote:

"Keeping cow and calf together is, emotionally, the only right thing to do."

Another farmer from the interviews emphasized the importance of operating on the premises of the animals:

"First, the calf must be fed - then we can take the rest"

There is also great consensus when it comes to workday flexibility, with a mean of 4.97 and a median of 6. When the calf feeds itself, the farmer does not have to be in the barn at 6AM, or at other specific times during the day, given that the farmer has a milking robot.

Another non-monetary effect, for both the farmer and the animals, is separation stress. If weaning and separation is associated with strong calling of cow and calf, this may lead to decreased farmer and animal wellbeing. Results from the survey indicate this to be a problem on several farms, with a mean of 4.57 and a median of 5. The variable "more accidents or reduced safety" may also be a potential non-monetary factor. When cow and calf stay together, some farmers express that they are afraid of reduced safety due to more accidents. This may occur due to the maternal instinct of the cow to protect her calf. However, results from the survey show that this is almost not present, with a mean of 1.79 and a median of 1, where 1 indicates "not at all". Even though this result does not indicate a problem with accidents and security, this could potentially be one, which further can lead to poorer labor quality. This will vary from farm to farm, depending on many things, such as race and cow barn layout, but also personalities of the cows themselves.

6.2.3 Summing up: Economic Consequences of CCC

The above analysis suggests that CCC decreases the income from milk, which is in line with most other studies on the effects of cow-calf contact (Asheim et al., 2016; Knierim et al., 2020; Barth, 2020). However, the decreased income from milk due to CCC will depend on the amount of milk fed to the calves through other methods, and is only considered a true loss if the suckled milk exceeds this amount (Meagher et al., 2019). Further, our analysis suggests that CCC can increase income from calves, which is also consistent with former studies (Asheim et al., 2016; Meagher et al., 2019).

The effect on direct costs is not clear, mainly due to missing data. Results indicate that labor costs will decrease, and that a smaller increase in building costs is expected due to required adjustments of the cow barn layout.

Of non-monetary effects, increased farmer wellbeing and workday flexibility is found as positive consequences, which is in line with Broucek et al. (2020) and Vaarst et al. (2020). The main negative non-monetary effect is increased separation stress. However, previous research (Meagher et al., 2019) and results from the interviews indicate that separation stress depends much on the separation method used and the age of the calf, but very early separation can reduce the acute distress response in both cows and calves. In total, socioeconomic consequences will vary depending on the degree of positive and negative consequences, as well as how much the non-monetary factors are emphasized.

6.3 Perceived Barriers to Implement CCC

The farmers not rearing calves with their dam today, are asked about barriers to implement the practice. Table 6.5 shows descriptive statistics from the variables on barriers.

Table 6.5: The farmer's reported barriers to implementing CCC

Statistic	N	Mean	St. Dev.	Min	Median	Max
FinancialPerformance	806	6.242	1.445	1	7	7
CowBarnLayout	920	6.096	1.706	1	7	7
WorkLoad	853	5.877	1.733	1	7	7
CalvingSeasons	878	5.106	2.154	1	6	7
Knowledge	873	4.360	2.301	1	5	7

The results indicate that the main barrier is the expectation of CCC leading to a poorer financial performance. From the results of economic consequences, it is confirmed that rearing calves with their dam is likely to lead to a reduction in milk produced, and a lower quota filling. Further, seen in combination with the barrier cow barn layout an implementation of CCC may call for new investments, and Mikuš et al. (2020) argue that these are not welcomed by farmers.

The second main barrier to adopting CCC is the cow barn layout. This finding is in line with Asheim et al. (2016) who states that most modern farm buildings are not designed for keeping cows and calves together. Despite this, many of the CCC farms in the survey are reporting that only small-scale investments were needed.

The third barrier to implementing the practice is an expected increase in workload. Many of the farmers having implemented the practice, express that they experience a decrease in workload, mainly due to the fact that the farmer no longer has to feed the calves. However, other factors could lead to a higher workload, like monitoring and carrying out required adjustments in the barn.

A final important barrier is reported to be the calving seasons, indicating that implementation of CCC would require a change in calving seasons. Calving seasons are likely to vary a lot between farms, and a large proportion of the respondents report that their calvings are spread throughout the year. It is therefore not clear which calving seasons that can cause the perceived barrier. This barrier can probably relate to the size of the cow barn, because more calvings with CCC require more space. Results from the interviews also show that most farmers have calvings spread throughout the year. However, some farmers consider spring calving to be beneficial due to the possibility of keeping the cow and calf outside. On the other hand, some farmers report that keeping them outside makes it harder to ensure sufficient calf feeding. From an economic point of view, Asheim et al. (2016) found that May-calving in general was profitable since cheap pasture feed can replace some concentrates.

The survey also investigates whether farmers have previously tested CCC, which counts to 213 farmers. The table below shows the main reasons for not continuing with the practice.

Table 6.6: Descriptive statistics - The main reason for not continuing with CCC

	n	Proportion
Separation stress	114	55%
Space requirement	35	17%
Less saleable milk	19	9%
Worsened health of cow/calf	16	8%
Reduced safety and risk of accidents	14	7%
Higher workload	8	4%
Decreased milk quality	3	1%
Total (N)	213	100%

The majority reported separation distress as the main reason for not continuing with the practice, as shown in table 6.6. When separating cow and calf, this often results in high pitched vocalizations by cows and calves and indicates severe distress (Johnsen et al., 2015). This may be distressing for the farmers too. However, the 31 CCC farmers (in table 6.2) do not report separation stress as a main negative consequence. An important reason for this may be that these CCC-farmers have tested and found a separation-method that works fine at their farm. Johnsen et al. (2016) suggests gradually separating the cow and calves by decreasing the contact frequencies and duration before complete separation. However, there are several ways of doing gradual separation, which make this a complex issue.

Other important reasons are space requirement and less saleable milk. Most barns are not built for keeping cow and calf together (Asheim et al., 2016). For instance, including an additional calving pen is often required. If the barn is too small, this will require a substantial amount of building investments. Many report less saleable milk as a reason, which is a natural consequence of CCC, also reported by the CCC-farmers themselves.

The results from table 6.6 indicate that non-monetary factors stand as main hinders from continuing with the practice. Financial performance is, for many farmers, not the main factor that hindered them from continuing with CCC. It is therefore interesting to investigate what could potentially explain the perceived barriers to adapting the practice, which will be analyzed in the following section.

6.3.1 Exploratory Factor Analysis

This part of the analysis seeks to explore the relationship between farmers' attitudes, objectives, intentions and perceived barriers. First, an EFA is executed, using a pre-specified selection of variables in dataset II which relate to perceptions of and attitudes towards keeping cow and calf together, work-related values and satisfaction, as well as barriers to implement CCC.

Figure 6.3: Pearson Correlation Matrix

	Job satisfaction	*Optimistic view on the future*	*FAW requirements negatively affects profits*	*Importance of earning money*	*Importance of product quality*	*Importance of environmental sustainability*	*Importance of autonomy*	*Importance of being proud of own work*	*Importance of animal welfare*	*Importance of maintaining traditions*	*Importance of securing domestic food production*	*Importance of maining cultural landscape*	*CCC leads to better financial performance*	*CCC provides good animal welfare*	*CCC will become more common*	*CCC will give milk production better reputation*	*The calf has not equally good welfare without CCC*	*The cow has not equally good welfare without CCC*	*Absence of barrier: Cow barn layout*	*Absence of barrier: Calving seasons*	*Absence of barrier: Work load*	*Barrier: Knowledge of possible practical solutions*	*Barrier: Knowledge of pros and cons*	*Absence of barrier: Poorer financial performance*	*Would implement CCC if financially compensated*	*Stay intention*	*Positive view about future farm economic conditions*
Job satisfaction	1.00																										
Optimistic view on the future	0.50	1.00																									
FAW requirements negatively affects profits	0.06	-0.08	1.00																								
Importance of earning money	0.00	-0.01	0.10	1.00																							
Importance of product quality	0.18	0.09	0.11	0.31	1.00																						
Importance of environmental sustainability	0.14	0.15	0.00	0.11	0.36	1.00																					
Importance of autonomy	0.27	0.19	0.04	0.14	0.27	0.25	1.00																				
Importance of being proud of own work	0.27	0.16	0.07	0.17	0.47	0.36	0.46	1.00																			
Importance of animal welfare	0.19	0.07	0.02	0.12	0.50	0.40	0.29	0.56	1.00																		
Importance of maintaining traditions	0.14	0.11	0.08	-0.01	0.19	0.18	0.21	0.30	0.21	1.00																	
Importance of securing domestic food production	0.19	0.14	0.09	0.10	0.40	0.23	0.30	0.51	0.35	0.39	1.00																
Importance of maining cultural landscape	0.16	0.09	0.09	0.05	0.34	0.33	0.30	0.45	0.39	0.48	0.61	1.00															
CCC leads to better financial performance	0.01	0.01	-0.15	-0.07	-0.04	0.03	-0.01	0.00	-0.04	0.03	0.00	0.01	1.00														
CCC provides good animal welfare	0.04	0.09	-0.10	-0.08	0.05	0.18	0.03	0.03	0.09	0.08	0.02	0.05	0.22	1.00													
CCC will become more common	0.06	0.08	-0.11	-0.10	0.02	0.15	0.01	0.03	0.07	0.01	0.01	0.03	0.17	0.59	1.00												
CCC will give milk production better reputation	0.04	0.10	-0.13	-0.08	0.04	0.16	0.02	0.06	0.10	0.08	0.04	0.08	0.16	0.60	0.72	1.00											
The calf has not equally good welfare without CCC	-0.01	0.02	-0.19	-0.13	-0.08	0.08	-0.01	-0.04	-0.02	0.01	-0.06	-0.05	0.23	0.51	0.40	0.37	1.00										
The cow has not equally good welfare without CCC	-0.03	0.02	-0.20	-0.09	-0.06	0.05	-0.01	-0.02	0.00	-0.02	-0.01	-0.04	0.21	0.50	0.40	0.34	0.74	1.00									
Absence of barrier: Cow barn layout	0.00	0.09	-0.17	-0.02	-0.18	-0.01	0.01	-0.03	-0.10	-0.04	-0.03	-0.05	0.18	0.12	0.06	0.09	0.23	0.17	1.00								
Absence of barrier: Calving seasons	0.10	0.15	-0.17	-0.07	-0.07	0.05	0.05	0.00	-0.04	-0.04	-0.07	-0.06	0.18	0.25	0.26	0.25	0.29	0.27	0.51	1.00							
Absence of barrier: Work load	0.05	0.11	-0.21	-0.03	-0.09	0.03	0.00	-0.03	-0.04	-0.02	-0.03	-0.05	0.18	0.22	0.19	0.18	0.32	0.28	0.44	0.52	1.00						
Barrier: Knowledge of possible practical solutions	0.01	0.07	-0.01	-0.06	0.01	0.07	-0.04	0.02	0.02	0.08	0.05	0.05	0.01	0.24	0.31	0.32	0.12	0.11	-0.14	-0.05	-0.13	1.00					
Barrier: Knowledge of pros and cons	0.04	0.06	0.00	-0.02	0.05	0.10	0.01	0.05	0.05	0.11	0.10	0.08	0.01	0.25	0.29	0.31	0.10	0.11	-0.12	-0.02	-0.11	0.84	1.00				
Absence of barrier: Poorer financial performance	0.07	0.16	-0.21	-0.06	-0.08	0.07	0.02	-0.03	-0.05	0.04	-0.02	0.02	0.25	0.26	0.20	0.20	0.24	0.24	0.33	0.29	0.37	-0.09	-0.11	1.00			
Would implement CCC if financially compensated	0.00	0.01	-0.04	0.03	0.10	0.14	0.04	0.09	0.13	0.11	0.12	0.11	0.15	0.43	0.42	0.44	0.28	0.28	-0.01	0.14	0.09	0.40	0.43	0.00	1.00		
Stay intention	0.29	0.47	-0.12	0.00	0.08	0.07	0.07	0.12	0.09	0.05	0.07	0.00	0.02	0.01	0.05	0.04	0.02	0.04	0.08	0.12	0.10	0.03	0.01	0.06	-0.02	1.00	
Positive view about future farm economic conditions	0.19	0.39	-0.05	0.00	0.05	0.08	0.08	0.05	0.07	0.08	0.06	0.04	-0.03	0.03	0.08	0.10	-0.01	-0.01	0.05	0.14	0.08	0.07	0.07	0.05	0.01	0.32	1.00

Correlation > 0.4

Correlation [0.2 , 0.4]

The correlation matrix in figure 6.3 shows that there are several correlations among the variables, both moderate (0.2 , 0.4) and strong (>0.4). This indicates that there could exist underlying dimensions and that latent factors can be found.

Some of the variables have very strong pairwise correlations, and the questions are similar in the wording. Thus, they are considered to measure a large amount of the same variation. The variable that has the lowest correlation with other variables, is kept. For instance, "The calf has not equally good welfare without CCC" and "The cow has not equally good welfare without CCC" have a pairwise correlation at 0.74, and only the latter is kept for further analysis.

The correlation matrix is tested for factorability. Bartlett's test for sphericity results in a significant chi-square value of 6 927 with a p-value at 0, and the KMO measure of sample adequacy yields a value of 0.82. This indicates that the sample has sufficient correlations between items to proceed with the EFA.

Both principal component analysis and common factor analysis is tested for the factor extraction, resulting in minor differences in eigenvalues. However, the two methods retain the same factor composition with similar factor loadings. Due to presentation- and interpretation purposes, principal component analysis is applied.

Table 6.7: The Ten Factors with the Greatest Eigenvalues (N = 966)

Factor	Eigenvalue
Factor 1	4.118
Factor 2	3.655
Factor 3	2.262
Factor 4	1.713
Factor 5	1.237
Factor 6	0.996
Factor 7	0.937
Factor 8	0.900
Factor 9	0.839
Factor 10	0.781

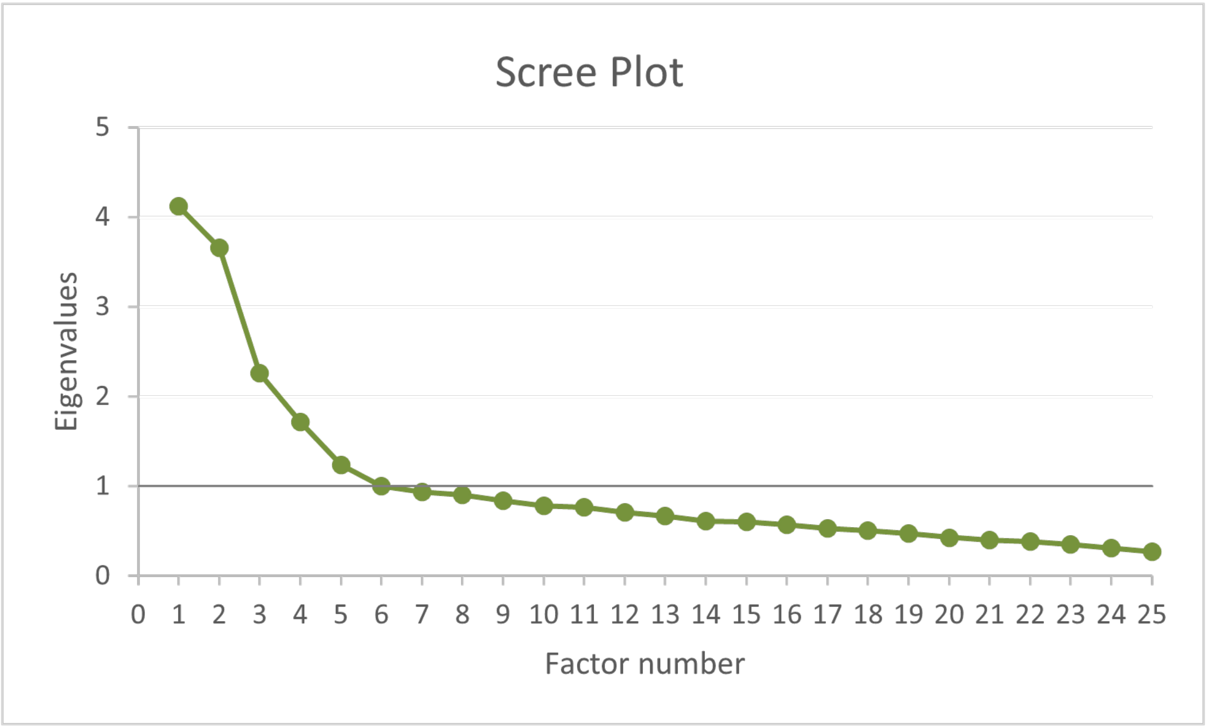

Figure 6.4: Scree Plot

Based on the criteria of retaining factors with eigenvalues above 1, five factors should be retained, as shown in table 6.7. However, the sixth factor is approximately 1. The "sharp bend" criteria also suggests five factors, shown in figure 6.4. The researchers have tested several solutions, and it is decided to retain six factors as these give the best basis for retaining meaningful factors.

Furthermore, the six factors are rotated using promax rotation, which is an oblique rotation method. The factor loading matrix is shown in table 6.8. Variables with weak loadings on all factors are removed, with a criteria of 0.3 on the factor loading.

Table 6.8: Factor Loading Matrix

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
CCC provides good FAW	0.674					
CCC will become more common	0.924					
CCC will give milk production better reputation	0.889					
The cow has not equally good welfare without CCC	0.333					
Importance of product quality		0.704				
Importance of being proud of own work		0.705				
Importance of animal welfare		0.745				
Importance of earning money		0.414				
Importance of environmental sustainability		0.438				
Importance of autonomy		0.428				
Absence of barrier: Cow barn layout			0.742			
Absence of barrier: Calving seasons			0.687			
Absence of barrier: Work load			0.683			
Absence of barrier: Poorer financial performance			0.392			
Job satisfaction				0.532		
Optimistic view on the future				0.904		
StayIntention				0.556		
Optimistic view on future farm-economic conditions				0.457		
Importance of maintaining tradition					0.608	
Importance of securing domestic food production					0.587	
Importance of maintaining cultural landscape					0.799	
Would implement CCC if financially compensated						0.889
Barrier: Knowledge						0.348

Factor 1 from the factor analysis with CCC-related variables is named CCC, which indicates a positive perception of CCC.

Factor 2 contains several statements about what is important for the farmer. These statements are quite different, resulting in difficulties with interpreting which underlying construct is measured by the factor. For instance, it is hard to understand what importance of environmental sustainability and autonomy have in common.

Factor 3 includes the four variables that are shown as the main barriers to implement CCC shown in table 6.5. These variables are now reversed, and should be interpreted as absence of barriers. Thus, this factor is named "Lack of barriers".

Factor 4 includes variables about the farmers' view of the future and the intention to continue being a dairy farmer. In a recent study, Hansen (2022) found that farmer wellbeing, such as job satisfaction and optimistic view on the future, were related to intentions to continue in the dairy industry. Thus, it is considered meaningful to name the factor "Continue".

Factor 5 includes variables related to farmers' underlying intentions of farming. However, factor 5, as with factor 2, contains several different statements, which result in difficulties when interpreting the factor. Thus, it seems like the factor analysis does not successfully separate these items. A reason for this could be that many respondents report all values to be important, and are selecting the highest alternative. It is therefore decided to test another composition of the factor, which will be tested in further analysis.

Factor 6 is considered challenging to use, as it is difficult to find any common construct for the items placed in the factors. In addition, at least three variables in a factor are recommended. As factor 6 only consists of two variables, this factor will not be used for further analysis.

6.3.2 Structural Equation Modeling

The purpose of the SEM is to explore how the underlying dimensions of farmers' beliefs relate to the perceived barriers to CCC. The factor analysis identified six underlying dimensions, where four of them are to be used in the SEM model. The model has a good overall model fit, see Appendix A5 for further details.

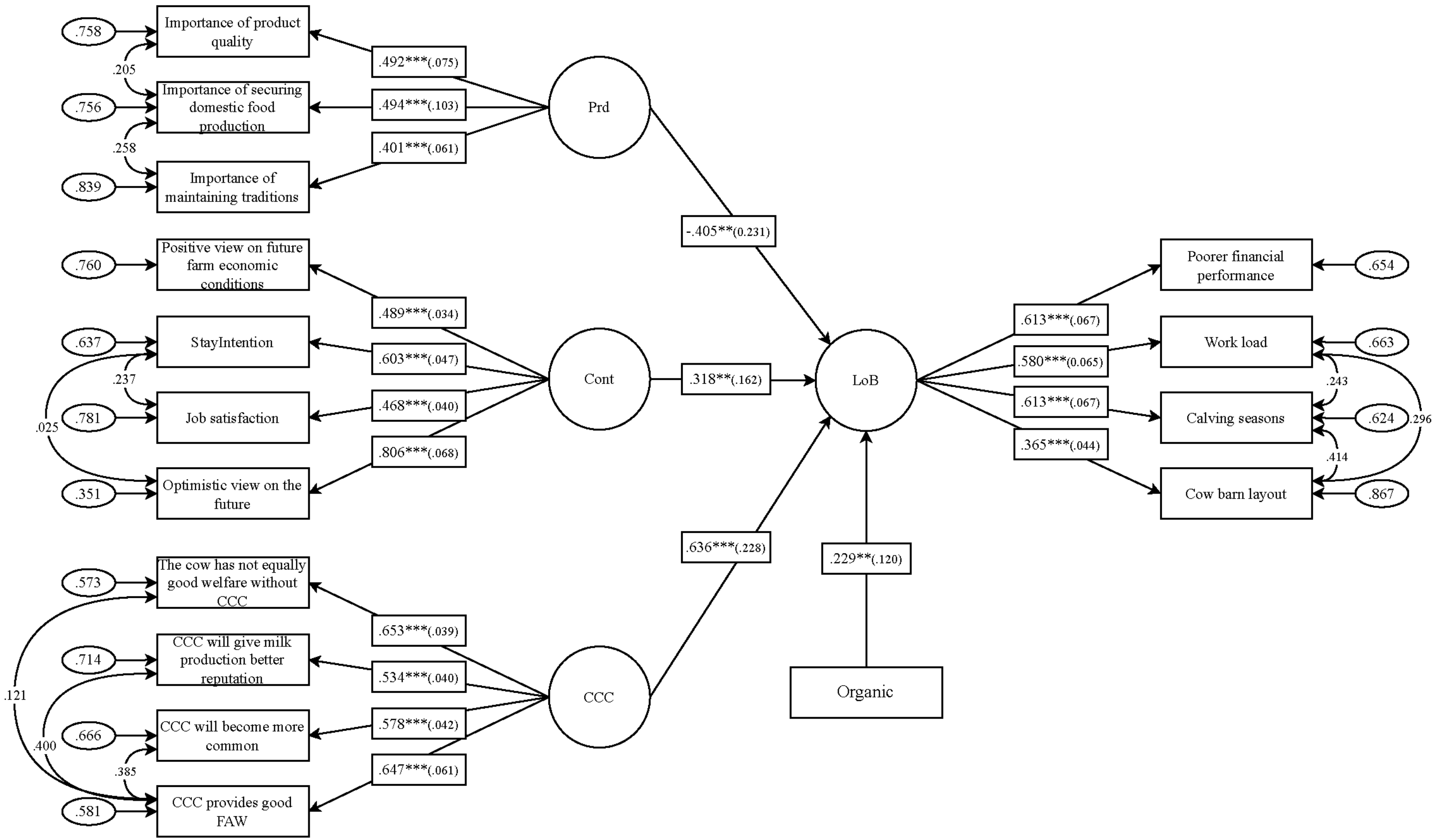

Figure 6.5: SEM Path Model

Figure 6.5 shows the SEM path model, where the factor, or latent variable *Lack of Barriers* act as the dependent variable and the three factors *Production orientation* (shortened "Prd"), *Continuing* (shortened "Cnt") and *Positive perception of CCC* (shortened "CCC") act as independent variables in a regression-like relationship. In the SEM, the composition of the items in factor 5 retained from the factor analysis containing values of farmers, is adjusted, resulting in a factor named "production orientation". This factor is thought to measure the farmers' degree of production orientation. This indicates a focus on production outputs, such as the quality of the milk and contributing to domestic food production, which also can be seen as a traditional view on dairy farming. An additional observed variable, *Organic*, that indicates whether the farmer has an organic management system, is also included as an independent variable in the SEM. The latent variable "Lack of barriers", consist of four variables, where most of them have loadings above 0.4, indicating that this is still a strong factor in the latent variable model. This latent variable suggests a farmer who has few barriers to implement the CCC practice. It is important to have in mind that this measures perceived barriers.

The model shows that Prd has a negative relationship (-0.41) with LoB, while the coefficients of Cnt (0.32), CCC (0.64) and Organic (0.23) show a positive association with LoB. All coefficients are significant. The model also illustrates which items each of the factors consists of. For instance, Cnt is a factor existing of four items: Positive view on future farm-economic conditions, StayIntention, Job satisfaction and Optimistic view on the future. Factor loadings are also given for the four factors: 0.49, 0.60, 0.47 and 0.81, respectively, confirming that all items have sufficient factor loadings.

The production-oriented factor indicates a farmer who has production outputs as a focus. The relationship from this factor to "Lack of barriers" is negative. This indicates that a production-oriented farmer sees more barriers than farmers without this focus. This makes sense, since CCC involves "giving away" some of the milk to the calf, which otherwise could have been sold. This can further be related to the closure of small farms. Profitability and subsidies lead to an increase in the number of larger farms, as figure 2.1 shows, which force the farmers to be more production oriented. To be able to make it as a dairy farmer, one will have to look at the production rate with the number of liters produced compared to inputs as a goal. This production-oriented focus may not be that consistent with CCC due to less milk sold and more space required, as two examples.

The factor named continue measures a farmer's intention to continue with dairy production. This factor has a positive connection to the factor "Lack of barriers". It may make sense to have less barriers and to be open for adaption and investments when one is sure to continue in the industry. The intention to continue is also shown to be indirectly associated with the degree of animal welfare at the farm, measured by the animal welfare index (Hansen and Østerås, 2019). This can possibly explain how a farmer that has the intention to continue may perceive less barriers to implement a new animal welfare initiative such as CCC. Additionally, a farmer whose intention is to quit within a few years, is not likely to be willing to innovate the rearing system, and thus perceive high barriers.

The CCC-factor indicates a positive attitude towards CCC, which in turn means that the farmer sees fewer barriers to implement the practice. The group that has a positive attitude towards CCC may have reflected more about the topic, and imagined how it could have been possible to switch to CCC. A negative perception of CCC, could be related to concerns about animal welfare in terms of cow health and increased separation stress as found by Neave et al. (2022). In addition, the negative perception is related to the belief that CCC does not belong to the future of dairy farming. With this perspective, it is reasonable that perceived barriers to implement the practice are higher.

Finally, an observed variable is added to the path model, named organic. This variable has a positive regression coefficient to "Lack of barriers" indicating that organic farmers have less barriers than conventional. One of the reasons for this may be that organic farmers have experience with CCC due to a requirement of the calf to suckle the dam in minimum 3 days after birth. Thus, the transition to CCC for more than 14 days is not that large, and they may therefore see fewer barriers. These findings are also in line with the results from the lasso regression, which selects the "Organic" variable as an important predictor of being a CCC farmer.

6.3.3 Summing up: Barriers to Implement CCC

This analysis has found the main barriers to implement CCC and explored which factors that can explain the level of perceived barriers. The presented findings give an understanding of the constraints that should be addressed to successfully implement the practice of keeping cow and calf together in milk production. Main constraints are poorer financial performance, cow-barn layout and increased workload. The two latter are consistent with findings from Neave et al. (2022), who found that farmers are concerned about increased labor and stress on staff, and required changes on the farming system. The first main finding from the SEM is that farmers with production oriented values are likely to see a higher degree of barriers than others. It is argued to be a natural implication, as farmers are depending on the production to earn for a living. The second main finding is that those who indicate a positive attitude to CCC see less barriers. The analysis also indicates that farmers that have the intention of staying in the industry perceive a lower level of barriers. Finally, organic farmers seem to perceive less barriers than conventional farmers.

6.4 Implications of the Findings

The most evident consequence of CCC is the reduced income for milk. This is a natural consequence that cannot be avoided, but which can be compensated by other income-increasing and cost-saving initiatives. Reduced income from milk is also found as one of the most important barriers to adopting the practice. Today, very few farmers are practicing CCC, and our findings imply that an increased prevalence will require economic incentives. Another barrier is the need to redesign or rebuild the cow barn, which also necessitates economic incentives. This also aligns with the finding which indicates that the majority of farms have a poor financial position, which restricts the ability of investing in animal welfare initiatives.

Today, the CCC-practice is only adopted on farms where the farmers have a special interest in animal welfare. Since animal welfare is an increasingly important concern in food production and society, it is likely that the farmers will have to meet consumer demands. With an increased demand of milk from animals with a high degree of animal welfare, it is likely that more farms will have to adopt the CCC practice in the future. Our findings also suggest that there are more farmers wishing to practice CCC, than the ones that exist today. Thus, economic incentives may be necessary.

One possible incentive could be to increase the price for milk coming from CCC-farms, similar to how organic farmers get a higher milk price today. Another option is to provide a subsidy to compensate for the extra cows needed to fill the quota. Additionally, as many farmers report investments in the cow barn as a main barrier, there may be a need for financial support to CCC-related investments. Today, farmers who want to convert to organic farming, have the possibility to apply Innovation Norway for a subsidy for required investments. Something similar may be an option for facilitating CCC.

In accordance with the theory presented in chapter 3, the relationship between animal welfare and economic performance, increasing the level of animal welfare is only profitable up to a certain point. Today, farmers focusing on increased animal welfare receive the same amount of subsidies as the farmers operating according to the minimum requirements of animal welfare. Our findings also suggest that CCC can decrease profits. Thus, if society is in favor of CCC rearing systems, it would have to be subsidized to increase the prevalence of the practice. In general, good animal welfare has to be awarded, for the dairy industry to meet future demands.

6.5 Limitations and Future Research Suggestions

The main limitation of the study is that the analysis of economic consequences is based on limited data material, mainly due to the fact that there are few farmers practicing CCC in Norway. This implies that the possibility of generalizing the results to the entire population or other contexts could be limited (Saunders et al., 2019). Another limitation is that most consequences are based on subjective evaluations, which can be seen as less reliable compared to accounting data and herd record data. One limit of choosing a survey as a data collection method is that not all types of questions can be asked. For instance, it would have been useful to obtain financial data on a more detailed level. However, few farmers have this in mind, and asking such difficult questions could have caused a high occurrence of non-responses.

The findings of this study are mainly related to negative economic consequences, implying that further research on positive consequences, such as long term health and productivity benefits of CCC is needed. It would also be interesting to investigate whether the known increased growth of calves has a positive effect on their performance later in life, which can have substantial impact on profits. In other words, there are still aspects related to economic consequences left to be studied, in order to determine whether CCC is profitable.

7 Conclusion

This thesis seeks to explore the socioeconomic consequences of implementing cow and calf contact, as well as perceived barriers to implement the practice. There are few studies that examine the economic consequences of CCC, and even fewer investigating the perceived barriers among farmers. The practice of early separation is increasingly questioned in society, which substantiates the importance of this research. By also studying farmers not practicing CCC, this thesis gives an understanding of which obstacles must be overcome to successfully implement the practice.

This study has been performed using several datasets, including survey-data and production-data. To investigate the consequences of CCC, relevant descriptive statistics has been presented. Further, lasso regression is conducted to identify production-related differences between CCC farmers and non-CCC farmers. To investigate perceived barriers to implement the practice, factor analysis and SEM are performed.

The results from the study indicate that practicing CCC will lead to a lower quota filling, resulting in a decreased income from milk. Another finding is that CCC leads to increased income from calves. Consequences on direct costs are less clear, but findings indicate that a smaller increase in building costs will occur, and that labor costs are likely to decrease. The results also show that poorer financial performance and layout of the cow barn are seen as main barriers to implement the practice. Further, the findings suggest that the level of perceived barriers depend on the farmers' degree of production orientation, the intention of continuing as a farmer and the attitude towards CCC. Additionally, being an organic farmer can decrease the level of perceived barriers. In total, the findings highlight which aspects to consider when adopting a future demand related to animal welfare in the Norwegian dairy industry.

Glossary

AMS Automatic Milking System- robots that milks the cows without the need of human labor.

calf shed An area where the calf is separated from the cow, where it can socialize with other calves, and relax between the feedings.

calving pen Where a pregnant cow spends time before, during and after calving.

colostrum Is the milk that the cow produces in the first 4-5 days after calving. Colostrum is absolutely necessary for the calf's immune system, and all calves receive colostrum in the first few days.

concentrates Animal feed that is rich in energy and/or protein.

dairy processor A company processing milk for consumption, such as TINE SA in Norway.

free-stall A type of cow housing where the animals roam loose in a fenced area indoors.

mastitis Is a bacterial infection in the cow's udder, which can reduce animal welfare and cause major financial losses in many herds due to veterinary treatment costs..

nursing When the cow feeds the calf.

suckling When the calf drinks milk from the dam.

tie-stall A type of cow housing where the animals are tethered at the neck to their stall.

List of Acronyms and Abbreviations

AMS Automatic Milking System.

CCC cow and calf contact.

CFA Confirmatory Factor Analysis.

CFI Comparative Fit Index.

DWLS Diagonally Weighted Least Squares.

EFA Exploratory Factor Analysis.

FIML Full Information Maximum Likelihood.

MAR Missing at Random Given Covariates.

MCAR Missing Completely at Random.

MI Multiple Imputation.

MICE Multivariate Imputation by Chained Equations.

ML Maximum Likelihood.

MNAR Missing Not at Random.

NAPR Norwegian Agricultural Producer Register.

NDHRS National Dairy Herd Recording System.

RMSEA Root Mean Square Error of Approximation.

SEM Structural Equation Modeling.

TLI Tucker-Lewis Index.

References

Ahmed, H., Alvåsen, K., Berg, C., Hansson, H., Hultgren, J., Röcklinsberg, H., and Emanuelson, U. (2021). Assessing animal welfare and farm profitability in cow-calf operations with stochastic partial budgeting. *Animals*, 11(2):382.

Asheim, L. J., Johnsen, J. F., Havrevoll, Ø., Mejdell, C. M., and Grøndahl, A. M. (2016). The economic effects of suckling and milk feeding to calves in dual purpose dairy and beef farming. *Review of Agricultural, Food and Environmental Studies*, 97(4):225–236.

Azur, M. J., Stuart, E. A., Frangakis, C., and Leaf, P. J. (2011). Multiple imputation by chained equations: what is it and how does it work? *International Journal of Methods in Psychiatric Research*, 20(1):40–49.

Baraldi, A. N. and Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of school psychology*, 48(1):5–37.

Barth, K. (2020). Effects of suckling on milk yield and milk composition of dairy cows in cow–calf contact systems. *Journal of Dairy Research*, 87(S1):133–137.

Beaujean, A. A. (2014). *Latent variable modeling using R: A step-by-step guide*. Routledge.

Beaver, A., Proudfoot, K. L., and von Keyserlingk, M. A. (2020). Symposium review: Considerations for the future of dairy cattle housing: An animal welfare perspective. *Journal of dairy science*, 103(6):5746–5758.

Bratberg, E. (2018). Jordbruksavtalen. Last accessed February 23, 2022 from https://snl.no/jordbruksavtalen. Store Norske Leksikon.

Britt, J., Cushman, R., Dechow, C., Dobson, H., Humblot, P., Hutjens, M., Jones, G., Ruegg, P., Sheldon, I., and Stevenson, J. (2018). Invited review: Learning from the future- A vision for dairy farms and cows in 2067. *Journal of dairy science*, 101(5):3722–3741.

Broucek, J., Uhrincat, M., Kisac, P., and Hanus, A. (2020). Effect of different rearing during the milk-feeding period on growth of dairy calves. *Agriculture*, 10(8):346.

Busch, G., Weary, D. M., Spiller, A., and von Keyserlingk, M. A. (2017). American and german attitudes towards cow-calf separation on dairy farms. *PLOS ONE*, 12(3):e0174013.

Buuren, S. and Groothuis-Oudshoorn, C. (2011). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software*, 45.

Byrne, B. M. (2016). *Structural Equation Modeling with Amos*. Multivariate Application Series. Routledge, 3rd edition.

Cogato, A., Brščić, M., Guo, H., Marinello, F., and Pezzuolo, A. (2021). Challenges and tendencies of automatic milking systems (ams): A 20-years systematic review of literature and patents. *Animals*, 11(2):356.

De Vries, A. and Marcondes, M. (2020). Review: Overview of factors affecting productive lifespan of dairy cows. *Animal: An international journal of animal bioscience*, 14(1):155–164.

De Vries, M., Bokkers, E., Van Reenen, C., Engel, B., Van Schaik, G., Dijkstra, T., and De Boer, I. (2015). Housing and management factors associated with indicators of dairy cattle welfare. *Preventive veterinary medicine*, 118(1):80–92.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., and Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological methods*, 4(3):272–299.

Farm Animal Welfare Committee (2011). Economics and farm animal welfare. https://www.gov.uk/government/publications/fawc-report-on-economics-and-farm-animal-welfare.

Fernandes, J. N., Hemsworth, P. H., Coleman, G. J., and Tilbrook, A. J. (2021). Costs and benefits of improving farm animal welfare. *Agriculture*, 11(2).

Flower, F. C. and Weary, D. M. (2003). The effects of early separation on the dairy cow and calf. *Animal Welfare*, 12(3):339–348.

Forskrift om hold av storfe (2004). Forskrift om hold av storfe (FOR-2004-04-22-665). https://lovdata.no/dokument/SF/forskrift/2004-04-22-665.

Forskrift om produksjonstilskudd og avløsertilskudd i jordbruket (2014). Forskrift om produksjonstilskudd og avløsertilskudd i jordbruket (FOR-2014-12-19-1817). https://lovdata.no/dokument/SF/forskrift/2014-12-19-1817.

Fraser, D. (1995). Science, values and animal welfare: exploring the ‘inextricable connection’.

Fraser, D., Weary, D. M., Pajor, E. A., and Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns.

Gaasland, I. (2020). Norsk produksjon av jordbruksvarer- hvem betaler regningen? Centre for Applied Research at NHH.

Grøndahl, A., Skancke, E., Mejdell, C., and Jansen, J. (2007). Growth rate, health and welfare in a dairy herd with natural suckling until 6-8 weeks of age: A case report. *Acta veterinaria Scandinavica*, 49(1):16.

Hair, J. F., Anderson, R. E., Babin, B. J., and Black, W. C. (2010). *Multivariate data analysis: A global perspective*. Upper Saddle River, NJ: Pearson, 7th edition.

Hansen, B. G. (2020). Making the most of data in dairy farming research-how twenty-first century statistical learning methods can contribute.

Hansen, B. G. (2022). Stay in dairy? Exploring the relationship between farmer wellbeing and farm exit intentions. *Journal of Rural Studies*, 92(4):306–315.

Hansen, B. G., Moland, K., and Lenning, M. I. (2019). How can dairy farmers become more revenue efficient? efficiency drivers on dairy farms. *International Journal of Agricultural Management*, 8(2):65–73.

Hansen, B. G. and Østerås, O. (2019). Farmer welfare and animal welfare-exploring the relationship between farmer's occupational well-being and stress, farm expansion and animal welfare. *Preventive veterinary medicine*, 170:104741.

Hastie, T., Tibshirani, R., and Wainwright, M. (2015). *Statistical Learning with Sparsity: The Lasso and Generalizations.*

Henningsen, A., Czekaj, T., Forkman, B., Lund, M., and Nielsen, A. (2016). The relationship between animal welfare and economic performance at farm level: A quantitative study of danish pig producers (IFRO working paper 2016 / 05).

Henningsen, A., Czekaj, T., Forkman, B., Lund, M., and Nielsen, A. (2017). The relationship between animal welfare and economic performance at farm level: A quantitative study of danish pig producers. *Journal of Agricultural Economics*, 69.

Hooper, D., Coughlan, J., and Mullen, M. R. (2008). Model fit. *Electronic Journal of Business Research Methods*, 6(1):53–60.

Hötzel, M. J., Cardoso, C. S., Roslindo, A., and von Keyserlingk, M. A. (2017). Citizens' views on the practices of zero-grazing and cow-calf separation in the dairy industry: Does providing information increase acceptability? *Journal of dairy science*, 100(5):4150–4160.

Hårstad, R. M. B. (2019). Bonden, familien og melkeroboten – en ny hverdag. Ruralis – Institutt for rural- og regionalforskning.

James, G., Witten, D., Hastie, T., and Tibshirani, R. (2013). *An introduction to statistical learning with applications in R.* Springer.

Johanssen, J. R. E. and Sørheim, K. M. (2021). Ku og kalv sammen i melkeproduksjon-intervjuer med melkeprodusenter. NORSØK- Norsk senter for økologisk landbruk.

Johnsen, J. F., Ellingsen, K., Grøndahl, A. M., Bøe, K. E., Lidfors, L., and Mejdell, C. M. (2015). The effect of physical contact between dairy cows and calves during separation on their post-separation behavioural response. *Applied Animal Behaviour Science*, 166(1):11–19.

Johnsen, J. F., Kischel, S. G., Rognskog, M. S., Vagle, I., Johanssen, J. R. E., Ruud, L. E., and Ferneborg, S. (2021). Investigating cow-calf contact in a cow-driven system: performance of cow and calf. *Journal of Dairy Research*, 88(1):56–59.

Johnsen, J. F., Zipp, K. A., Kälber, T., de Passillé, A. M., Knierim, U., Barth, K., and Mejdell, C. M. (2016). Is rearing calves with the dam a feasible option for dairy farms?—Current and future research. *Applied Animal Behaviour Science*, 181:1–11.

Jöreskog, K. G., Olsson, U. H., and Wallentin, F. Y. (2016). *Multivariate analysis with LISREL.* Springer.

Kang, H. (2013). The prevention and handling of the missing data. *Korean journal of anesthesiology*, 64(5):402–6.

Kho, C. W. (2018). *Future Studies Research Methodology: A Collection of Studies*, chapter The Likert Scale, pages 17–31. University of Malaya Press.

Kisac, P., Broucek, J., Uhrincat, M., and Hanus, A. (2011). Effect of weaning calves from mother at different ages on their growth and milk yield of mothers. *Czech Journal of Animal Science*, 56(6):261–268.

Knierim, U., Wicklow, D., Ivemeyer, S., and Möller, D. (2020). A framework for the socio-economic evaluation of rearing systems of dairy calves with or without cow contact. *Journal of Dairy Research*, 87(S1):128–132.

Knutsen, H. (2021). Utsyn over norsk landbruk- Tilstand og utviklingstrekk 2021. Norwegian Institute of Bioeconomy Research.

Koğar, H. and Koğar, E. Y. (2015). Comparison of different estimation methods for categorical and ordinal data in confirmatory factor analysis. *Journal of Measurement and Evaluation in Education and Psychology*, 6(2):351–364.

Lohr, S. L. (2022). *Sampling: Design and Analysis*. Chapman & Hall/CRC, Boca Raton, 3rd edition.

Lusk, J. L. and Norwood, F. B. (2011). Animal welfare economics. *Applied Economic Perspectives and Policy*, 33(4):463–483.

McGlone, J. (2001). Farm animal welfare in the context of other society issues: Toward sustainable systems. *Livestock Production Science*, 72(1-2):75–81.

Meagher, R. K., Beaver, A., Weary, D. M., and von Keyserlingk, M. A. (2019). Invited review: A systematic review of the effects of prolonged cow-calf contact on behavior, welfare, and productivity. *Journal of dairy science*, 102(7):5765–5783.

Mikuš, T., Mikuš, O., et al. (2020). Early weaning: new insights on an ever-persistent problem in the dairy industry. *Journal of Dairy Research*, 87(S1):88–92.

Neave, H. W., Sumner, C. L., Henwood, R. J., Zobel, G., Saunders, K., Thoday, H., Watson, T., and Webster, J. R. (2022). Dairy farmers' perspectives on providing cow-calf contact in the pasture-based systems of new zealand. *Journal of Dairy Science*, 105(1):453–467.

Norwegian Agriculture Agency (2022a). 11,5 milliarder kroner til norske bønder denne uka. Last accessed February 22, 2022 from https://www.landbruksdirektoratet.no/nb/nyhetsrom/nyhetsarkiv/11-5-milliarder-kroner-til-norske-bonder-denne-uka.

Norwegian Agriculture Agency (2022b). Melkekvoter. Last accessed February 1, 2022 from https://www.landbruksdirektoratet.no/nb/jordbruk/regulering-og-kvoter/melkekvoter.

Norwegian Agriculture Agency (2022c). Produksjonstilskudd og avløsertilskudd – beregningsveiledning. Last accessed May 18, 2022 from https://www.landbruksdirektoratet.no/nb/jordbruk/ordninger-for-jordbruk/produksjonstilskudd-og-avlosertilskudd-i-jordbruket/produksjonstilskudd-og-avlosertilskudd–beregningsveiledning.

Norwegian Agriculture Agency (2022d). Tilskudd til jordbruksforetak. Last accessed May 18, 2022 from https://www.landbruksdirektoratet.no/nb/statistikk-og-utviklingstrekk/tilskudd-til-jordbruksforetak.

Norwegian Animal Protection Alliance (2019). Breaking news: Norway bans fur farming. Last accessed April 30, 2022 from https://dyrevern.no/dyrevern/breaking-news-norway-bans-fur-farming/.

OECD (2022). Agricultural support (indicator). Last accessed February 22, 2022 from https://data.oecd.org/agrpolicy/agricultural-support.htm.

Opplysningskontoret for Meieriprodukter (2022a). Melkekua- dyrehelse. Last accessed February 24, 2022 from https://www.melk.no/Melkekilden/Melkekua/Dyrehelse.

Opplysningskontoret for Meieriprodukter (2022b). Melkekua- ku og kalv. Last accessed February 21, 2022 from https://www.melk.no/Melkekilden/Melkekua/Ku-og-kalv.

Overrein, H., Skjold, A. V., and Kischel, S. G. (2021). Kalvebrosjyre 2021- Godt kalveoppdrett 0-3 måneder. Last accessed May 27, 2022 from https://sway.office.com/JP1mfwAul4MFX2XI.

Pett, M. A., Lackey, N. R., Sullivan, J. J., et al. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. SAGE.

Popescu, S., Borda, C., Diugan, E. A., Niculae, M., Stefan, R., and Sandru, C. D. (2014). The effect of the housing system on the welfare quality of dairy cows. *Italian Journal of Animal Science*, 13(1):2940.

Pristilskuddforskriften (2008). Forskrift om pristilskudd i landbrukssektoren (FOR-2008-12-19-1490). https://lovdata.no/dokument/SF/forskrift/2008-12-19-1490.

Regjeringen (2016). Meld. st. 11 (2016–2017) Endring og utvikling — En fremtidsrettet jordbruksproduksjon.

Regjeringen (2020). Importvernet for jordbruksvarer. Last accessed May 23, 2022 from https://www.regjeringen.no/no/tema/mat-fiske-og-landbruk/jordbruk/innsikt/handel-med-jordbruksprodukter/importvernet-for-jordbruksvarer/id2364459/.

Regjeringen (2022). Sluttprotokoll fra forhandlingsmøte 16. mai 2022 mellom staten og norges bondelag og norsk bonde- og småbrukarlag. Last accessed May 23, 2022 from https://www.regjeringen.no/no/aktuelt/avtale-som-styrker-norsk-matproduksjon/id2913329/.

Regnskapsloven (1999). Lov om årsregnskap m.v. (LOV-1998-07-17-56). https://lovdata.no/dokument/NL/lov/1998-07-17-56.

Ritter, C., Mills, K. E., Weary, D. M., and von Keyserlingk, M. A. (2020). Perspectives of western canadian dairy farmers on the future of farming. *Journal of dairy science*, 103(11):10273–10282.

Saunders, M., Lewis, P., and Thornhill, A. (2019). *Research Methods for Business Students*. Pearson Education Limited, 8th edition.

Schumacker, R. E. and Lomax, R. G. (2010). *A beginner's Guide to Structural Equation Modeling*. Routledge, 3rd edition.

Statistics Norway (2015). Landbruket i Norge 2015.

Statistics Norway (2022). Livestock husbandry. Last accessed February 22, 2022 from https://www.ssb.no/en/statbank/table/03789/tableViewLayout1/.

Syverud, G., Bratberg, E., and Almås, R. (2021). Jorbruk i Norge. Last accessed February 21, 2022 from https://snl.no/jordbruk_i_Norge. Store Norske Leksikon.

TINE SA (2022a). Fakta om norsk melk. Last accessed May 1, 2022 from https://www.melk.no/Kosthold-og-helse/Skole/Fakta-om-norsk-melk.

TINE SA (2022b). Fett og protein i melk. Last accessed May 22, 2022 from https://medlem.tine.no/melk/fett-og-protein-i-melk.

TYR (2022). Oppstart. Last accessed April 29, 2022 from https://www.tyr.no/storfekjottproduksjon/oppstart/.

Vaarst, M., Hellec, F., Verwer, C., Juni, R., and Sørheim, K. (2020). Cow calf contact in dairy herds viewed from the perspectives of calves, cows, humans and the farming system. farmers' perceptions and experiences related to dam-rearing systems. *Journal of sustainable and organic agricultural systems*, 70(1):49–57.

Van Buuren, S. (2018). *Flexible imputation of missing data*. CRC press.

von Keyserlingk, M. A., Barrientos, A., Ito, K., Galo, E., and Weary, D. M. (2012). Benchmarking cow comfort on north american freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing holstein dairy cows. *Journal of Dairy Science*, 95(12):7399–7408.

Watkins, M. W. (2018). Exploratory factor analysis: A guide to best practice. *Journal of Black Psychology*, 44(3):219–246.

Weary, D., Ventura, B., and Keyserlingk, M. (2015). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal: An international journal of animal bioscience*, 10(2):309–317.

White, I. R., Royston, P., and Wood, A. M. (2011). Multiple imputation using chained equations: issues and guidance for practice. *Statistics in medicine*, 30(4):377–399.

Wulff, J. N. and Ejlskov, L. (2017). Multiple imputation by chained equations in praxis: Guidelines and review. *The Electronic Journal of Business Research Methods*, 30:41–56.

Zahl-Thanem, A., Fuglestad, E. M., and Vik, J. (2018). Trender i norsk landbruk 2018- Et landbruk i endring. Ruralis – Institutt for rural- og regionalforskning.

Zahl-Thanem, A. and Melås, A. M. (2020). Trender i norsk landbruk 2020. Ruralis – Institutt for rural- og regionalforskning.

Zou, H. and Hastie, T. (2005). Regularization and variable selection via the elastic net. *Journal of the royal statistical society: series B (statistical methodology)*, 67(2):301–320.

Appendix

A1 Stratified Random Sampling

The stratified sampling is conducted by dividing the sample frame into counties, and within each county the sampling frame is divided into females and males. First, the correct number (according to the share of female farmers within each county) of female farmers is randomly selected. Secondly, the sampling frame within each county is divided into organic and conventional farmers. The correct proportion of organic farmers are then randomly selected. When deciding the number of organic farmers to select within a county, it is first checked whether any of the organic farmers are female. If that is the case, the number of organic farmers to be selected is reduced. Finally, the rest of the sample is randomly drawn from the remaining population within each county, according to the total number required.

For the sampling, we calculate the required response rate based on a confidence interval of 95 percent and a margin of error at 3 percent.

The desired precision is often expressed as (Lohr, 2022, p. 49):

$$\mathbf{P}\left(|\bar{y} - \bar{y}_u| \leq e\right) = \mathbf{1} - \alpha = 0.95 \tag{.1}$$

To calculate the minimum sample size required, n_0, we have:

$$n_0 = \frac{z_{\alpha/2}^2 S^2}{e^2} \tag{.2}$$

Where $z_{\alpha/2}$ is taken from the standard normal distribution table with an α at 0.05, e is the selected margin of error, and S^2 is the variance of the population values about the mean (Lohr, 2022). "For large populations, the variance is $S^2 \approx p(1-p)$ which attains its maximum value when p = 1/2" (Lohr, 2022, p.52), resulting in an estimated maximum variance of $S^2 \approx 0.5(1-0.5) = 0.25$ and a standard error of $S \approx 0.25^2 = 0.5$. Thus, the minimum required sample size is:

$$n_0 = \frac{1{,}96^2 0.25}{0.03^2} = 1067$$

1067 represents the required sample size for any large population. However, the required sample size can be corrected according to the finite population correction (fpc) (Lohr, 2022, p. 52). The adjustment of the sample size n_0 is given by:

$$n = \frac{n_0}{1 + \frac{n_0}{N}} \tag{.3}$$

In our case, this is equal to:

$$n = \frac{1067}{1+\frac{1067}{6486}} \approx 917$$

This implies that our minimum sample size is 917.

Estimating a response rate of about 40%, the total sample for the survey is calculated as follows:

$$n_{actual} = \frac{n}{re\%} \tag{.4}$$

where n_{actual} is the actual sample size required, n is the minimum sample size and re% is the estimated response rate expressed as a percentage (Saunders et al., 2019):

$$n_{actual} = \frac{1067}{0.40} = \ 2\ 668 \approx 2\ 700$$

With the given response rate the actual sample size required is 2 700. The figure below shows the final selected sample.

	County	Total population (Sampling frame)	Selected sample Female	Organic	Conventional	Sum
300	Oslo	1	-	-	-	-
1100	Rogaland	1 029	47	3	378	428
1500	Møre og Romsdal	584	22	4	218	244
1800	Nordland	432	20	3	158	180
3000	Viken	349	15	18	111	145
3400	Innland	1 254	62	20	441	522
3800	Vestfold Telemark	115	9	7	32	48
4200	Agder	241	11	2	86	100
4600	Vestland	924	40	2	343	385
5000	Trøndelag	1 321	72	32	446	550
5400	Troms Finnmark	236	18	2	78	98
SUM		**6 486**	315	93	2 291	**2 700**

Figure A1.1: The Survey Sample

A2 Respondents

In the sampling frame consisting of 6 486 Norwegian dairy farmers, 210 farmers are registered without an email-address. This implies that out of the sampling frame, 3.2% of the dairy farmers are not eligible for the survey. We could not obtain any information about whether this group has any characteristics, and thus we are not able to consider if it could cause a selection bias.

The survey was distributed the 7th of February 2022, first reminder 20th of February, and last reminder the 25th of February. The survey was closed on the 7th of Mars.

When calculating the response rate, one should define what is meant by a respondent (Lohr, 2022). According to Lohr (2022, p. 32) a respondent is a unit that "provides data for the survey". In this survey, respondents that have answered at least all the background questions are viewed as units that provide data. With this definition, we are left with 1 038 respondents, and a response rate of 38.4%. Among the respondents, there are 182 females (17%) and 52 organic farmers (5%). The total population has 11.7 % female farmers and 3.5 % organic farmers. Table A2.1 below, with the distribution of the respondents by counties, shows that the respondents are geographically well distributed.

County	Respondents	Proportion	Correct Proportion	Deviation
Oslo	0	0%	0%	0%
Rogaland	175	17%	16%	1%
Møre og Romsdal	87	8%	9%	-1%
Nordland	67	6%	7%	-1%
Viken	68	7%	5%	2%
Innland	198	19%	19%	0%
Vestfold og Telemark	23	2%	2%	0%
Agder	32	3%	4%	-1%
Vestland	139	13%	14%	-1%
Trøndelag	215	21%	20%	1%
Troms og Finnmark	34	3%	4%	-1%
Total	1038			

Table A2.1: Distribution of respondents

As shown in the table above, the respondents are geographically well distributed, while female and organic farmers are slightly overrepresented.

A3 Missing data

The questionnaire has the following distribution of missing data.

Table A3.1: Distribution of missing data in dataset II

Variable	Missing
CCC leads to poorer financial performance	31.4%
Approx. required investment to implement CCC	21.1%
CCC will become a future legal requirement	19.2%
Barrier: poorer financial performance	16.5%
Would implement CCC if financially compensated	16.2%
CCC will become more common	12.2%
Barrier: Work load	11.7%
CCC will give milk production better reputation	10.2%
CCC provides good FAW	9.8%
Barrier: Lack of knowledge 1	9.7%
The calf has equally good welfare without CCC	9.5%
The cow has equally good welfare without CCC	9.2%
Barrier: Calving seasons	9.1%
Barrier: Lack of knowledge 2	8.6%

Table A3.1 shows all variables with more than 5% missing data. For these variables, there are not found indications that the probability of N/A is dependent on the missing data variable itself. Further, the probability of responding seems to depend on other observed variables in the dataset. For instance, the probability of non-response on the question "CCC leads to poorer financial performance" seems to be related to "Previously tested CCC", as there is a larger proportion of missing among those who answered "no" on "Previously tested CCC". Thus, the type of missing data for "CCC leads to poorer financial performance" is likely to be MAR.

A4 Descriptive Statistics

Table A4.1 shows descriptive statistics for dataset I (production data). Note that the variables have their original value and are not standardized for the descriptive statistics.

Table A4.1: Descriptive statistics of production data (N=94)

Continuous variables	Mean	St. Dev.	Min	Median	Max
Milk quota	242 842	128 939	39 760	218 504	540 145
Birth year 19xx	72	12	35	72.5	98
Milk measurement controls	11.26	1.56	2	12	12
Number of milk samples for analysis	7.92	3.10	0	8	12
Kg milk per cow	7 727	1 174	5 225	7 706	10 548
Kg energy-corrected milk per cow	8 183	1 226	5 487	8 188	10 960
Number of dairy cows	32.14	15.44	7.50	30.15	64.40
Kg concentrates	30.72	6.75	7	31	50
Kg other fodder	68.42	12.59	30	68	128
Cow fertility (FS index)	61.53	25.13	2	66.5	122
Age of first calving	25.57	1.88	23.00	25.10	31.40
Milk protein content	3.48	0.12	3.28	3.46	3.97
Milk fat content	4.37	0.27	3.96	4.36	6.40
Milk delivered	225 794	125 294	35 812	196 286	514 585
Quota filling	0.92	0.11	0.56	0.95	1.07
Milk delivered 2020	226 310	125 509	36 602	196 823	514 585
Milk quota 2020	271 897	145 035	42 484	248 367	589 750
Delivery percentage 2020	92.68	13.90	33.20	93.20	152.60

Binary variables	0	1
Cow-calf contact	59.6%	40.4%
Female	18.1%	81.9%
Organic	89.4%	10.6%
Loose housing	34.0%	66.0%
Automatic milking system (AMS)	55.3%	44.7%
Approved for NDHRS	80.9%	19.1%

The following tables show descriptive statistics from the survey data (dataset II).

Table A4.2: Descriptive statistics of relevant variables from the survey (N=966)

Ordinal variables	Mean	St. Dev.	Min	Median	Max
Job satisfaction	5.085	1.540	1	5	7
Optimistic view on the future	3.975	1.738	1	4	7
FAW requirements negatively affects profits	5.679	1.694	1	6	7
Importance of earning money	6.136	1.130	1	7	7
Importance of product quality	6.618	0.748	1	7	7
Importance of environmental sustainability	5.591	1.327	1	6	7
Importance of autonomy	6.063	1.102	1	6	7
Importance of being proud of own work	6.379	0.952	1	7	7
Importance of animal welfare	6.520	0.743	1	7	7
Importance of maintaining traditions	4.921	1.738	1	5	7
Importance of securing domestic food production	6.085	1.349	1	7	7
Importance of maintaining cultural landscape	5.953	1.262	1	6	7
CCC leads to poorer financial performance	2.588	1.860	1	2	7
CCC provides good FAW	3.734	1.977	1	4	7
CCC will become a future legal requirement	3.904	2.167	1	4	7
CCC will become more common	4.043	1.912	1	4	7
CCC will give milk production better reputation	4.362	2.044	1	5	7
The calf has not equally good welfare without CCC	2.225	1.666	1	1	7
The cow has not equally good welfare without CCC	2.227	1.678	1	1	7
Absence of barrier: Cow barn layout	1.881	1.693	1	1	7
Absence of barrier: Calving seasons	2.859	2.150	1	2	7
Absence of barrier: Work load	2.071	1.705	1	1	7
Barrier: Knowledge 1	4.330	2.312	1	5	7
Barrier: Knowledge 2	4.301	2.327	1	5	7
Absence of barrier: Poorer financial performance	1.715	1.398	1	1	7
Would implement CCC if financially compensated	4.342	2.374	1	5	7
StayIntention	0.551	0.498	0	1	1
Optimistic view on future farm-economic conditions	0.273	0.446	0	0	1

Table A4.3: Descriptive statistics of binary variables in the survey data (N=966)

Binary variables	0	1
Organic	96.1%	3.9%
StayIntention	44.9%	55.1%
Optimistic view on farm-economic conditions	72.7%	27.5%

A5 SEM: Assessing the model fit

The Chi-Square (χ^2) measures the overall model fit of the model to the data. It measures the distance between the sample covariance (correlation) matrix and the fitted covariance (correlation) matrix. When interpreting the Chi-square one has to compare the obtained (χ^2)-value with the tabled value for the given degrees of freedom (df). A relative Chi-square-value ($\chi^2/2$) at less than 2 indicates a good model fit. However, the Chi-square model fit should be interpreted with caution due to its sensitiveness to larger sample sizes (Schumacker and Lomax, 2010). Other indices have emerged from the Chi-square, such as the CFI and the TLI. CFI is used to compare a restricted model with a full model using a baseline null model. This index rescales Chi-square into a 0, indicating no fit, to 1.0, indicating perfect fit. The TLI measure can be used to compare alternative models or to compare a proposed model against a null model (Schumacker and Lomax, 2010). Finally, the RMSEA determines whether the specified model approximated the data reasonably, where values closer to 0 indicate close fit (Beaujean, 2014).

The model in our analysis obtained a good overall model fit. When comparing the obtained (χ^2)-value with the tabled value for the given degrees of freedom, the model gets a value of 1.7, which indicates good model fit. Other model fit criteria are also applied. The model has a RMSEA of 0.028 which is less than 0.05, thus indicating close fit. The criteria of CFI and TLI also indicate good model fit, with values of 0.985 and 0.979 respectively.

A6 The Survey (in Norwegian)

When designing the questionnaire it is important to make it manageable for the farmers to answer questions without having to check through documents or other sources. Further, it is important to discuss which financial factors would provide value for the chosen research question. For example, we chose to not include questions about profits due to various reasons. Firstly, since the CCC lasts for a relatively short period of time, the probability of finding effects on operating profits is low, as the measure is affected by a number of factors and thus becomes too broad. Secondly, the survey was conducted in February/Mars before most farmers had the financial statement for 2021 ready. As a consequence, we considered profits to be of limited value in the research. Alternatively, contribution margin level could have been used, but this is something few farmers have knowledge about (B.G. Hansen- TINE SA, personal communication, January, 2022). This could potentially have led to a number of "Don't know"- or arbitrary responses. Thus, no financial questions would be asked on such an aggregate level, which is also confirmed by farmers during the compilation of the survey.

Kjære melkebonde! Takk for at du vil svare på denne undersøkelsen.

Du har nå mottatt en spørreundersøkelse om samvær mellom ku og kalv fra Ruralis – Institutt for rural- og regionalforskning i Trondheim. For at resultatene skal komme til nytte for deg som melkeprodusent trenger vi flest mulig svar. Vi håper du har anledning til å svare, undersøkelsen tar omtrent 15 minutter å gjennomføre.

Hvorfor fylle ut skjemaet?
Formålet med undersøkelsen er å finne ut hva norske melkebønder mener om samvær mellom ku og kalv i melkeproduksjonen, samt kartlegge hvor mange som har denne driftsformen i dag. Et viktig formål er også å undersøke hva bønder anser som hindringer for å endre til et system med samvær mellom ku og kalv.

Resultatene vil bli brukt i prosjektet SUCCEED – Funksjonelle løsninger for kontakt mellom melkeku og kalv. Prosjektet ledes av Veterinærinstituttet med Ruralis, Tine og NORSØK som forskningspartnere. Svarene du gir vil ikke kunne spores tilbake til deg eller ditt gårdsbruk i publikasjoner fra undersøkelsen..

Hvordan kan jeg delta?
Du deltar ved å klikke deg inn på vedlagt lenke. Undersøkelsen kan besvares fra mobil, nettbrett eller datamaskin. Når du har besvart alle spørsmålene, trykk "avslutt" for å sende inn dine svar.
Hvem skal svare?
Vi setter pris på om den som er hoveddriver av gårdsbruket fyller ut spørreskjemaet. Hvis det er din partner eller noen andre som i praksis utfører mesteparten av arbeidet på gården, ber vi om at han eller hun fyller ut spørreskjemaet. Alle spørsmål er formet slik at du ikke trenger å lete i andre dokumenter for å svare. Er du i tvil om svaret, ber vi deg gi et best mulig anslag fremfor å la være å svare. Hvis du er en del av en samdrift ber vi deg svare på spørsmålene med utgangspunkt i egen drift der du føler det passer, og med utgangspunkt i samdriften der du føler det passer bedre.

Deltakelse og personvern
Ruralis er ansvarlig for undersøkelsen og det er frivillig å delta. Hvis du velger å delta, innebærer det at du fyller ut og returnerer spørreskjemaet. Den praktiske gjennomføringen av undersøkelsen skjer gjennom programvaren SurveyXact. Vi har sendt ut denne invitasjonen til 2700 melkebønder, alle tilfeldig trukket fra Landbrukets Dataflyt (tidligere Produsentregisteret). Fra Landbrukets Dataflyt har vi fått din epostadresse, i tillegg til informasjon om areal og antall melkekyr. Vi innhenter også registerdata fra Ku-kontrollen som vi kobler til ditt organisasjonsnummer som bakgrunnsinformasjon i ulike analyser. Forskere ved Ruralis vil være ansvarlige for å koble informasjon om ditt gårdsbruk med svarene dine i spørreundersøkelsen, og all videre analyse vil foregå uten personopplysninger. Etter datainnsamlingen, og senest innen prosjektslutt 31/12-2023, vil koblingsnøkkelen bli slettet og data bli oppbevart uten personopplysninger. Det innebærer at dine personopplysninger, som epostadresse og organisasjonsnummer vil bli slettet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Undersøkelsen er meldt til personvernombudet for forskning, Norsk Senter for Forskningsdata (NSD). Svarene du gir vil ikke kunne spores tilbake til deg eller ditt gårdsbruk i publikasjoner fra prosjektet.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet har du rett til: a) få innsyn i hvilke personopplysninger som er registrert om deg, b) å få rettet personopplysninger om deg, c) få slettet personopplysninger om deg, d) få utlevert en kopi av dine personopplysninger (dataportabilitet), og e) å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger. Det har ingen negative konsekvenser for deg hvis du ikke vil svare eller senere velger å trekke deg.

Kontakt
Hvis du har spørsmål til undersøkelsen, eller ønsker å benytte deg av dine rettigheter, ta kontakt med: Brit Logstein (Forsker ved Ruralis), på epost (brit.logstein@ruralis.no) eller telefon: 99 58 23 86 NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17 På forhånd takk for at du tar deg tid til å fylle ut skjemaet!

Bakgrunnsspørsmål

Kjønn

(1) ❍ Mann

(2) ❍ Kvinne

(3) ❍ Annet

(4) ❍ Ønsker ikke å oppgi

Fødselsår (ÅÅÅÅ)

_____

Sivilstatus

(1) ❍ Gift

(2) ❍ Samboer

(3) ❍ Enslig

Driver du gården alene, eller sammen med samboer/ektefelle?

(1) ❍ Alene

(2) ❍ Sammen med samboer/ektefelle

(3) ❍ Sammen med annen familie

(4) ❍ Sammen med andre

Er gården en del av en melkesamdrift?

(1) ❍ Ja

(2) ❍ Nei

Er du oppvokst på gård?

(1) ❍ Ja, oppvokst med melkeproduksjon

(2) ❍ Ja, oppvokst med annen gårdsdrift

(3) ❍ Nei, ikke oppvokst på gård

Er din eventuelle samboer/ektefelle oppvokst på gård?

(1) ❍ Ja, oppvokst med melkeproduksjon

(2) ❍ Ja, oppvokst med annen gårdsdrift

(3) ❍ Nei, ikke oppvokst på gård

(4) ❍ Ikke relevant

Hva er din høyeste fullførte utdaninng?

(1) ❍ Grunnskole eller tilsvarende

(2) ❍ Videregående skole

(3) ❍ Universitet/høyskole inntil 3 år

(4) ❍ Universitet/høyskole over 3 år

Har du landbruksfaglig utdanning?

(1) ❍ Ja

(2) ❍ Nei

Anslå hvor stor prosentandel av husholdningens totale inntekt som kom fra produksjon av melk og storfekjøtt i 2021

(1) ❍ 0

(2) ❍ 1-19%

(3) ❍ 20-39%

(4) ❍ 40-59%

(5) ❍ 60-79%

(6) ❍ 80-99%

(7) ❍ 100%

Hvordan vil du beskrive standarden på brukets driftsbygninger?

(1) ❍ Meget dårlig	(2) ❍ Dårlig	(3) ❍ Middels	(4) ❍ God	(5) ❍ Meget god

Hvilket årstall (ÅÅÅÅ) ble melkefjøset bygd og/eller eventuelt vesentlig ombygd?

Opprinnelig byggeår	____
Siste eventuelle vesentlige ombygging/påbygging	

Driver du/dere melkeproduksjon i båsfjøs eller løsdriftsfjøs?

(1) ❍ Løsdrift

(2) ❍ Båsfjøs

(3) ❍ En kombinasjon

Har du/dere melkerobot?

(1) ❍ Ja

(2) ❍ Nei, men planlegger å anskaffe

(3) ❍ Nei

Driver du/dere konvensjonell eller økologisk produksjon?

(1) ❍ Konvensjonell

(2) ❍ Økologisk

(3) ❍ Under omlegging til økologisk

Ser du for deg at du/dere fortsatt er melkeprodusent om 5-10år?

(1) ❍ Ja

(2) ❍ Ja, men ikke mye lenger enn det

(3) ❍ Usikkert

(4) ❍ Nei

Hvilke planer har du/dere for melkeproduksjonen de neste to årene?

(1) ❍ Planlegger å øke

(2) ❍ Planlegger å redusere

(3) ❍ Ingen planer om endring

Hvor mange timer arbeidet du, din eventuelle ektefelle/samboer og andre på gården i løpet av 2021? (for eksempel gir 40 timers arbeidsuke i 50 av årets uker 2000 arbeidstimer totalt)

Antall arbeidstimer i 2021

	Deltar ikke i gårdsarbeidet	1-199	200-899	900-1599	1600-2299	2300-2999	3000-3499	3500 eller mer
Du selv	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Ektefelle/samboer	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Familie og andre	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Avløsere og annen leid hjelp	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍

Omtrent hvor mange hele dager i 2021 hadde du fri fra gårdsdrifta?

____

Økonomi

Vi vil nå be deg svare på noen spørsmål om økonomi. Er du i tvil om svaret, ber vi deg gi et best mulig anslag fremfor å la være å svare.

Hvor stor var samlet omsetning i kroner fra produksjon av melk og storfekjøtt i 2021?

(1) ❍ Under 1 000 000 kr

(2) ❍ 1 000 000 – 1 999 999 kr

(3) ❍ 2 000 000 – 2 999 999 kr

(4) ❍ 3 000 000 - 3 999 999 kr

(5) ❍ 4 000 000 - 4 999 999 kr

(6) ❍ 5 000 000 - 5 999 999 kr

(7) ❍ 6 000 000 kr eller mer

Hvor stort beløp har du/dere brukt på investeringer og vedlikehold av driftsbygninger tilknyttet melkeproduksjon i løpet av de siste fem årene?

(1) ❍ 0

(2) ❍ 1 – 999 999 kr

(3) ❍ 1 000 000 – 2 999 999 kr

(4) ❍ 3 000 000 – 4 999 999 kr

(5) ❍ 5 000 000 – 6 999 999 kr

(6) ❍ 7 000 000 – 8 999 999 kr

(7) ❍ 9 000 000 - 10 999 999 kr

(8) ❍ 11 000 000 - 12 999 999 kr

(9) ❍ 13 000 000 - 14 999 999 kr

(10) ❍ 15 000 000 kr eller mer

Hvor stort beløp planlegger du/dere å bruke på investeringer og vedlikehold av driftsbygninger tilknyttet melkeproduksjon i løpet av de neste 10 årene?

(1) ❍ 0

(2) ❍ 1 – 999 999 kr

(3) ❍ 1 000 000 – 2 999 999 kr

(4) ❍ 3 000 000 – 4 999 999 kr

(5) ❍ 5 000 000 – 6 999 999 kr

(6) ❍ 7 000 000 – 8 999 999 kr

(7) ❍ 9 000 000 - 10 999 999 kr

(8) ❍ 11 000 000 - 12 999 999 kr

(9) ❍ 13 000 000 - 14 999 999 kr

(10) ❍ 15 000 000 kr eller mer

Har økonomien i din kjøtt- og melkeproduksjon endret seg i positiv eller negativ retning de siste fem årene?

(1) ❍ Ingen endring

(2) ❍ Endret seg i positiv retning

(3) ❍ Endret seg i negativ retning

(4) ❍ Vet ikke

(5) ❍ Bruket har vært i drift i mindre enn 5 år

Tror du økonomien i din kjøtt- og melkeproduksjon vil endre seg i positiv eller negativ retning de neste fem årene?

(1) ❍ Ingen endring

(2) ❍ Endre seg i positiv retning

(3) ❍ Endre seg i negativ retning

(4) ❍ Vet ikke

Spørsmål om din praksis og meninger og om ulike forhold knyttet til det å jobbe som melkebonde

I hvor stor grad er du enig i følgende påstander, fra (1) helt uenig til (7) helt enig?

	(1) Helt uenig	(2)	(3)	(4)	(5)	(6)	(7) Helt enig
Jeg er tilfreds med jobben som melkebonde	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Jeg har et optimistisk syn på fremtiden	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Stadig nye krav til økt dyrevelferd går på bekostning av økonomien	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Hvor viktig, fra ikke viktig (1) til svært viktig (7) er følgende faktorer for deg som melkebonde?

	(1) Ikke viktig	(2)	(3)	(4)	(5)	(6)	(7) Svært viktig
Å tjene penger	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å produsere trygg og god melk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å drive på en miljømessig bærekraftig måte	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Å kunne styre min egen arbeidshverdag	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å gjøre en jobb jeg kan være stolt av	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å drive i tråd med god dyrevelferd	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å ta vare på tradisjonen	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å sikre produksjon av norsk mat	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Å ta vare på kulturlandskapet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Her er noen påstander om samvær mellom ku og kalv som vi ber deg ta stilling til. Med samvær menes at kua er sammen med sin egen kalv i mer enn 14 dager.

	(1) Helt uenig	(2)	(3)	(4)	(5)	(6)	(7) Helt enig	Vet ikke
Økonomien i samvær er dårligere enn uten samvær	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Samvær mellom ku og kalv bidrar til god dyrevelferd	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Jeg tror samvær mellom ku og kalv vil bli et forskriftsmessig krav i framtiden	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Jeg tror samvær mellom ku og kalv blir mer vanlig framover	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍

Jeg tror samvær mellom ku og kalv gir melkeproduksjonen et bedre omdømme i samfunnet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Kalven har like god velferd når den skilles fra kua innen noen timer etter fødsel, som ved samvær	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Kua har like god velferd når den skilles fra kalven innen noen timer etter fødsel, som ved samvær	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍

Hvordan er praksisen med ku og kalv på ditt gårdsbruk? Kryss av for det som passer best for deg.

(1) ❍ Jeg skiller ku og kalv innen noen timer etter fødsel

(2) ❍ Mine kyr går sammen med kalvene sine i inntil 14 dager

(3) ❍ Jeg lar kua være sammen med sin egen kalv i mer enn 14 dager

(4) ❍ Jeg lar mine kyr gå sammen med sin egen kalv de første dagene, deretter går kalvene med ammetanter

(5) ❍ Jeg benytter vanligvis ammetanter til kalven

Når kalver kyrne i din besetning?

(1) ❍ Spredt gjennom hele året

(2) ❍ Puljevis gjennom året

(3) ❍ Hovedsakelig vårkalving

(4) ❍ Hovedsakelig høstkalving

(5) ❍ Annet

Spørsmål til de som praktiserer samvær i dag:

Hvor mange dager lar du/dere vanligvis kalven gå sammen med mor?

_____

Hvor mange dager lar du/dere vanligvis kalven gå sammen med ammetante?

_____

Hvilket årstall startet du/dere med samvær mellom ku og kalv i melkeproduksjon?

_____

Hvor stort beløp investerte du/dere for å kunne ha samvær mellom ku og kalv?

(1) ❍ Ingen investeringer

(2) ❍ Under 10 000 kr

(3) ❍ 10 000 - 49 999 kr

(4) ❍ 50 000 - 99 999 kr

(5) ❍ 100 000 - 399 999 kr

(6) ❍ 400 000 - 699 999 kr

(7) ❍ 700 000 - 999 999 kr

(8) ❍ 1 000 000 eller mer

Hvilke tilpasninger har du/dere gjort i fjøset for å få til samvær? (flere valg mulig)

(1) ❑ Ingen spesielle

(2) ❑ Kjøpt grinder, planker, gummimatter o.l.

(3) ❑ Laget kalvegjemme

(4) ❑ Laget flere eller større fødebinger

(5) ❑ Anskaffet smart-grinder

(6) ❑ Kjøpt ny innredning

(7) ❑ Bygd om eksisterende fjøs

(8) ❑ Bygd tilbygg til eksisterende fjøs

(9) ❑ Lagt til rette for samvær ved bygging av nytt fjøs

(10) ❑ Annet: ______

Etter at du startet med samvær mellom ku og kalv, i hvor stor grad opplever du at du har fått...

	(1) Ikke i det hele tatt	(2)	(3)	(4)	(5)	(6)	(7) I svært stor grad	Vet ikke	Har alltid hatt samvær
...mer arbeid i fjøset	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...økt fleksibilitet i fjøsarbeidet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...økt trivsel for meg som bonde	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...flere ulykker og/eller svekket sikkerhet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...lavere kvotefylling	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...lavere melkeinntekt	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...behov for mer plass i fjøset	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...behov for flere kyr for å fylle kvoten	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍

Etter at du startet med samvær mellom ku og kalv, i hvor stor grad opplever du at du har fått...

I besetningen:

	(1) Ikke i det hele tatt	(2)	(3)	(4)	(5)	(6)	(7) I svært stor grad	Vet ikke	Har alltid hatt samvær
...kyr med bedre helse og mindre sykdom	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...dårligere fruktbarhet i besetningen	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...kalver med bedre helse og mindre sykdom	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...bedre tilvekst på kalvene	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...bedre adferd, læring og sosialisering hos kalven	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
...økt stress hos ku og/eller kalv ved separasjon	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍

Omtrent hvor mange liter anslår du at kalven drikker fra mora eller ammetanta i gjennomsnitt per dag?

(1) ❍ Liter i gjennomsnitt per dag: ______

(2) ❍ Vet ikke

Spørsmål til de som ikke praktiserer samvær i dag:

Har du/dere tidligere hatt ku og kalv sammen i mer enn 14 dager?

(1) ❍ Ja

(2) ❍ Nei

Hva var den viktigste grunnen til at du/dere gikk bort fra å ha ku og kalv sammen i mer enn 14 dager?

(1) ❍ Mindre melk å levere til meieriet

(2) ❍ Dårligere melkekvalitet

(3) ❍ Dårligere helse hos ku og/eller kalv

(4) ❍ Økt stress hos ku og/eller kalv ved separasjon

(5) ❍ Større arbeidsmengde

(6) ❍ Plassmangel

(7) ❍ Fare for ulykker eller svekket sikkerhet

Ta stilling til følgende påstander om samvær mellom ku og kalv, fra helt uenig (1) til helt enig (7)

	(1) Helt uenig	(2)	(3)	(4)	(5)	(6)	(7) Helt enig	Vet ikke
Slik fjøset er utformet i dag er det lite aktuelt å innføre samvær mellom ku og kalv	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Med dagens kalvingsperiode(r) er det ikke mulig å ha samvær mellom ku og kalv	(1) ❍	(2) ❍	(3) ❍	(4) ❍	5) ❍	(6) ❍	(7) ❍	(8) ❍
Samvær vil gi meg mer arbeid enn dagens praksis	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍

Før jeg eventuelt innfører samvær mellom ku og kalv trenger jeg mer tilgjengelig kunnskap om hvordan det kan gjøres i praksis	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Før jeg eventuelt innfører samvær mellom ku og kalv trenger jeg mer tilgjengelig kunnskap om fordeler og ulemper med denne måten å drive på	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍
Jeg ville lagt om til samvær mellom ku og kalv dersom jeg fikk kompensasjon for eventuelle merkostnader og tapte inntekter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍

Planlegger eller ønsker du/dere å starte med samvær mellom ku og kalv i mer enn 14 dager?

(1) ❍ Planlegger

(2) ❍ Ønsker

(3) ❍ Verken planlegger eller ønsker

Hvis samvær i mer enn 14 dager hadde blitt et forskriftsmessig krav i dag, hvilke tilpasninger måtte du/dere gjort for å innføre samvær? (flere valg mulig)

(1) ❑ Ingen spesielle

(2) ❑ Måtte kjøpt grinder, planker, gummimatter el.

(3) ❑ Måtte laget kalvegjemme

(4) ❑ Måtte laget flere eller større fødebinger

(5) ❑ Måtte anskaffet smart-grinder

(6) ❑ Måtte satt inn ny innredning

(7) ❑ Måtte bygd om eksisterende fjøs

(8) ❑ Måtte bygd tilbygg til eksisterende fjøs

(9) ❑ Måtte bygd helt nytt fjøs

(10) ❑ Vet ikke

(11) ❑ Annet: ______

Hvis samvær i mer enn 14 dager hadde blitt et forskriftsmessig krav i dag, om lag hvor stort beløp måtte du/dere investert for å innføre samvær?

(1) ❍ Ingen investeringer

(2) ❍ Under 10 000 kr

(3) ❍ 10 000 - 49 999 kr

(4) ❍ 50 000 - 99 999 kr

(5) ❍ 100 000 - 399 999 kr

(6) ❍ 400 000 - 699 999 kr

(7) ❍ 700 000 - 999 999 kr

(8) ❍ 1 000 000 kr eller mer

(9) ❍ Vet ikke

Har du andre kommentarer til samvær mellom ku og kalv i melkeproduksjonen?

____
____
____
____
____
____

Tusen takk for at du tok deg tid til å svare på denne spørreundersøkelsen!
Vennligst trykk avslutt for å sende inn dine svar.