FACULTY OF LIFE SCIENCES
UNIVERSITY OF COPENHAGEN

Risk Factors of Bovine Cysticercosis in Cattle Herds in Denmark

Veterinary Thesis 27 ECTS

Dorte Murmann Clausen V9461

Supervisor:
Liza Rosenbaum Nielsen
Associate Professor, DVM, PhD
Department of Large Animal Science

Co-supervisors:
Francisco Fernando Calvo Artavia, DVM, Msc, PhD Student
Department of Large Animal Science

Lis Alban, Chief Scientist, DVM, PhD, Dipl. ECVPH
Danish Agriculture and Food Council

Preface

This veterinary thesis was composed at the Department of Large Animal Science at The Faculty of Life Sciences, University of Copenhagen during fall 2010 and January 2011. The objective of the thesis is to pass the results of a case-control study identifying risk factors of bovine cysticercosis in Danish cattle herds to persons with interest in the subject. The thesis applies to veterinarians, farmers and scientists in the Danish cattle industry and meat industry.

I would like to send a big thanks to the 308 farmers interviewed during October. Also I would like to thank Poul Møller Hansen, Danish Agriculture & Food Council for providing recordings of *Cysticercus bovis* positive animals from the Danish abattoirs, Ole Nielsen, Knowledge Centre for Agriculture for providing movement data of *Cysticercus bovis* positive animals and Flemming Thune- Stephesen, Danish Agriculture and Food Council for providing information about abattoir procedures.

I would like to thank Anne Mette Graumann, AgroTech for feedback and help creating the questionnaire and Mette Høst Hammershøj also for feedback and for conducting interviews of the farmers.

For financing the project I would like to thank The Danish Livestock and Meat Board.

For inspiration and great support through the period of the study I would like to thank my supervisor Liza Rosenbaum Nielsen. Also I would like to thank to my co-supervisors Francisco Fernando Calvo Artavia for inspiration and technical support and Lis Alban for inspiration and hints.

Thank to Mogens Jakobsen, Boehringer-Ingelheim for arranging printing of the report, and to Ninna Schultz and Lisbeth Norup for proofreading parts of the thesis.

Frederiksberg, January 21st 2011

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Dorte Murmann Clausen V9461

Summary

The aim of this veterinary thesis was to identify risk factors of bovine cysticercosis in cattle herds in Denmark. It is a part of the work providing documentation for potential changes in the meat inspection of bovine cysticercosis towards a risk-based system. A questionnaire with 24 main questions and 24 sub questions were developed and included questions that were thought to cover potential risk factors for bovine cysticercosis based on a literature review and hypothesised associations. A case control study was conducted where 77 case herds and 331 control herds were interviewed by telephone in October 2010 regarding routines in the herd. The herds were selected based on recordings of cyst-positive and cyst-negative animals detected at Danish abattoirs in the study period January 2006 until July 2010.

A logistic analysis was performed and the results were that the probability of being a *Cysticercus bovis* positive herd increased with herd size, the risk was around twice as high in herds having all animals grazing compared to herds having none or some of the animals grazing in the herd, and it was a risk to allow cattle to drink from a risky water source (streams, rivers, lakes and surface water) while having a sewage treatment plant in proximity of the farmland. These risk factors are logical as they are closely linked to the life cycle of the parasite.

Other risk factors were identified, but were more difficult to explain. It was indicated that it is a risk factor for cattle herds for being *Cysticercus bovis* positive to share machinery or hire contractors. It was also indicated that the risk of the herd being *Cysticercus bovis* positive was significantly higher when person with daily access to the herd were all older than 50 years or older than 50 years and less than 18 years old, meaning that there were no persons in the age 18-50 years old that had daily access to the herd. It most likely that the risk associated with the age of persons with daily access to the herd is an indicator for some other underlying factor(s) related to age, but not explained by the data this study provided.

Resumé

Formålet med dette veterinære speciale var at identificere risikofaktorer for bovin cysticercose i danske kvægbesætninger. Specialet er en del af et projekt der skal give dokumentation for eventuelle ændringer i kødkontrollen for bovin cysticercose i retning af et mere risikobaseret sytem. Et spørgeskema med 24 hovedspørgsmål og 24 underspørgsmål blev udviklet og inkluderede spørssmål, der blev anset for at dække potentielle risikofaktorer for bovin cysticercose baseret på en litteraturgennemgang og antaget hypoteserEt case-control studie blev udført, hvor 77 case besætninger og 331 kontrol besætninger blev interviewet via telefon i oktober 2010 om rutiner i besætningen. Besætninger blev udvalgt på baggrund af registreringer af cyste-positive og cyste-negative fund hos kvæg på danske slagterier i studie perioden januar 2006 til juli 2010.

En logistisk analyse blev udført, og resultaterne var, at sandsynligheden for at være en *Cysticercus bovis* positiv besætning steg med besætningsstørrelse, det var en ca. dobbelt så stor risiko ved at have alle dyr på afgræsning i forhold til besætninger der havde ingen eller nogle dyr i besætningen på afgræsning, og det var en risiko at tillade kvæg at drikke fra såkaldt risikabelt drikkevand (vandløb, åer, søer og overfladevand) og samtidig have et rensningsanlæg i nærheden af landbrugsjorden. Disse risikofaktorer er logiske i forhold til parasittens livscyklus.

Andre risikofaktorer blev identificeret, men var svære at anskueliggøre. Det blev indikeret at det er en risikofaktor for kvægbesætninger at blive *Cysticercus bovis* positiv når der anvendes maskinstation eller maskinfællesskab. Samtidig blev også indikeret at risikoen for at en besætning er *Cysticercus bovis* positiv var signifikant højere, når personer med daglig adgang til besætningen, alle var ældre end 50 år eller ældre end 50 år og yngre end 18 år, hvilket betyder, at der ikke var nogen personer i alderen 18-50 år, der havde daglig adgang til besætningen. Det mest sandsynligt, at den risiko, der er forbundet med alder af personer med daglig adgang til den besætning, er en indikator for nogle andre underliggende faktorer relateret til alder, men som ikke forklares med de data, dette studie stiller til rådighed.

Indhold

Introduction

Cattle are the intermediate hosts of the tapeworm *Taenia saginata* (*T. saginata*) causing taeniosis in humans. The larval stage of *T. saginata* is causing bovine cysticercosis (beef measles) in cattle. Cattle are infested by *T. saginata* eggs in human faeces and humans are infested by eating raw or undercooked infested beef (Flisser *et al.* 2005).

All cattle older than 6 weeks are inspected for bovine cysticercosis at the abattoirs in Denmark and it is mandatory to record cyst-positive animals (EC 2004b) . The inspection involves incisions and inspection of the masseter muscles and heart followed by visual inspection of diaphragm (EC 2004b; Anonymous 2009a). Even though all cattle are inspected only a few number of cyst-positive animals are recorded yearly. For instance in 2008 and 2009 the numbers of registered approved slaughtering of cattle in Denmark were 489,200 and 480,900 (Anonymous 2010b) and numbers of cyst-positive animals recorded in the Danish Cattle Database were 28 (0.0057 %) and 31 (0.0064 %).

According to the national surveillance of communicable diseases in Denmark at Statens Serumsinstitut (SSI) there were 8, 2 and 5 *Taenia* subspecies positive faeces samples detected at the laboratory in 2006, 2007 and 2008 respectively. This only covers a fraction of human cases in Denmark and these numbers cover both *Taenia solium* and *T. saginata* cases and infestations gained both abroad and in Denmark (Anonymous 2009b). This shows that taeniosis caused by *T. saginata* in humans does occur in Denmark. However, because it is not mandatory to report cases of taeniosis (SSI 2010) it is impossible to give an exact number of humans infested in Denmark. But the numbers from the laboratory at SSI give an impression that taeniosis caused by *T. saginata* in humans in Denmark is rare. A rough estimation of people infested yearly in Denmark based on the sale of the cestocide niclosamid in 1986 were 0, 02 % (Ilsoe *et al.* 1990a) and there is no indication of an increase in the number of infested humans in Denmark.

It is costly to perform meat inspection of bovine cysticercosis in all cattle slaughtered resulting in finding and recording quite few cyst-positive animals and in relation to the assumed low number of human cases diagnosed yearly. This veterinary thesis is a part of the work providing documentation for possible changes to the meat inspection of bovine cysticercosis towards a risk-based system which will reduce the costs. Therefore it is interesting if it is possible to define certain risk factors of bovine cysticercosis in Danish cattle herds that might help classify cattle herds as high or low risk in the future.

Number of cattle slaughtered, geographical location, free access of cattle to surface water and proximity of wastewater effluent have been identified as risk factors of bovine cysticercosis in a Belgian study (Boone *et al.* 2007). Herd type, herd size and also geographical location has been found to be factors that are statistically significant in a study in Spain (Allepuz *et al.* 2009). A Swiss study identified the following risk factors of bovine cysticercosis: a presence of a railway line or a car park close to areas grazed by cattle, leisure activities around these areas, use of purchased roughage and organized public activities on farms attracting visitors (Flutsch *et al.* 2008). Septic tank sludge applied on farmland were identified as the most common route of infection in Danish herds with cases of massive bovine cysticercosis (Ilsoe *et al.* 1990a). In a case-control study carried out by Kyvsgaard *et al.* (1991) in South Jutland, the most important risk factor identified was allowing the animals to drink from streams carrying effluent from sewage treatment plants.

Even though the studies conducted recently are from European countries it is possible there is some national differences compared to cattle herds in Denmark. The studies carried out in Denmark were performed approximately 20 years ago and infested herds were based on grade of infection also the study of Kyvsgaard *et al.* (1991) was limited to a part of Denmark. The numbers of cattle herds have decreased and the herd sizes have increased especially in the dairy herds since then (Anonymous 2009c). Furthermore it is possible that changes in management practices in the cattle herds have occurred.

The aim of this veterinary thesis is therefore to make an attempt to identify risk factors of bovine cysticercosis in cattle herds all over Denmark. This was done by conducting a case control study where 77 case herds and 331 control herds were interviewed regarding herd demographics, feeding and grazing practises, management practices, access of people to the farm, location of farm and toilet facilities in the stable. The herds were selected based on recordings of cyst-positive and cyst-negative animals at the Danish abattoirs in the study period January 2006 until July 2010.

The literature used in this thesis is mainly studies from western countries with culture and life style comparable to Denmark. The larval stage of *T. Saginata* causing bovine cysticercosis is referred to as *Cysticercus bovis.*

1 Theory

1.1 Life cycle

Humans are the only carriers of *T. saginata* and the only route of infestation of humans are raw or undercooked beef that have not been frozen infested with *Cysticercus bovis*. After ingesting the infested meat the larvae is released from the cyst and attaches to the intestinal wall in jejunum and develop into the adult tapeworm *T. saginata* (Pawlowski & Murrel 2001). The prepatens period is 3 months and the tapeworm starts to produce proglottids which contain 50,000 to 80,000 eggs. The proglottids are shed with human faeces or migrate from the host independently of defecation and the infestations in humans may remain for up to 25 years (Flisser *et al.* 2005). The symptoms in humans are mild these include abdominal discomfort, weight loss, mild diarrhoea and anal pruritus related to migrating proglottids (Dorny & Praet 2007).

When cattle are infested with eggs from *T. Saginata* the eggs are activated in the gastrointestinal canal and start migrating through the mucosa of the intestinal wall and begin to create cysts in muscles (Flisser *et al.* 2005). The development is fulfilled after 4-5 months and the primary locations of cyst are in the skeletal muscles and heart muscle (Scandrett *et al.* 2009). The cysts become infective to humans in about 10 weeks (Dorny & Praet 2007). A viable cyst is 6-10 mm and contains fluid but after a few months degeneration begins and after 9 months a large part of the cysts are calcified (Flisser *et al.* 2005).

It is possible that a minimal dose of eggs is required to cause infestation of bovin cysticercosis in Cattle. Previously unexposed calves developed 3-8 cysts when exposed to 30-100 *T. Saginata* eggs and exposed to 500 eggs induced 60-80 cysts (Jepsen & Roth 1949). In a study by Scandrett *et al.* (2009) where 42 beef cattle where inoculated in the rumen with different amount of *T. Saginata* eggs. Cyst-negative animals were detected among the animals inoculated with less than 100 eggs (4 among 10 animals inoculated with 10 eggs and 1 among 10 animals inoculated with 100 eggs).

1.2 Immunity

It should be kept in mind that cattle are capable of acquiring resistance to reinfestation (Penfold & Penfold 1937; Urquhart 1961) but the number of eggs required has not been precisely determined (Murrell 2005). Dorny *et al.* (2000) suggest that countries with a frequent transmission of *T.saginata* between humans and cattle the young cattle are more likely to become infested and gain immunity to reinfestation, compared to Western Europe where transmission is more hazardous and therefore exposure time may be more important.

1.3 Sources of infestations of *Cysticercus bovis*

The routes of infestations in cattle of bovine cysticercosis can be direct or indirect. Direct contamination is referring to human defecation directly at for instance pasture, fodder and water supplies. Indirect route of infection refer to cross contamination of for instance fodder, water supplies and pasture (EFSA 2004).

1.4 Viable Eggs in the Environment

Water is described as being of importance in relation to infestations of bovine cysticercosis in several studies. Water from a local creek used as water supply was suggested as a source of infestation in a feedlot in Canada (Scandrett & Gajadhar 2004). Using a scoring system based on a risk assessment system developed by EFSA water supply was found to have the highest score among 23 infested farms in Spain (Allepuz *et al.* 2009). As mentioned previously allowing the animals to drink from streams carrying effluent from sewage treatment plants is a risk factor (Kyvsgaard *et al.* 1991) and free access to surface water, proximity to wastewater effluent and flooding of pastures are risk factors (Boone *et al.* 2007). The study by Ilsoe *et al.* (1990a) found that grazing in close proximity to a sewage treatment plant probably was the source of infestation in two herds. These two herds also had direct contact to the streams carrying the effluent. The survival of eggs in water has been reported to be approximately a month (Jepsen & Roth 1949; Hadjuk *et al.* 1969).

For survival of *Taenia* eggs in the environment high humidity and low to moderate temperatures is required (Ilsoe *et al.* 1990b). In a study simulating sewage treatment processes proglottids ruptured after 30 days at 4˚C and number of viable eggs fell rapidly after 50 days and at 35˚C the proglottids started to rupture and release eggs after 20 days in liquid stored sludge (Storey 1987).

Also mentioned in the introduction Ilsoe *et al.* (1990a) found that sludge from septic tanks was a source of infestation. The sludge was illegally applied to farmland and in some cases after having been mixed with slurry. In the study by Kyvsgaard *et al.* (1991) significantly more of the owners of herds with cyst-positive animals recorded that machinery used for handling liquid manure also had been used for emptying septic tanks. Cross contamination of cattle manure with human faeces therefore has to be kept in mind.

Sewage sludge applied to farmland has been considered as a risk of spreading viable eggs and has been linked to outbreaks of bovine cysticercosis in Denmark (Nansen & Henriksen 1986), but Kyvsgaard *et al.* (1991) could not demonstrate a definite risk in the use of sewage sludge as a fertilizer.

Survival of eggs in soil in Danish climate can be up to approximately 8 months depending on season (Ilsoe *et al.* 1990b). Also it has been reported that eggs can survive in hay for 22 days (Lucker & Douvres 1960) in silage for 80 days (Enigk *et al.* 1969) and on grass for more than 180 days (Hadjuk *et al.* 1969). Birds may also play a role in distributing viable *T. saginata* eggs as it has been reported that seagulls shot near a sewage treatment plant in Denmark were carrying viable *Taenia* eggs (Guildal 1956).

Human contact to cattle herds and farmland of course also has to be considered. Assumed sources of outbreaks of bovine cysticercosis in feedlots in Canada have been described as; Vegetable refuse contaminated by an human carrier and fed to the cattle (Bundza *et al.* 1988) and an infested employee who failed to observe desirable personal sanitary practices (McAninch 1974). According to Flutsch *et al.* (2008) four of the risk factors found was related to possible contaminating farm or grazing areas by humans (railway line or a car park close to areas grazed by cattle, leisure activities around these areas and organized public activities on farms attracting visitors). Tourist from countries with a higher human prevalence of taeniasis has also being suggested having a significant importance of shedding eggs to the environment (Ilsoe *et al.* 1990a). Countries as for example Slovakia, Turkey and Afghanistan have been reported having prevalence up to 10 % of human taeniosis (Cabaret *et al.* 2002).

1.5 Meat inspection in Denmark

The *post-mortem* meat inspection of bovine cysticercosis in Denmark is based on the "knife and eye" method at assumed predilection sites which are; heart, masseter muscles, diaphragm, oesophagus and tongue (Dorny *et al.* 2005).

The legislation requires at the routine meat inspection that six incisions are involved in the in the examination of the masseter muscles; two in the external muscle and one in the internal muscle parallel to the mandible (EC 2004b; Anonymous 2009a). In the examination of the heart it is required to do lengthwise incision of the ventricles and the intraventricular septum is intersected (EC 2004b; Anonymous 2009a). The diaphragm and oesophagus are visual inspected and the tongue is palpated as well as visual inspected (EC 2004b; Anonymous 2009a).

The Danish meat inspection circular describes that if a cyst viable or dead is detected in an animal at the routine meat inspection further investigation follows. The masseter muscles, the diaphragm and the heart are sliced into thin slices and all muscle groups are thoroughly inspected. If 10 cysts are detected either viable or dead the tongue and underlying musculature also has to be sliced. If more than ten cysts viable or dead are detected at this investigation the carcass and organs are discarded. If up to 10 viable or dead cysts are detected at the investigation there are different possibilities of approval of the carcass:

- If less than 10 or 10 viable or dead cysts are detected then the carcass can be approved for human consumption, if the carcass has been subjected to freezing for at least 10 days at a temperature of at least -10˚C.
- But if an animal is more than two years old and up to 10 dead cysts are detected the carcass can be approved without being subjected to freezing.

Head, heart, diaphragm, oesophagus, organs with cysts and tongue if sliced at the investigation are always discarded regardless of viability of cysts and age of animal (Anonymous 2009a).

Light infections of *Cysticercus bovis* are assumed to be the most common in European countries and therefore also in Denmark (Dorny & Praet 2007). Kyvsgaard N.C. *et al.* (1990) demonstrated that the sensitivity is low at routine meat inspection in cattle harbouring only few cysts. In the study, where the cattle were experimentally infested with different doses of eggs, it was detected that in light infested animals 15.7 % of the cysts were located in the

heart and 6.7 % of the cysts were located in the masseter musceles (Kyvsgaard N.C. *et al.* 1990). Other studies abroad has also demonstrated a low sensitivity to the traditionally meat inspection of bovine cysticercosis (Dorny *et al.* 2000; Scandrett *et al.* 2009). The low sensitivity can also be linked the person performing the meat inspection as incision technique is important (Biering-Soerensen 1977) and viable cysts might be harder to recognize by the human eye (Wanzala *et al.* 2003).

1.6 Questionnaire Design and Interviewing

There are three main question types; open questions which allows the respondent to answer freely, closed questions were the answers are already formulated and semi-open questions were answers are already formulated but additional information is possible (Nielsen *et al.* 2004; Dohoo *et al.* 2009b). Closed and semi-open questions will classify the outcome as qualitative dichotomous, qualitative nominal or qualitative ordinal. Open questions will classify the outcome as quantitative discrete or continuous (Nielsen *et al.* 2004). Questionnaires can be either quantitative or qualitative (Dohoo *et al.* 2009b). Qualitative questionnaires often are used for acquiring background knowledge and often consist of open questions (Nielsen *et al.* 2004; Dohoo *et al.* 2009b). Quantitative questionnaires are designed to collect data for hypothesis testing and can be conducted as standardized questionnaires meaning that all questions are put in the same way to all respondents (Nielsen *et al.* 2004).

1.6.1 Validity and Reliability of Questions

The validity and reliability are measurements of how well the questions succeed in their purpose (Oppenheim 1992) . Validity refers to if the question measure what it is supposed to measure (Oppenheim 1992) and can be evaluated by a visit of the farm to observe the true conditions (Nielsen *et al.* 2004). Sometimes an independent source of information such as a database can also be used to evaluate the validity of a question (Oppenheim 1992). The reliability measures the consistency and repeatability of a question (Oppenheim 1992). The repeatability can be tested by giving respondents the same questions twice and the results are compared (Schukken *et al.* 1989; Nielsen *et al.* 2004). Type of errors can be due to coding and typing errors or respondent/interviewer differences either caused by a different interpretation of the answer by the interviewer or the respondent answering differently the second time (Schukken *et al.* 1989).

1.6.2 Computer Assisted Telephone Interviewing

Telephone interviews are timesaving and cheap (Olsen H. 2006) and the response rate is often high (Nielsen *et al.* 2004). Sensitive questions are often more useful when conducting telephone interviews due the anonymity of the respondent compared to face to face interviews (Olsen H. 2006). The interviewer can provide guidance if misunderstandings of questions occur and therefore reduce information bias (Nielsen *et al.* 2004). Interviewer bias may occur when telephone interviews are performed due to the interaction between the interviewer and respondent (Dohoo *et al.* 2009b) and a risk of prejudged categorization of the respondent by the interviewer is also possible (Nielsen *et al.* 2004). Telephone interviews require questions that are short and easy to communicate, therefore open questions are not recommendable (Olsen H. 2006). Telephone interviews also has to be kept time limited in concern of the respondent (Olsen H. 2006; Dohoo *et al.* 2009b).

(Hansen & Couper 2004) describe some interactions between the interviewer, the computer and the respondent that have to be considered when performing computer assisted interviews, in order to complete an interview. The interviewer's focus of attention is divided between the respondent and the computer. The interviewer has to read the question to the respondent from the screen and collect the data in the computer which the respondent provides. The success of the interview is very dependent on the interviewer's ability to cope with these multiple tasks.

2 Materials and Methods

The method used to identify possible risk factors of bovine cysticercosis in Danish cattle herds was a secondary based case-control study. The term secondary based refer to that the study base is registrations from a central registry (Dohoo *et al.* 2009a). A semi-quantitative standardized questionnaire was made to perform computer-assisted telephone interviews of persons in the herds included in the study.

2.1 Selecting case herds

The case herds were selected based on recordings of bovine cysticercosis in Danish abattoirs from January 2004 until July 2010. There were 205 recorded cyst-positive animals in this period. An animal was considered cyst-positive whether more or less than 10 cysts were detected at meat inspection. Movement data from the Danish Cattle Database was combined with the recorded cyst- positive animals. This way it was possible to detect which herds the animals spent time in and therefore which herds were most likely to be the case herds. Due to a change in the recording system introduced in 2006 at the abattoirs 80 case herds were selected based on cyst- positive animals recorded from January 2006 to July 2010. The following table 2.1 show the number of cyst- positive animals in the restricted study period.

Table 2.1: Number of cyst-positive animals recorded from January 2006 to July 2010

Year	Number
2006	35
2007	14
2008	28
2009	31
2010	9
Total	117

The selection of the 80 case herds based on investigation of movement pattern of the cyst-positive animals in the study period was based on the following decisions:

- If an animal stayed in only one herd that herd was selected as a case herd. The animal was born in this herd and then going directly to the abattoir. There were 69 case herds of this type that represented 72 of the cyst-positive animals (three herds were represented by two animals each).
- Animals which spent time in two herds a threshold of 100 days was set. If an animal spent less than 100 days in the first herd the first herd was not considered a case herd and the second herd was chosen as the case herd. There were 11 case herds of this type representing 11 of the cyst-positive animals.

A typical combination of two herds were a bull calf born in a dairy herd an then going into a veal calf herd or a beef herd. In table 2.2 it is shown how the selected case herds were distributed in relation to animals staying in one or two herds.

Table 2.2: Distribution of case herds in relation to animals staying in one or two herds

Stayed in only one herd	69 herds
Stayed in two herds:	
1st herd: Dairy ≤ 60 days 2nd herd: Veal or beef	8 herds
1st herd: Dairy > 60 days* 2nd herd: Veal or beef	1 herd
1st herd: Dairy ≤ 60 days, 2nd herd: Dairy	1 herd
1st herd: Beef > 60 days* 2nd herd: Beef	1 herd
Total	80 herds

*Stayed more than 60 days in the herd but less than 100 days

Herds not selected as case herds based on investigation of movement pattern of the cyst-positive animals in the study period was based on the following decisions:

- If an animal stayed in more than two herds none of the herds were selected as case herds.
- If an animal stayed in two herds but more than 100 days in each none of the herds were selected as case herds.
- Animals fulfilling the criteria for being selected as a case herd but ceased before the 1st of January 2009.

For the animals that spent more than 100 days in at least two herds it was considered impossible to know which one of the herds were the real case herd and thus these herds were not included as case herds.

2.2 Selecting control herds

The aim was to have 3 control herds for each case herd because of the rather small number of case herds. This improves the power of the study compared to having one control per case and usually there is no benefit in having more than 3-4 controls per case (Dohoo *et al.* 2009a). The control herds were selected randomly among all types of cattle herds in Denmark using the Danish Cattle Database. However the control herds were stratified on dairy and non-dairy. These were herds that were considered negative of any detection of bovine cysticercosis in the period between January 2004 and first quarter of 2010. Herds in which there had been cyst-positive animals but not selected as case herds were not able to be selected as a control herd. Furthermore herds where animals spent less than 100 days in the restricted study period (January 2006 to July 2010) were not allowed to be selected as a control herd.

2.3 Computer-assisted telephone interviews

A questionnaire was made to gain information about the herds not available in the Danish Cattle Database. Subjects covered in the questionnaire were:

- "Basic Information" including questions about position of respondent in the herd, number of people with daily access to the herd and knowledge of *Cysticercus bovis*.
- "Cattle Production" including questions regarding confirmation of herd type registered in the Danish Cattle Database, use of heifer hotel, feeding and grazing practice, flooding of grazing land and drinking facilities when animals were grazing.
- "Management" including questions regarding fertilization of farmland, use of suction machinery and use of shared machinery or hired contractors.
- "Staff and Visitors" including questions regarding number of employees and their nationality and the use of the farm involving people from "outside".
- "Location of Farm" including questions regarding proximity of a sludge sewage treatment plant, camping site, picnic area, parking area, shelter, concert area and area for military exercises. Also questions regarding toilet facilities in the stable and knowledge of people diagnosed with taeniosis with access to the farm were included in this section.

An English version of the questionnaire is provided in Appendix A.

The questionnaire was made in multiple steps during September 2010 in cooperation with the supervisors and the author of this veterinary thesis. Also one of the interviewers and a consultant from the agricultural advisory firm AgroTech A/S who have experience in creating questionnaires gave feedback. The questions made were based on risk factors identified in previous studies and other relations assumed to be relevant.

The questionnaire consisted of 48 questions. The number of closed questions was 31, number of semi-open questions was 10 and number of open questions was 7. Furthermore 7 boxes for additional comments were included in the questionnaire. The 48 questions is the number of both main and follow-up questions. Not all respondents were asked all 48 questions, follow-up questions of no relevancy in the particular interview the respondent were not asked. For instance if the respondent had answered no to having animals grazing, the respondent was not asked which groups of animals had been grazing.

A translation from English to Danish of the questionnaire was made to be set up in the internet based program SurveyXact® by an employee at AgroTech A/S. The Danish version of the questionnaire exported from SurveyXact® to Microsoft Word is provided in Appendix B. The registrations were made by choosing one or several options or writing comments in the program SurveyXact® and were saved automatically.

A letter with information about the project was sent to the farmers ultimo September before calling them. The interviews were done during October 2010 by an interviewer from AgroTech A/S and by the author of this veterinary thesis. The number of letters sent out was 331 (80 case herds and 251 control herds) and the interviewers tried to reach all farms.

Before calling the farm the interviewer gain information about contact information, type of farm, size of herd, if there were any veterinary problems in the herd and if the herd had stopped by looking at the second screen picture in SurveyXact®. This information from each herd had been collected from the Danish Cattle Database and put into the program. When a farm was called the person reached were informed that it was important that the respondent of the interview should be the person who knew most about the current herd and production and 5 years back. The duration of the interviews were in most cases 10 – 15 minutes. The ten first herd called were considered as test herds, but all were still included in the study. Only some small technical changes were made after calling these 10 herds, and the changes had no influence of the outcome of the answers.

2.4 Data Management

An overview of distribution of answers and comments in the questionnaire called a Frequency Analysis in SurveyXact® were imported from SurveyXact® to Microsoft Word. Distributions of answers are provided in Appendix C and comments in Appendix D. Results of answers in the questionnaire were also exported from SurveyXact® directly to Microsoft Excel and a final dataset were created for statistical analyses.

Univariable analyses were performed using Fisher's exact test in SAS® version 9.2. Variables with *p*-values less than 0.2 in the Fisher's Exact Tests and variables assumed to be of importance were further analyzed in a multi variable model. Correlation between variables decided to be further analyzed in a multi variable model were checked in SAS® version 9.2 by using spearman's correlation coefficient. When a correlation coefficient was > 0.75 or < -0.75

a correlation between variables was considered too high for both variables to be analyzed in the model simultaneously. The linear relation between the explanatory continuous variable herd size in the logistic analysis and the probability of being a case herd were evaluated in the raw data before being used further in the analysis. The multivariable logistic analysis was performed in SAS® version 9.2 by the genmod procedure. Due to the sample size stepwise inclusion of variables was used and the significance level for variables to remain in the final model was 5%.

Some of the answers from the questionnaire were grouped or questions were combined and new variables were created. This was either due to a low number of answers or reasonable biological explanations. Furthermore all text answers and comments were evaluated and relevant answers and comments were grouped in a variable as well. A log was kept regarding decisions made when answers was grouped. It was reported in Appendix C how groping of answers or comments have been performed.

3 Results

The Frequency analysis imported from SurveyXact® to Microsoft Word provides an overview of distributions of answers (numbers of respondents and percentages) see Appendix C. Tables with descriptive statistics and results of *p*-values from the Fisher's exact tests in the univariable analyses performed are added continuously in the Frequency Analysis and therefore also provided in Appendix C. Comments and text answers imported from SurveyXact® are provided in Appendix D and referred to in Appendix C. Appendix D is in Danish.

3.1 Response rate of computer-assisted telephone interviews and case-control ratio

As mentioned previously letters with information about the project were sent to 331 herds. The total number of herds which participated in the study was 308 (93.1 %). Out of the 80 case herds selected 77 (96.3 %) participated and 231 (92.0 %) of the 251 control herds participated. Therefore 23 herds (6.9 %) did not participate. Six of the not participating herds the interviewers were not able to reach, and 17 herds did not want participate due to either business on the farm, they did not believe that the project would be beneficial to them or they were simply just tired of being called by telephone interviewers.

The number of participating herds resulted in exactly 3 controls per case. Due to missing values in two variables the number of case herds in the multivariable model was 75 and number of control herds was 227 (a total number of 302 herds) this resulted in 3.03 controls per case.

3.2 Questions where no statistical calculations where performed

In 16 questions no statistical calculations were performed. Either due a low number of respondents or it was considered irrelevant. All distributions of answers and comments are available in Appendix C and Appendix D.

Question 1.1: What is your job position in the farm?

The most frequent answers were "owner" or "manager". Of the 308 respondents 273 answered "owner" (88.6 %) and 88 of the 308 answered "manager" (28.6 %). Note in relation to the numbers and percentage that the respondent could choose several options when answering this question. The distribution of the rest of the answers in question 1.1 is provided in Appendix C. No further analysis of question 1.1 was performed.

Question 1.3: Have you heard about *Cysticercus bovis* (beef measles) before you got the invitation letter from the project?

Knowledge of *Cysticercus bovis* was present at 80 (26 %) of the 308 respondents. In the case herds 40.3 % (31 of 77) of the respondents had heard of *Cysticercus bovis* and in the control herds 21.2 % (49 of 231) of the respondents had heard of *Cysticercus bovis*. Question 1.3 was not tested in the model and underlying causes will be discussed later.

Question 1.4: Have you heard about the presence or occurrence *Cysticercus bovis* (beef measles) in your area?

In question 1.4 only 6 (1.9 %) of all respondents had heard of presence or occurrence of *Cysticercus bovis* in their local area. Question 1.4 was not further analyzed.

Question 2.2: Has the cattle production changed in the past 5 years?

The purpose of this question was mainly to categorize the herds into type of herd and was therefore not analyzed further.

Question 2.4: Have you used or currently use fresh grass in your feeding plan?

Due to misinterpretation of the question by one of the interviewers question 2.4 was not analyzed further. This will be discussed later.

Question 2.9.1.1: Has this practice been the same in the past 5 years? (Grazing practice)
Question 2.9.1.2: How did the grazing practice change? And when did the grazing practice change?

Twenty respondents answered there had been a change in grazing practice; therefore the three questions demonstrated that it was not common to change grazing practice. When text answers were evaluated it was revealed that the majority of changes were of minor importance. Text answers are provided in Appendix D.

Question 2.9.2.1: Has the grazing practice been the same during the past 5 years at the place where they are out stationed? (Out stationed animals),
Question 2.9.2.2: How did the grazing practice change? And when did the grazing practice change?

Only two respondents answered there had been a change in grazing practice where the animals were outstationed, and text answers were not useable.

Question 3.2: Have you fertilized with sewage sludge, pasture areas that will be used for hay or grass silage production, or animal grazing?

Question 3.2.1: Time of year? And which year(s)?

One respondent in a case herd and three respondents in control herds answered that sewage sludge had been used as fertilizer. Due to a low number of respondents no further analyzes were performed.

Question 3.3.1: For what purpose and when? (Use of suction machinery)

No variable was created regarding purpose of use of suction machinery due to difficulties in grouping the very varying text answers (provided in Appendix D).

Question 4.1.3.1: Where were the foreign employees from?

The number of herds which both had foreign and Danish employees was 49 and five respondents answered that they only had foreign employees (three herds had only Ukrainians, one herd only Hungarians and one herd only Polish people as employees). In the 49 herds with both Danish and foreign employees the most frequent combination was Danish and Ukrainian employees, this occurred in 25 herds. Other combinations with Danish employees involved employees from Lithuania, Latvia, Poland, Romania, Brazil, Thailand, Japan, Thailand, Holland and New Zealand.

Question 5.4: Has anybody with access to the stables or farmland in the 5 past years been diagnosed with tapeworm (taeniasis)?

The majority answered either no or I do not know. Number of respondents who answered no was 101 (32.8 %) and number of respondents who answered I do not know was 205 (66.6%). As “I do not know” will be considered as missing values no further analyses were performed.

3.3 Descriptive Statistics and Univariable Analyses

Univariable analyses were performed for those questions with *p*-values below 0.2 in the Fisher's exact test and for which it made sense to perform them. If grouping of answer options or questions were done it will be reported in the following section. Table 3.1 at the end of the section provides descriptive statistics and *p*-values of Fisher's exact tests of all variables for which univariable analyses was performed and also tested in the multivariable model.

Note that in the tables providing descriptive statistics and results of *p*-values from the Fisher's exact tests in the univariable analyses performed, the percentage of cases represents the percentage of the total number of case herds and percentage of controls represents the percentage of the total number of control herds. This presentation was because the study is a case-control study, which does not allow for interpretation of row percentages.

Also note that in the tables providing descriptive statistics and results of *p*-values from the Fisher's exact tests in the univariable analyses performed the numbers in parenthesis behind variable names are referring to the number of the original question(s) the variable was based on.

Question 1.2: Number of people with daily access to the stables and/or the farmland?

Three variables with three levels were created based on this question in relation to age of the persons with daily access to farm area and univariable analysis was performed. The variables and the levels in them were:

- "Daily access to stable or farmland, number of persons < 18 years old"
  zero, one to two and above two
- "Daily access to stable or farmland, number of persons 18 to 50 years old"
  zero, one to three and above three
- "Daily access to stable or farmland, number of persons > 50 years old"
  zero, one to three and above three

Descriptive statistics and results of *p*-values of Fisher's exact tests in all three variables are provided in table 1.1 in Appendix C. There were four missing values in these variables due to registrations of zero people with daily access to farm area in all three age groups in four herds. This indicates that the question was most likely misunderstood by the respondents as there had to be some people with daily access to the stables and farmland, or there have been

some problems in the registration procedure. The *p*-value of Fisher's exact tests in one of the three above mentioned variables created had a *p*-value of 0.129 therefore it was tested in the multivariable model, namely the variable "persons 18-50 years old with daily access (yes/no)". Before testing the variable in the multivariable model the variable was dichotomized and renamed "Persons with daily access to farm area" with the possible outcomes "No persons between 18-50 years old with daily access" (indicating that persons with daily access would either be below 18 years old or above 50 years old) and "At least one person between 18 and 50 years old with daily access". The *p*-value for the dichotomized variable was 0.308 but the variable was still tested in the model despite of a *p*-value above 0.2. Descriptive statistics and *p*-value of Fisher's exact test are provided in table 3.1.

Question 2.1: Can you confirm that you have this …… cattle production? Currently, besides this production do you have any other type of cattle production?
Question 2.2.1: Which type of cattle production was it before the change?
Farmers were asked if they could confirm the type of cattle production that was recorded in the database and if they had other types of production ongoing in the herd. These two questions were combined and categorisation of herd type was made. Further details about creating the variable are available in the frequency analysis in Appendix C. Two levels in a variable named "type of herd" were created. In the level "Beef and other" ("other" was for example hobby herds) there were 106 herds. Dairy and veal calf herds were in the same level consisting of 202 herds, 10 of these herds were "true" veal calf herds. Descriptive statistics and results of *p*-values of Fisher's exact test of "type of herd" are provided in table 3.1. The *p*-value of the Fisher's exact test was 0.680 but due to assumed importance of the variable it was selected to be tested in the multivariable model despite a *p*-value above 0.2.

Question 2.3: Have you had any of your animals out-stationed for example in a heifer hotel in the past 5 years? & Question 2.3.1: Where were the animals out-stationed?
These two questions were combined into a three level variable. Of the 308 herds 37 reported that animals had been out stationed. Descriptive statistics and results of *p*-value of Fisher's exact tests in the univariable analysis performed are provided in table 2.1 in Appendix C. The *p*-value of the Fisher's exact test was above 0.2 (0.463) and therefore the variable was not selected to be tested in the multivariable model.

Question 2.5: Have you used or currently use hay in your feeding plan?

Question 2.5.1: Have you purchased hay?

Question 2.6: Have you used or currently use silage from grass in your feeding plan?

Question 2.6.1: Have you purchased silage from grass?

Question 2.7: Have you used or currently use "Wrap" in your feeding plan?

Question 2.7.1: Have you purchased wrap?

Question 2.8: Has the hay or "wrap" come from a farmland that can be flooded?

There were no *p*-values in the Fisher's exact tests below 0.2 in any of the variables based on the questions above regarding roughage when the univariable analyses were performed. Therefore none of the variables were selected for being tested in the multivariable model. An overview of distribution of answers are provided in the frequency analysis in Appendix C and descriptive statistics and results of *p*-values of Fisher's exact tests in the univariable analyses performed are provided in table 2.2 in Appendix C. Note that question 2.5 was dichotomized.

Organic status

The respondents were not asked about their organic status. But a variable regarding organic status was created mainly based on information from the Danish Cattle Database. A herd was classified as organic if it was registered as organic, had ever been organic or if it was becoming organic. There were 35 herds were classified as organic (15 case herds and 20 control herds). The variable called "organic status" had two levels and resulted in a significant *p*-value (0.013) in the Fisher's exact test in the univariable analysis. Descriptive statistics and result of *p*-value of Fisher's exact test in the univariable analysis are provided in table 2.1 in Appendix C. The variable "organic status" was combined with the variable groups of animals grazing and the combined variable was tested in the multivariable model. Underlying causes will be described when question 2.9 and 2.9.1 are described.

Question 2.9: Have any of your animals been grazing in the past 5 years?

Question 2.9.1: Which group or groups?

Initially a three level variable named "groups of animals grazing" with the levels "all", "some" and "none" was created based on the two question 2.9 and 2.9.1. Dairy herds was classified as having all animals grazing if they had answered that cows, heifers and calves younger than six months were grazing. Descriptive statistics and result of *p*-value (0.127) in Fisher's exact test in the univariable analysis of "groups of animals grazing" are provided in table 2.3 in Appendix C. Cross tabulation between "organic status" and "groups of animals

grazing" revealed that all organic herds had answered that all animals were grazing; therefore the two variables were re-coded into a combined three level dummy-variable named "Animals grazing and farming type". The number of herds having all animals grazing and being organic was 35. The number of herds that were conventional and had all animals grazing was 122, and conventional herds having none or some animals grazing were 151 herds. A significant association was found in the Fisher's exact test (*p*-value = 0.020), and the variable was tested in the multivariable model. Descriptive statistics and result of *p*-value in Fisher's exact test in the univariable analysis of "animals grazing and farming type" are provided in table 3.1.

Question 2.9.2: Do the out stationed animals graze?
Question 2.9.3: Where do the cattle graze?
Question 2.9.4: While the cattle are grazing are there parts of the grazing areas flooded sometimes? & Question 2.9.4.1: From where? (Referring to flooding)
There were no *p*-values in the Fisher's exact tests below 0.2 in any of the variables based on the questions above when the univariable analyses were performed, and therefore no testing in the multivariable model was performed. An overview of distribution of answers are provided in the frequency analysis in Appendix C and descriptive statistics and results of *p*-values of Fisher's exact tests are provided in table 2.3, table 2.4 and table 2.5 in Appendix C. Note that answers in question 2.9.3 and 2.9.4.1 were grouped and further information regarding the grouping is provided in Appendix C.

Question 2.9.5: When grazing is the cattle allowed drinking water from:
The possibilities of answer options were: -streams, -river, -lakes and other. Answer options were grouped and a new two level variable was created named "Drinking water source when grazing" with the levels "From potentially risky water" and "From no risky water or no animals grazing". The *p*-value in the Fisher's exact test was strongly significant (0.00023) and this variable was tested in the multivariable model. Of the 77 case herds 53 herds (68.8 %) had allowed the cattle to drink from what was considered a "risky water source", and 103 herds of the 231 (44.6 %) control herds had allowed the cattle to drink from a risky water source. Further distribution of answers in the variable and *p*-value of Fisher's exact test are provided in table 3.1. "Risky water source" was considered as water from stream, river or surface water. The term "surface water" was a result of text answers from "other" grouped with lake. Water source of no risk was considered as tap water, water from own well or water from a field drilling. Text answers are provided in Appendix D and information regarding

grouping and initially created variables are provided in the frequency analysis and table 2.6 in Appendix C. This variable "Drinking water source when grazing" was combined with the variable "Sewage treatment plant in proximity" based on question 5.1. The re-coding into a dummy variable will be described when question 5.1 is described.

Question 3.1: Have you fertilized with slurry, pasture areas that will be used for hay, silage or "wrap" production or animals grazing? & Question 3.1.1 When?

These were both questions regarding fertilizing grass with slurry. The variable based on question 3.1 (fertilized grass with slurry yes/no) and the variable was tested in the multivariable model due to a *p*-value in the Fisher's exact test below 0.2 (0.153). Descriptive statistics and *p*-value in the Fisher's exact test is provided in table 3.1 in this section. Question 3.1.1 was grouped based on text answers which are provided in appendix D. A three level variable was created regarding if fertilizing grass with slurry had been a management practice throughout the whole study period. The *p*-value in the Fisher's exact test was above 0.2 and the variable was not tested in the multivariable model descriptive statistics and results of Fisher's exact test are provided in table 3.1 in Appendix C.

Question 3.1.1.a: When? Use of slurry < 3 months before grazing?

The two level variable based on question 3.1.1.a was tested in the multivariable model as the *p*-values in the Fisher's exact test was 0.086. Due to correlation between the variables based on question 3.1 (fertilized grass with slurry yes/no) and question 3.1.1.a they were not tested in the multivariable model simultaneously. Descriptive statistics and results of Fisher's exact test are provided in table 3.1 in this section.

Question 3.1.1.b: When? Use of slurry < 3 months before harvest for silage, wrap or hay?

The two level variable based on question 3.1.1.b was not tested in the multivariable model as the *p*-values in the Fisher's exact test was above 0.2. Descriptive statistics and results of Fisher's exact test are provided in table 3.1 in Appendix C.

Question 3.3: Have you used suction machinery (Slamsuger) at the farm for handling slurry?
Question 3.3.1: For what purpose and when?

Of the 77 case herds 29 herds (37.7 %) and 61 herds (26.4 %) of the 231 control herds had used suction machinery for handling slurry and the *p*-value in the Fisher's exact test was

0.082 and therefore tested in the multivariable model. Descriptive statistics and results of Fisher's exact test are provided in table 3.1.

Question 3.3.1 was text answers (provided in Appendix D) and these were grouped and a variable with three levels regarding how often suction machinery had been used in the study period. The *p*-value in the Fisher's exact test of the variable based on question 3.3.1 was 0.142. The two variables based on question 3.3 and question 3.3.1 was both tested in the multivariable model, but not simultaneously due to correlation between variables the. Descriptive statistics and results of Fisher's exact test are provided in table 3.1.

Question 3.4: Do you share machinery with other farmers or hire contractors?

The *p*-value in the Fisher's exact test of the variable based on this question was 0.179 and was therefore tried in the multivariable model. Only 2 herds (2.6 %) of the 77 case herds and only 18 herds (7.8 %) of the 231 control herds answered no to having shared machinery or hired contractors. Descriptive statistics and result of Fisher's exact test are provided in table 3.1.

Question 4.1: Over the past 5 years have you had employees in your farm, besides the wife or husband?

In total 155 respondents (50.3 %) of the 308 herds reported having employees in question 4.1 and the *p*-value in the Fisher's exact test was 0.294 and the variable was tested in the multivariable model. Descriptive statistics and result of Fisher's exact test are provided in table 3.1.

Question 4.1.1: Approximately how many employees have you had over the 5 years?

Grouping of answers was performed in question 4.1.1. The number of employees reported (available in Appendix D) were converted into a three level variable regarding if the herd had more than 5 employees, 1-5 employees or no employees resulting in a *p*-value at 0.444 in the Fisher's exact test and the variable was not tested in the multivariable model. Descriptive statistics and result of Fisher's exact test are provided in table 4.1 in Appendix C.

Question 4.1.2: How many of those in average were Danish? (referring to employees)
Question 4.1.3: How many of those in average were foreigners? (referring to employees)
Question 4.1.2 and question 4.1.3 were combined into one variable with three levels regarding if the herd had both foreign and Danish employees, only Danish employees or no employees, the *p*-value in the Fisher's exact test in this variable was 0.173 and the variable was tested in the multivariable model. Descriptive statistics and result of Fisher's exact test are provided in table 3.1.

Question 4.2: Over the 5 years has your farm or farmland been used for activities like?
In this question the respondent had 13 different options when answering and the respondent could choose several options. Answers were grouped into 7 new two level variables based on answers in question 4.2. Details about how grouping was performed are provided in the frequency analyses in Appendix C. Six of the variables were tested in the multivariable model. Five of the variables had *p*-values in the Fisher's exact test below or equal to 0.2 and these were; "Use of farm or farm land for leisure activities" (*p*-value = 0.202), "Use of farm or farm land for outdoor stay" (*p*-value = 0.137), "Many people passing by farm or farmland" (*p*-value = 0.086), "Use of farm or farm land for hunting" (*p*-value = 0.042) and "Farm or farm land has not been used for activities" (*p*-value = 0.028). "Use of farm or farm land for tourists" (*p*-value = 0.028) was tested in multivariable model as well due to assumed importance of this variable. Descriptive statistics and results of *p*-value in Fisher's exact tests of the univariable analyses of the six variables are provided in table 3.1. Distribution and results of *p*-values in Fisher's exact tests in all seven variables are provided in table 4.2 in Appendix C.

Question 5.1: Is there a sewage treatment plant in the proximity area of your farmland?
Of the 77 case herds 20 herds (26 %) and 34 herds (14 %) of 229 control herds had answered yes to having a sewage treatment plant in proximity area of farmland. There were 2 missing values due to that two control herds had answered "I do not know". The *p*-value in the Fisher's exact test was significant (0.037) and the variable based on question 5.1 was tested in the multivariable model. The variable based on question 5.1 was combined with the variable "Origin of drinking when grazing" (based on question 2.9.5 described previously) and a three level dummy variable "Drinking water source and location of sewage treatment plant (STP)" was created. The levels in the variable were "Risky water source and STP in proximity", "Risky water source and no STP in proximity" and "No risk or no animals grazing" a risky

water source was the same as described in question 2.9.5. The *p*-value in the Fisher's exact test in this new dummy variable was strongly significant (0.000067) and was included in the multivariable model. Underlying causes for creating this variable will be discussed later. Distribution and *p*-values in Fisher's exact tests of all three variables are provided in table 3.1.

Question 5.2: Is there a distance less than approximately 200 meters from your farmland or grazing land for your cattle to:

Answer options were: -camping site, -picnic area, -shelter, -festival/concert site, -military/training area and –parking/rest area. The respondent could choose several options. Answers were grouped into 5 two level variables based on answers in question 5.2. More details about the grouping are provided in the frequency analysis in Appendix C. The distribution and results of *p*-values in the Fisher's exact tests in all 5 variables based on answers in question 5.2 are provided in table 5.1 in Appendix C. Two of the variables "Shelter within 200 meters" and "Parking area within 200 meters" had *p*-values in the Fisher's exact test less than 0.2 respectively 0.002 and 0.105 and were tested in the multivariable model. Distribution of answers and results of *p*-values in the Fisher's exact tests in the two variables based on answers in question 5.2 are provided in table 3.1.

Question 5.3: Is there a toilet in the stable?

Question 5.3.1: Does the toilet always go to a septic tank or a public sewage system?

Question 5.3.1.1: If no, where does it go?

The three questions regarding the presence of a toilet in the stable were grouped into one variable. Thirteen respondents had reported that a toilet present in the stable was draining into the slurry, but only two of these were case herds. The *p*-value of the Fisher's exact test was 0.693 and the variable was not tested in the multivariable model. Distributions of answers are provided in table 5.1 in Appendix C.

Table 3.1. Descriptive statistics and *p*-values of Fisher's exact tests in univariable analyses performed of the variables selected to be tested in the multivariable model. Numbers in parenthesis behind variable names are referring to the original question(s) the variable was based on (See Appendix A and C). The % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value
Variable and level	**n**	**% of cases**	**n**	**% of controls**	**Fisher's exact**
Persons with daily access to farm area (1.2)[1]					
No persons aged 18-50 years	26	34.7	64	28.0	
At least one person aged 18-50 years	49	65.3	165	72.1	0.308
Type of Herd (2.1 and 2.2.1)					
Dairy and Veal	49	63.6	153	66.2	
Beef and other	28	36.4	78	34.8	0.680
Animals grazing and farming type[2]					
All animals, organic	15	19.5	20	8.7	
All animals, conventional	32	41.6	90	39.0	
None or some animals, conventional	30	38.9	121	52.3	0.020
Drinking water source when grazing (2.9.5)					
Risky water source	53	68.8	103	44.6	
No risk or no animals grazing	24	31.2	128	55.4	0.00023
Use of slurry on grazing land or farmland for production of hay grass silage or wrap (3.1)					
Yes	59	76.6	155	67.1	
No	18	23.4	76	32.9	0.153
Use of slurry less than 3 months on grazing land before grazing (3.1.1.a)					
Yes	34	44.2	71	30.7	
No	43	56.8	160	69.3	0.037
Use of suction machinery for handling slurry (3.3)					
Yes	29	37.7	61	26.4	
No	48	62.3	170	73.6	0.082
Period suction machinery was used (3.3.1)					
Yearly whole study period	10	13.0	25	10.8	
Yearly part of study period	19	24.7	36	15.6	
No use of suction machinery	48	62.3	170	73.6	0.142
Share machinery or hire contractors (3.4)					
Yes	75	97.4	213	92.2	
No	2	2.6	18	7.8	0.179
Nationality of employees (4.1.2 and 4.1.3)					
Foreign and Danish employees	19	24.7	35	15.2	
Only Danish employees	24	31.2	77	33.3	
No employees	34	44.2	119	51.5	0.173
Use of farm or farm land for leisure activities (4.2)					
Yes	28	36.4	66	28.6	
No	49	63.6	165	71.4	0.202
Use of farm or farm land for tourists (4.2)					
Yes	18	23.4	42	18.2	
No	59	76.6	189	81.2	0.323
Use of farm or farm land for outdoor stay (4.2)					
Yes	15	19.5	29	12.6	
No	62	80.5	202	87.5	0.137

[1]Note there are four missing values in the variable.
[2]Variable created based on a combination of organic status and groups of animals grazing based on question 2.9 and 2.9.1

Table 3.1.-continued

Variable and level	Case herds n	Case herds % of cases	Control herds n	Control herds % of controls	*p*-value Fisher exact
Many people passing by farm or farmland (4.2)					
Yes	41	53.3	96	41.6	
No	36	46.8	135	58.4	0.086
Use of farm or farm land for hunting (4.2)					
Yes	66	85.7	171	74.0	
No	11	14.3	60	26.0	0.042
Farm or farm land has not been used for activities (4.2)					
Yes	4	5.2	35	15.2	
No	73	94.8	196	84.9	0.028
Shelter within 200 meters (5.2)					
Yes	7	9.1	6	2.6	
No	70	90.9	225	97.4	0.022
Parking area within 200 meters (5.2)					
Yes	17	22.1	32	13.9	
No	60	77.9	199	86.2	0.105
Sewage treatment plant in proximity(5.1)*					
Yes	20	26.0	34	14.9	
No	57	74.0	195	85.1	0.037
Drinking water source and location of sewage treatment plant (STP) (2.9.1 and 2.5)*					
No risk or no animals grazing	24	31.2	126	55.0	
Risky water source and STP in proximity	19	24.7	19	8.3	
Risky water source and no STP in proximity	34	44.1	84	36.7	0.000067

*Note there are two missing values in the variable

3.4 Multivariable Model

The explanatory variables resulting in the final multivariable model (a logistic analysis) are provided in table 3.2. The parameter estimates, *p*-values, odds ratios (OR) and 95 % confidence intervals for OR (95% - CI) of the logistic analysis model of the associations between the explanatory variables and the probability of being a *Cysticercus bovis* positive herd are also provided in table 3.2.

The explanatory variables; "animals grazing and farming type" (*p*-value = 0.037), "drinking water source and location of sewage treatment plant" (*p*-value = 0.002), "persons with daily access to farm area" (*p*-value = 0.013), "share machinery or hire contractors" (*p*-value = 0.028) and "herd size" (p - value < 0.0001) all have a significant association to the probability of being a *Cysticercus bovis* positive herd when evaluated by *p*-value in the likely hood ratio statistics for the type 3 analysis in the genmod procedure in SAS® version 9.2.
Due to 4 missing values in the variable "persons with daily access to farm area" and 2 missing values in "drinking water source and location of sewage treatment plant" there are 302 herds (75 case herds and 227 control herds) in the final multivariable model.

Table 3.2: Parameter estimates (β), standard errors (SE), level of significance (*P*-value), odds ratios (OR) and confidence intervals for OR in the logistic analysis model for associations between explanatory variables and the probability of being a *Cysticercus bovis* positive herd in Denmark between January 2006 and July 2010 among 302 cattle herds.

Variable and level	B	SE	*P*-value[1]	OR	95% confidence interval for OR
Intercept	-4.08	1.05			
Animals grazing and farming type			0.037		
All animals, organic	0.92	0.44		2.5	1.1 - 6.0
All animals, conventional	0.72	0.36		2.0	1.0 - 4.1
None or some animals, conventional	0	-		1.0	-
Drinking water source and location of sewage treatment plant (STP)			0.002		
No risk[2]	-0.57	0.33		0.6	0.3 - 1.1
Risky water source[3] and STP in proximity	0.90	0.41		2.5	1.1 - 5.6
Risky water source and no STP in proximity	0	-		1.0	-
Persons with daily access to farm area			0.013		
No persons aged 18-50 years[4]	0.88	0.36		2.4	1.2 - 4.8
At least one person aged 18-50 years	0	-		1.0	-
Share machinery or hire contractors			0.028		
Yes	1.74	0.95		5.7	0.9 - 36.5
No	0	-		1.0	-
Herd size (per 100 animals increase)	0.39	0.10	<0.0001	1.5	1.2 – 1.8

[1] Estimated by likely hood ratio statistics for the type 3 analysis in the genmod procedure in SAS® version 9.2
[2] Water sources of no risk are tap water, water from own well and water from a field drilling. Herds with no grazing animals are also classified no risk.
[3] Risky water sources are surface water, streams or rivers.
[4] Ninety of these herds had only persons above 50 years old with daily access to the farm area, and three herds had both persons above 50 years old and persons below 18 years old with daily access to farm area.

The logistic analysis model is given by:

$$\text{Logit}(p_{ijklm}) = \alpha + \beta_i + \delta_j + \lambda_k + \epsilon_l + \gamma x_{ijklm}$$

Where:

p_{ijklm} is the probability of being a *Cysticercus bovis* positive herd

α is the intercept.

β_i is the effect of the qualitative variable animals grazing and farming type.

δ_j is the effect of the qualitative variable drinking water source and location of sewage treatment plant (STP)

λ_k is the effect of the qualitative variable persons with daily access to farm area.

ϵ_l is the effect of the qualitative variable share machinery or hire contractors.

x_{ijklm} is the continuous variable herd size.

γ is the slope of the continuous variable herd size.

The three levels in “animals grazing and farming type” were tested in relation to each other and showed a significant difference between “All animals, organic” and “None or some animals, conventional” (*p*-value = 0.037) the OR was 2.5 and 95% - CI [1.1; 6.0]. Therefore the odds of being exposed to having all animals grazing and being organic is 2.5 greater among the *Cysticercus bovis* positive herds than among the negative herds. The difference between “All animals, conventional” and “None or some animals, conventional” is significant but just barely (*p*-value = 0.045) the OR was 2.0 and 95% - CI [1.0; 4.1] thus the odds of being exposed to having all animals grazing and being conventional is 2.0 greater among the *Cysticercus bovis* positive herds than among the negative herds. There were no significance difference between “All animals, organic” and “All animals, conventional” (*p*-value = 0.670). Therefore the variable indicates that the risk factor is having all animal grazing compared to having no or some animals grazing without influence of organic status.

The three levels in “drinking water source and location of sewage treatment plant (STP)” were also tested in relation to each other. There was no significance difference between “no risk” and “risky water source and no STP in proximity” (*p*-value = 0.078). There was a significance difference between “risky water source and STP in proximity” and “risky water source and no STP in proximity” (*p*-value = 0.030) and OR was 2.5 and 95% - CI [1.1; 5.6] which indicates that being exposed to the factor “risky water source and STP in proximity” is 2.5 greater among the *Cysticercus bovis* positive herds than among the negative herds. Also the difference between “no risk” and “risky water source and STP in proximity” was significant (*p*-value = 0.0006). Therefore the risk factor is allowing the cattle to drink from a risky water source and having a sewage treatment plant in proximity area of farmland.

In the variable “persons with daily access to farm area” the OR in the level “no persons aged 18-50 years” was 2.4 and 95%-CI [1.2; 4.8] thus being exposed to the factor “no persons aged 18-50 years” was 2.4 greater among the *Cysticercus bovis* positive herds than among the negative herds. This variable suggest that risk factor of being *Cysticercus bovis* positive herd is when the only persons with daily access to the herd is older than 50 years old or older than 50 years old and less than 18 years old.

The explanatory variable “share machinery or hire contractors” the OR in the level “yes” was 5.7 with 95%-CI [0.9; 36.5]. The *p*-value in the Wald’s test in the model showed borderline significance (*p*-value =0.067) which explains the 95%-CI [0.9; 36.5] and as mentioned earlier the *p*-value estimated by likely hood ratio statistics for the type 3 analysis showed significance. Therefore the variable suggest that the risk factor is sharing machinery or hire contractors, but with an uncertainty due to the conflicting *p*-values.

When the variable “shelter within 200 meters” was tested in the multivariable model in table 3.2 it was borderline significance with the *p*-value 0.067 estimated by likely hood ratio statistics for the type 3 analysis.

Figure 3.1 and figure 3.2 illustrates estimated probabilities of being a *Cysticercus bovis* positive herd based on the logistic analysis model. It is important to note that the estimated probabilities are not exact probabilities but only illustrates a pattern due to the type of study.

The predictive probability *p(x)* is estimated by:

$$p(x)=\frac{1}{1+\exp\left(-\left(\alpha+\beta_i+\delta_j+\lambda_k+\epsilon_l+\gamma x_{ijklm}\right)\right)}$$

Herds with at least one adult aged 18-50 years and shared machinery or hired contractors were the most common events in the variables “persons with access to farm area” and “share machinery or hire contractors”. Figure 3.1 illustrate the relationship between herd size and the estimated probabilities of being a *Cysticercus bovis* positive herd for each of three grazing and farming type groups in herds with at least one adult aged 18-50 years, shared machinery or hired contractors and water sources of no risk (A), risky water sources combined with a sewage treatment plant in proximity (B) or risky water sources combined with no sewage treatment plant in proximity (C).

Figure 3.1 (A), (B) and (C) show how increasing herd size also increase the estimated probability of being a *Cysticercus bovis* positive herd and having all animals grazing results in greater estimated probability of being a *Cysticercus bovis* positive herd than having no or some animals grazing. Figure 3.1 (B) shows there is a higher estimated probability of being a *Cysticercus bovis* positive herd when the cattle are allowed to drink from a risky water source combined with a sewage treatment plant in proximity.

Herds with at least one adult aged 18-50 years and no shared machinery or hired contractors were low risk events in the variables “persons with access to farm area” and “share machinery or hire contractors” this is illustrated in Figure 3.2. The same pattern is shown in figure 3.2 as in figure 3.1 but in general lower estimated probabilities of being a *Cysticercus bovis* positive herd is demonstrated in figure 3.2.

Herds with no persons aged 18-50 years and shared machinery or hired contractors were high risk events in the variables “persons with access to farm area” and “share machinery or hire contractors” the estimated probabilities are not illustrated as the graphs were very similar to those in figure 3.1 but in general higher estimated probabilities of being a *Cysticercus bovis* positive herd was seen.

The unadjusted probability in figure 3.1 and figure 3.2 illustrate that the in this case-control study where 3 controls were selected for each case, resulted in a 25 % probability that a herd included in the study was a case herd.

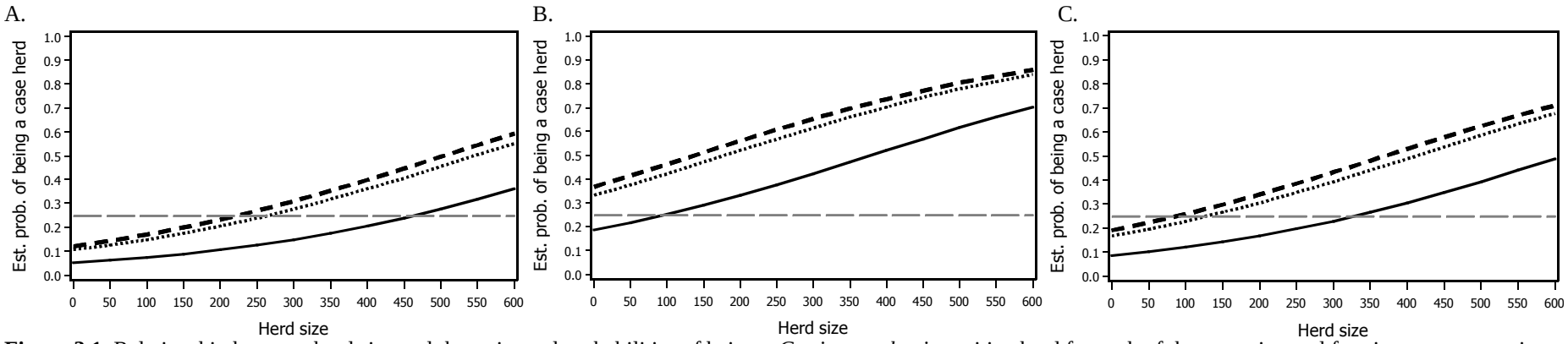

Figure 3.1. Relationship between herd size and the estimated probabilities of being a *Cysticercus bovis* positive herd for each of three grazing and farming type groups in herds with at least one adult aged 18-50 years, shared machinery or hired contractors and water sources of no risk (A), risky water sources combined with a sewage treatment plant in proximity (B) or risky water sources combined with no sewage treatment plant in proximity (C).

No or some animals grazing All animals grazing conventional herds All animals grazing organic herds Unadjusted probability of being a case herd

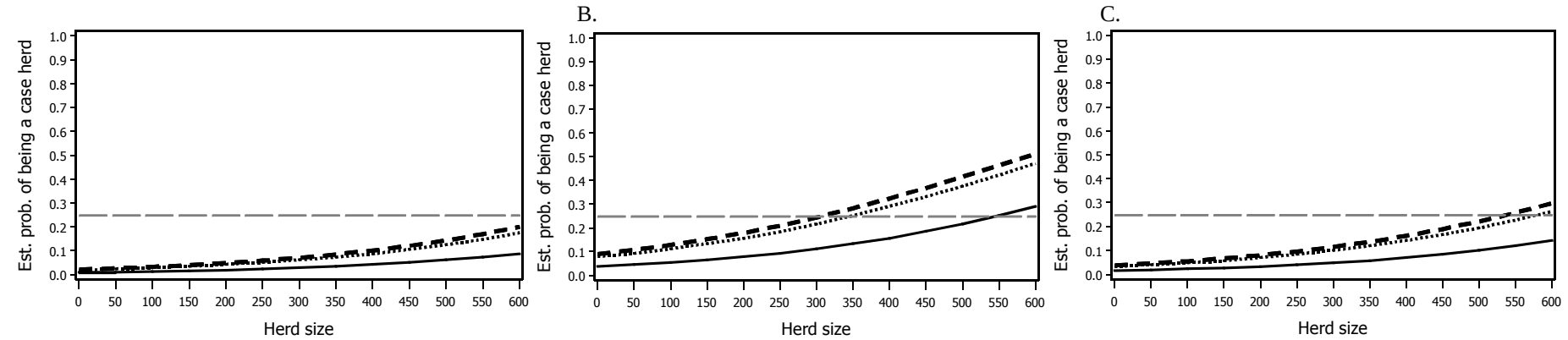

Figure 3.2. Relationship between herd size and the estimated probabilities of being a *Cysticercus bovis* positive herd for each of three grazing and farming type groups in herds with at least one adult aged 18-50 years, no shared machinery or hired contractors and water sources of no risk (A), risky water sources combined with a sewage treatment plant in proximity (B) or risky water sources combined with no sewage treatment plant in proximity (C).

No or some animals grazing All animals grazing conventional herds All animals grazing organic herds Unadjusted probability of being a case herd

4 Discussion

4.1 Questionnaire design validity and reliability

The questionnaire was initially discussed by a number of persons with either experience of designing questionnaires and with knowledge about *Cysticercus bovis*. It is recommended to test a questionnaire before collecting the data (Nielsen *et al.* 2004). A specific pretesting was not conducted but, but after calling the first 10 herds an evaluation was made which revealed small technical problems that were adjusted. Also after calling the first herds the interviewers discussed their experiences.

The validity of the questionnaire was not evaluated by a visit on the farm to observe true conditions as suggested by (Nielsen *et al.* 2004).The reason was that many of the questions were not very suitable for this kind of evaluation. Question 2.1 "Can you confirm that you have this …… cattle production? Currently, beside this production do you have any other type of cattle production?" could have been used for evaluating the validity by comparing the information the respondent provided with the data from the Danish Cattle Database as this method was suggested by (Oppenheim 1992). But the question as phrased in the questionnaire was guiding and therefore not suitable for this type of evaluation and a few herds were not registered correctly in the Danish Cattle Database. The first question in the questionnaire regarding job position in the farm of the respondent, the majority answered either owner or manager. Therefore these in formations could provide as a non scientific validation of the questionnaire, as it must be assumed that these persons was most capable of providing correct answers. The reliability could have been tested by interviewing some of the respondents twice and compare results (Schukken *et al.* 1989) this was not conducted. Therefore it cannot be evaluated how well the questions in this questionnaire succeeded in their purpose.

4.2 Selecting case herds

The selected case herds was based on recordings of cyst-positive animals from January 2004 until July 2010 but a restricted study period from January 2006 until 2010 was decided as there had been a change in the recording system and the new procedure was introduced in 2006. If the study period had been extended to January 2004 until July 2010 the sample size would have been bigger. A bigger sample size could have improved the study, but to be sure that cyst-positive animals were recorded the same way the restricted period from January 2006 until July 2010 was decided. Another possible to include more herds in the study could

have been to choose a herd randomly among those animals that stayed in two herds for more than 100 days in each. But that would probably haved resulted in including some herds in which the animal did not become infested.

There is a risk that the 11 herds included in the study, where cyst-positive animals stayed in two herds but less than 100 days in the first herd, was not the herd where the animals become infested in. It was the second herd that was considered a case-herd and there is a risk that the animal became infested in the first herd. The threshold of 100 days was set based on that risk of infestation increase with age (Dorny *et al.* 2000; EFSA 2004).

4.3 Selecting control herds

The control herds were stratified on dairy and non-dairy herds and chosen randomly among all herds in Denmark. Another approach could have been to just choose randomly without stratifying on dairy and non-dairy, but that would probably have resulted in too many non-dairy herds as control herds compared to the number of dairy case herds.

The control herds were herds that were considered negative in any detection of *Cysticercus bovis* in the period January 2004 until first quarter of 2010. It is possible that there have been some cyst-postive animals in the control herds not detected at the abattoir. This could be due to the low sensitivity in the meat inspection in light infested animals (Kyvsgaard N.C. *et al.* 1990). It is also possible that the control herds could have had detection of cyst-positive animals before January 2004.

4.4 Data Management Multivariable Model

As mentioned in materials and methods the linear relation between the explanatory continuous variable herd size in the logistic analysis and the probability of being a case herd were evaluated in the raw data before being used further in the analysis. A linear relation indicates that the assumptions for the logistic analysis are fulfilled (Ersbøll *et al.* 2004). The linear relation was not perfect, and therefore it can be argued if data support the logistic analysis entirely. But due to a strong tendency of a linear relation it was considered reasonable to perform a logistic analysis. In the genmod procedure in SAS in criteria for assessing goodness of fit the Pearson Chi-square was close to one (1.0329) which indicate that the model fits data (Ersbøll *et al.* 2004).

Stepwise inclusion of variables was used. Interactions were checked before leaving out non-significance variables. The significant interactions found were very hard to interpret as they were not true to the raw data. Therefore none of the significant interactions discovered were included in the model as they were found not to be biologically plausible or not true to the raw data. These problematic interactions are probably due to a small dataset with few animals in some combinations.

It was decided to test all variables with *p*-values less than 0.2 in Fisher's exact test in the multivariable model. It can be argued if this threshold should have been set higher or all variables should have been tested in the multivariable model. The variable "Person with daily access to farm area" which are in the final model, initially had three levels and the *p*-value was less than 0.2 (0.129) but when the variable was dichotomized it resulted in a *p*-value above 0.2 (0.308) and therefore supports the argument that the threshold could have been set higher. After the final model presented in table 3.2 a quick test was made (no test of interactions and correlation) of all variables not tested in the model previuosly was performed in the genmod procedure in SAS®. None of the variables not tested previously had significant *p*-value in the likely hood ratio statistics for the type 3 analysis in the genmod procedure in SAS® when tested one by one in the model presented in table 3.2. Therefore the threshold of 0.2 can be assumed to be reasonable.

4.5 Results Questionnaire

The respondent was asked to think five years back when answering the questions. But the animals could have been infested before the period. Therefore it is possible that the respondent did not provide information that covered the source of infection, as the management routines in the herd could have been different before the five year period.

Question 1.3 "Have you heard about *Cysticercus bovis* (beef measles) before you got the invitation letter from the project?". In this question no statistical calculations were performed as the aim of the question was to get an impression of knowledge about *Cysticercus bovis*. The greater knowledge about *Cysticercus bovis* among the case herds (40.3 % had heard of it) compared to the control herds (21.2 % had heard of it) must be expected as the case herds are informed of findings of a cyst-positive animals by the abattoir.

This fact also makes the question biased. Only 26 % of all respondents had heard of *Cysticercus bovis*. It should be noted that the Danish term "oksetinte" was used when doing the interviews.

Question 2.4 "Have you used or currently use fresh grass in your feeding plan?. The answers of this question were not useable as the one the interviewers thought it also covered grazing animals. The purpose of the question was to gain information about fresh grass fed in the stable. Therefore this question should have been specified more.

Question 3.2 "Have you fertilized with sewage sludge, pasture areas that will be used for hay or grass silage production, or animal grazing?" Only four respondents answered yes to this question. In dairy herds it is probably due to the quality program "Arlagården" developed by the dairy Arla Foods. Dairy farms are not allowed to deliver their milk to the dairy if there has been a of use sewage sludge at all (Anonymous 2008). If the question had been asked regarding all types of farmland the number of respondents who said yes might have been higher. But the study indicates that the use of sewage sludge is limited in cattle herds in Denmark. It is probably also a low risk factor for bovine cysticercosis using sewage sludge due to the legislation in this area. It is not allowed to use farmland applied sewage sludge for crops for animals before a year has past (Anonymous 2006). The *T. Saginata* eggs are not viable after a year has past (Ilsoe *et al.* 1990b). But of course cross contamination by machinery used for handling sewage sludge can occur. Also the use of sewage sludge could not be demonstrated to be a risk factor of bovine cysticercosis by Kyvsgaard *et al.* (1991) 20 years ago in Denmark.

The purpose of use of suction machinery (question 3.3.1) was an open question. The answers provided in Appendix D clearly demonstrate the difficulties in using open question as it was not possible to group these answers. But many answered they had used suction machinery for moving slurry or flushing slurry channels. In the general question 3.3 "have you used suction machinery at the farm for handling slurry" some of the respondents might have thought that the machinery asked about was "normal" machinery for handling slurry.

In the question regarding number of people with daily access to stables and farmland and age (question 1.2) was biased by registration errors as four herds were registered as having no people in any of the three age groups. The question might have been misunderstood by the respondents as there had to be some people with daily access to the stables and farmland, or there have been some problems in the registration procedure. Therefore the analyses where variables based on this question are included should be interpreted with care.

In the variable "type of herd" there were two levels "Beef and other" and "Dairy and veal". The dairy herds and veal calf herds were grouped as there were only 10 herds categorized as true veal calf herds. The majority of the veal calf herds could be compared with dairy herds having no animals grazing. But two of the herds did have some animals grazing. The veal calf herds could have been excluded from the dataset, but as there were four case herds among it was decided to group them with dairy instead.

Question 5.1 "Is there a sewage treatment plant in the proximity area of your farmland?" was asked a bit vague as the purpose of the question was to identify if a sewage treatment was in connection with a stream or river going through the farmland. Question 2.9.5 regarding if the cattle were allowed to drink from streams, rivers, lakes and other could have been followed up by a question asking if the stream river or lake had connection to a sewage treatment plant. This could have proved directly that the cattle were drinking from a stream or river carrying effluent from a sewage treatment plant. But a subjective evaluation is that most of the respondents answered yes if the sewage treatment plant had a stream connecting to their farmland, as a lot of them had a comment about it.

In the question regarding where the toilet in the stable drained, thirteen respondents had reported that a toilet present in the stable was draining into the slurry, but only two of these were case herds. This installation is not legal and very unsafe in relation to bovin cysticercosis. The farmers probably know that it is illegal, but have not taken *Cysteticercus bovis* into concern due to lack of knowledge in the subject. Therefore farmers should be informed that there is a potential risk for their cattle of infestation of bovine cysticercosis having a toilet installed this way.

4.6 Results Multivariable Model

Two of the variables in the multivariable model were a combination of two originally created variables. Organic status was combined with the variable indicating which groups of animals were grazing, because all organic herds had answered that (almost) all animals were grazing. The original variable regarding grazing had three options "All", "some" and "none" referring to the groups of animals grazing. These two variables were then re-coded to a combined three level-dummy variable,"Animals grazing and farming type": "All animals,organic", "All animals, conventional" and "None or some, conventional". Initially the variable had four levels were "None or some, conventional" was split into two. However, the group with "Some, conventional" gave very unstable results when tried in different models therefore it was grouped together with "None, conventional". The instability of "Some, conventional" was probably due to a large variation of grazing patterns among the herds in this group.

The variable "Animals grazing and farming type" showed that the risk factor of bovine cysticercosis was higher when all animals were grazing compared to having none or some of the animals grazing. There was no significant difference in risk between organic herds that had all animals grazing and conventional herds having all animals grazing. Organic herds could be assumed to have animals grazing for a longer period due to the legislation for organic farming (Anonymous 2010a), but this did not seem to influence the risk much when compared to having all animals grazing and being a conventional herd. The majority of beef herds were in the "All animals, conventional" group (80 % of beef herds) and the majority of dairy herds were in the "None or some animals, conventional" group (69 % of dairy herds).

The other variable that was re-coded into a dummy variable combining two originally created variables was "Drinking water source and location of sewage treatment plant". The decision of combining the originally created variable "Drinking water source when grazing" with the variable "Sewage treatment plant in proximity" was based on a significant association between the variables and reported risk in the literature of drinking from streams carrying effluent from a sewage treatment plant (Kyvsgaard *et al.* 1991). In a model prior to the one presented in table 3.2 "Drinking water source when grazing" was significant when not combined with "sewage treatment plant in proximity" but "Sewage treatment plant in proximity" alone was not. The interaction term between the two variables gave misleading results compared to the trends suggested in the raw data. Therefore the combined variable was created. The prior model referred to consisted of the same variables as the one presented in

table 3.2 except that “Drinking water source when grazing” was not combined with “Sewage treatment plant in proximity”. All variables in this prior model also had significant p-values in the likelyhood ratio statistics for the type 3 analysis in the genmod procedure except “Sewage treatment plant in proximity”. The re-coded dummy variable was stable in the models and lead to explainable results. Thus, it was decided to keep this variable as the main effect.

Question 5.1 was: “Is there a sewage treatment plant in the proximity area of your farmland”. The question was not directly related to whether the potentially risky water source the cattle were drinking from had any connection to the sewage treatment plant in proximity. Therefore it can be argued if “Drinking water source when grazing” should have remained as it was originally with the two levels “Risky water source” and “No risk or no animals grazing”. Indicating that it is a risk factor of bovine cysticercosis allowing cattle to drink from, streams, rivers, lakes and surface water compared to allowing the cattle to drink from tap water, own well, field drilling or having no animals grazing.

If “drinking water source when grazing” had remained as it was originally. The variable “shelter within 200 meters” had also been significant in the model and not borderline significant (0.067) as it was in the model presented in table 3.2. But only 7 case herds and 6 control herds had answered yes to having a shelter within 200 meters of farm or farmland and the variable must therefore be interpreted with care.

To summarize; the variable “Drinking water source and location of sewage treatment plant” demonstrated that it is a risk factor allowing cattle to drink from a risky water source (streams, rivers, lakes and surface water) while having a sewage treatment plant in proximity of the farmland. But a general recommendation to the farmers should be that it is not advisable to allow cattle to drink from streams, rivers, lakes or surface water (also because of other pathogens such as *Salmonella*).

The variable “Persons with daily access to farm area” indicated that the risk of the herd being *Cysticercus bovis*-positive was significantly higher when persons with daily access to the herd were all older than 50 years (n=90 herds), or older than 50 years and less than 18 years old (n=3 herds), meaning that there were not persons in the age 18-50 years old that had daily access to the herd. A reasonable explanation is hard to give, but it might be that older people have kept some previously common personnel routines that did not involve a toilet in the

stable, but this is just a suggestion as we do not have data on that. Furthermore, the variable indicating whether there was a toilet in the barn or not was not significant in the analyses. There were 4 missing values for the variable "Persons with daily access to farm area". This is most likely due registration errors, because 4 herds were registered as having no people at all in any age group in the 4 herds. Therefore it can be discussed if the result of this variable can be defined as a true risk factor. And even if it is true a risk factor it is not very usable in risk profiling of a herd.

The explanatory variable "Share machinery or hire contractors" suggested that it is a risk factor for cattle herds for being *Cysticercus bovis*-positive to share machinery or hire contractors. The variable was significant when estimated by likelyhood ratio statistics for the type 3 analysis (*p*-value = 0.028) but the *p*-value in the Wald's test in the genmod procedure showed borderline significance (*p*-value =0.067). The variable also had a very wide confidence interval (95%CI [0.9; 36.5]). The borderline significance in the Wald's test and the wide confidence interval is probably due to the fact that only 20 respondents answered no to sharing machinery or hiring contractors and only two of those were case herds. The variable should therefore be interpreted with care. But if shared machinery or hiring contractors is considered a risk factor an advice to farmers could be that it is important to require good hygiene practice in relation to the machinery shared or used by a contractor. This is also recommendable to prevent infection with other pathogens, particularly those that are spread via manure.

The continuous explanatory variable "herd size" was very significant in the model presented in table 3.2. The probability of being a *Cysticercus bovis* positive herd increased with herd size. This is probably because large herds have more animals slaughtered and therefore have a higher probability of having an animal detected as cyst-positive in the meat inspection. It was investigated if the effect of herd size was overestimated. Overestimation was evaluated by only including herds with up to 338 heads in the model as this was the largest beef herd (the largest dairy herd was 1500 heads). The estimates in the model did not change considerably therefore it was concluded that the effect of herd size was probably not overestimated.

To evaluate the risk factors in beef herds and in dairy herds the data set could be split into these two groups with a model for each group, but this would result in very few animals in some categories of variables. As the variable "Type of herd" (dairy or beef) was assumed to be of importance it was tested in the model. However, the dairy herds were generally larger than beef herds and the majority of cases (63.6 %) were from the "Dairy and veal" group. This implies that the two variables are explaining a lot of the same and therefore cannot be included in the multivariable model simultaneously. It should be remembered that only 10 herds in the "Dairy and veal" were true veal herds.

The results of the study demonstrates that the herds with the highest risk of delivering *Cysticercus bovis* positive animals to the abattoirs are big herds allowing all animals to graze. The risk increases if the animals are also allowed to drink from a stream, river, lake or surface water and there is a sewage treatment plant located in proximity of farmland.

5 Conclusion

The results of the logistic analysis showed that the groups of animals grazing and farming type, drinking water source and location of sewage treatment plant, age of persons with daily access to farm area, shared machinery or hiring contractors and herd size all had a significant association to the probability of being a *Cysticercus bovis* positive herd.

The probability of being a *Cysticercus bovis* positive herd increased with herd size.

The practice of having all animals grazing in the herd can be considered as a risk factor of bovine cysticercosis compared to having none or some animals grazing. Organic status has no influence.

Allowing the cattle to drink from a stream, river, lake or surface water and a sewage treatment plant located in the proximity area of farmland can be considered as a risk factor of bovine cysticercosis. This compared to allowing the cattle to drink from the same water sources but with no location of a sewage treatment plant in the proximity area of farmland or allowing the cattle to drink tap water, water from own well, water from a field drilling or having no animals grazing. This corresponds with the previous identified risk factor of bovine cysticercosis in Denmark which was allowing the cattle to drink from streams carrying effluent from a sewage treatment plant (Kyvsgaard *et al.* 1991).

It was indicated that a risk factor of bovine cysticercosis was when the only persons with daily access to the herd were older than 50 years old or older than 50 years old and less than 18 years old, meaning that no persons in the age 18-50 years old had daily access to the herd. It is possible the variable was biased due to registration errors.

The use of shared machinery or hired contractors could be considered a risk factor of bovine cystercercois, but with an uncertainty due to the conflicting *p*-values in Walds test and in the likely hood ratio statistics for the type 3 analysis in the genmod procedure in SAS®.

6 Perspective

The risk factors identified in this study is a part of a PhD-project providing documentation for possible changes in the current meat inspection in Denmark of bovine cysticercosis towards a risk-based system. Some of the risk factors detected could be used as a part of risk profiling a farm of bovine cysticercosis. For instance all animals that have been grazing could be inspected of bovine cysticercosis. Perhaps electronic earmarks could be somehow coded to identify if the animal had been grazing. Cattle allowed drinking from streams, rivers, lakes and surface water could also be inspected. The information regarding these risk factors in a herd could also be noted in food chain information which all herds are required to provide the abattoirs (EC 2004a).

The two other variables concerning hiring contractors or sharing machinery and the age of persons with daily access to the herd might be relevant but hard to retrieve valid information about.

The knowledge regarding *Cysticercus bovis* were very limited among farmers. Therefore risk factors identified and other observations in this study could provide a set of recommendations to farmers to reduce the risks of infestations of bovine cysticercosis.

An example of practical recommendations to farmers to minimize infestations with bovine cysticercosis based on both significant results and other observations could be;

- It is not advisable allowing cattle to drink from streams, rivers, lakes or surface water due to other pathogens as well.
- It is important to require good hygiene practice in relation to the machinery shared or used by a contractor.
- It is not advisable allowing toilets to drain into slurry.
- Be sure that suction machinery used for handling slurry, has not been used for emptying septic tanks.

No grazing or to reduce number of animals grazing is not a recommendation despite significant risk related to having all animals grazing. For instance organic herds do not have that option due to legislation, also in relation to animal welfare it is not reasonable to recommend reducing the number of animals grazing in the herd.

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Appendix

Appendix A: English version of questionnaire

Appendix B: Dansk version af spørgeskema importeret fra Surveyxact®

Appendix C: Frequency Analysis imported from SurveyXact® and translated to English
Tables of descriptive statistics and p-values of the uni variable analyses

Appendix D: Comments and text answers imported from SurveyXact®

Appendix

Appendix A: English version of questionnaire

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Appendix A

English version of questionnaire

It is important that the person who is doing the interview knows who the respondent is. It is also important that the respondent will be the one that knows the most about the herd and the production

The questionnaire is covering the period 2006-2010, therefore is important to make the respondent to be aware about the recall of information for 5 years back to date of the interview.

Symbol meaning

- The respondent can choose several options
- The respondent can only choose one option

1. Basic Information

1.1 What is your job position in the farm?

- Owner
- Manager
- Wife
- Employee
- Other

1.2 Number of people with daily access to the stables and/or the farmland?

- Children or teenagers <18 yrs old _____
- Adults between 18 and 50 yrs old _____
- Adults > 50 yrs old _____

1.3 **Have you heard about *C. bovis* (beef measles) before you got the invitation letter from the project**?

- Yes
- No

Here the interviewer should be prepared to explain what it is Oksetinte. The explanation from the letter can be used for this

1.4 Have you heard about the presence or occurrence of it in your area?

- Yes
- No

Comments section 1 – Basic information

_____

2. Cattle production

2.1 Can you confirm that you have this …… cattle production? Currently, besides this production do you have any other type of cattle production?

- Beef
- Dairy
- Veal Calves
- Hobby
- None
- Other_____

2.2 Has the cattle production changed in the past 5 years?

- Yes
- No

2.2.1 If answer to question 2.2 is yes, which type of cattle production was it before the change?

- Beef
- Dairy
- Veal Calves
- Hobby
- None
- Other_____

2.3 Have you had any of your animals out stationed for example in a heifer hotel in the past 5 years?

- Yes
- No

2.3.1 If the answer on question 2.3. is yes, where were the animals out stationed?

- Heifer hotel
- Other_____

Comments section 2 – Cattle production

_____

In the stable:

2.4 Have you used or currently use fresh grass in your feeding plan?

- Yes
- No

2.5 Have you used or currently use hay in your feeding plan?

- Yes
- No
- In special situations, for instance for sick animals_____

2.5.1 If the answer to 2.5 is yes. Have you purchased hay?

- Yes
- No

2.6 Have you used or currently use silage from grass in your feeding plan?

- Yes
- No

2.6.1 If answer yes to question 2.6. Have you purchased silage from grass?

- Yes
- No

2.7 Have you used or currently use "Wrap" in your feeding plan?

- Yes
- No

2.7.1 If answer yes to question 2.7. Have you purchased wrap?

- Yes
- No

2.8 Has the hay or wrap come from a farmland that can be flooded?

- Hay or wrap is not used/has not been used
- Yes
- No
- Don´t know

Comments section 2 – Cattle production – In the stable

_____

Grazing:

2.9 Have any of your animals been grazing in the past 5 years?

- Yes
- No

2.9.1 If yes to question 2.9, which group or groups?

- All animals
- Heifers (also hotel heifers)
- Cows
- Bulls
- Calves, below 6 months
- Other_____

2.9.1.1 Has this practice been the same in the past 5 years?

- Yes
- No

2.9.1.2 If the answer to question 2.9.1.1. is no, give an explanation of the change in the grazing practice.

- How did the grazing practice change?

  _____

- When did the grazing practice change?

  _____

2.9.2 If answer to question 2.3 is yes. Do the out stationed animals graze?

- Yes
- No
- I don´t know

2.9.2.1 If answer to question 2.9.2 is yes. Has the grazing practice been the same during the past 5 years, at the place where they are out stationed?

- Yes
- No
- I don´t know

2.9.2.2 If answer to question 2.9.2.1 is no. Give an explanation of the change in the grazing practice.

- **How did the grazing practice changed?**

  _____

- **When did the grazing practice changed?**

  _____

2.9.3 Where does the cattle graze (if 2.9 answer is yes)?

- Within the premises of the farm
- Meadows, not within the farm premises*
- Common pasture area shared with other farms
- Protected or natural reserve area
- Other_____

* NB. The respondent is not responsible of the farming practice in the land not within his/hers farm premises

2.9.4 While the cattle are grazing are there parts of the grazing areas flooded sometimes?

- Yes
- No
- I don´t know

2.9.4.1 From where (if 2.9.4 answer is yes)?

- Stream
- River
- Lake
- Sea
- Other_____

2.9.5 When grazing is the cattle allowed drinking water from:

- streams
- lakes
- river
- Other_____

Comments section 2 – Cattle production – Grazing

_____

3 Management (Thinking about the past 5 years)

3.1 Have you fertilized with slurry, pasture areas that will be used for hay or silage production, or animal grazing?

- Yes
- No

3.1.1 If question 3.1 is answered yes, when?

- Which year(s)____

3.1.1.a When?

- < 3 months before grazing ?
  - Yes
  - No
- < 3 months before harvest for silage, wrap or hay?
  - Yes
  - No

3.2 Have you fertilized with sewage sludge, pasture areas that will be used for hay or grass silage production, or animal grazing?

- Yes
- No

3.2.1 If question 3.2 is answered yes, when?

- Time of year
  - Spring
  - Fall
- Which year_____

3.3 Have you used suction machinery the farm for handling slurry?

- Yes
- No

3.3.1 If question 3.3 yes, for what purpose and when?_____

3.4 Do you share machinery with other farmers or hire contractors?

- Yes
- No

Comments section 3 – Management

_____

4 Staff and visitors

4.1 Over the past 5 years have you had employees in your farm, besides the wife or husband?

- Yes
- No

4.1.1 Approximately how many employees have you had over the 5 years? _____

4.1.2 How many of those in average were Danish, if the answer to question 4.1 is yes?

- 0
- 1-2
- 3-4
- 5-6
- >6

4.1.3 How many of those in average were foreigners, if the answer to question 4.1 is yes?

- 0
- 1-2
- 3-4
- 5-6
- >6

4.1.3.1 Where were the foreign employees from, if answer to question 4.1.3 is >0?

_____

4.2 Over the past 5 years has your farm or farmland been used for activities like:

- Sports
- School visits
- Tourists
- Hunters
- Scouts
- People walking their dogs
- Horse riders
- Horse barn
- Military practices
- Bed and breakfast
- Fishery
- Other / other groups_____
- Has not been used for activities or visits

Comments section 4 – Staff and visitors

_____

5 Location of Farm

5.1 Is there a sewage treatment plant in the proximity area of your farmland?

- Yes
- No
- Do not know

5.2 Is there a distance less than approximately 200 meters from your farmland or grazing land for your cattle to:

- Camping site
- Pic-nic area
- Forrest shelter
- Festival/concert site
- Military training area
- Parking/rest area

5.3 Is there a toilet in the stable?

- Yes
- No

5.3.1 If answer to question 5.3 is yes. Does the toilet always go to a septic tank or a public sewage system?

- Yes
- No
- Don´t know

5.3.1.1 If answer to question 5.3.1 is no, where does it go?

_____

5.4 Has anybody with access to the stables or farmland in the 5 past years been diagnosed with tapeworm (taeniasis)?

- Yes
- No
- Do not know

Comments section 5 – Location of farm

_____

Appendix B
Dansk version af spørgeskema importeret fra Surveyxact®

Det er vigtigt at den person der interviewer, ved hvem respondenten er. Det er vigtigt, at så vidt det er muligt, er den person der ved mest om besætningen og produktionen.

Desuden skal spørgsmålene dække perioden 2006-2010, derfor er det vigtigt at gøre respondenten opmærksom på at vedkommende skal tænke 5 år tilbage når der svares.

1. Grundoplysninger

1.1 Hvilken funktion har du i besætningen?

- ❑ Ejer
- ❑ Driftsleder
- ❑ Ægtefælle
- ❑ Medarbejder
- ❑ Andet

1.2 Hvor mange personer færdes dagligt i besætningen, stald og mark?

1 2 3 4 5 6 7 8 9 10 11 12 13141516 1718 19 20

Antal børn / teenagere? ❑

Antal voksne i alderen 18-50 år? ❑

Antal voksne over 50 år? ❑

1.3 Havde du hørt om oksetinten før du fik det orienterende brev om undersøgelsen?

- ❑ Ja
- ❑ Nej

1.4 Har du hørt om tilfælde af oksetinter i besætninger i dit nærområde?

- ❑ Ja
- ❑ Nej

Kommentarer til sektion 1 - grundoplysninger

_____

2. Kvægproduktionen

2.1 Kan du bekræfte at du har …….. (f.eks. malkekvæg), har du desuden andre typer kvægproduktion på nuværende tidspunkt?

- ❑ Kødkvæg
- ❑ Malkekvæg
- ❑ Slagtekalve
- ❑ Hobby
- ❑ Ingen
- ❑ Anden type_____

2.2 Har typen af kvægproduktion skiftet inden for de sidste 5 år?

- ❑ Ja
- ❑ Nej

2.2.1 Hvilken type kvægproduktion var der før?

- ❑ Kødkvæg
- ❑ Malkekvæg
- ❑ Slagtekalve
- ❑ Hobby
- ❑ Ingen
- ❑ Anden type_____

2.3 I de sidste 5 år har du på noget tidspunkt udliciteret nogle af dine dyr, f.eks. på kviehotel?

- ❑ Ja
- ❑ Nej

2.3.1 Hvor var dyrene udliciteret?

- ❑ Kviehotel
- ❑ Andet_____

Kommentarer til sektion 2 - kvægproduktionen

_____

På stald

2.4 Har du brugt eller bruger du friskt græs i din foderplan?

- ❑ Ja
- ❑ Nej

2.5 Har du brugt eller bruger du hø i din foderplan?

- ❑ Ja
- ❑ Nej
- ❑ I særlige tilfælde, f.eks. til syge dyr_____

2.5.1 Har du indkøbt hø?

- ❑ Ja
- ❑ Nej

2.6 Har du brugt eller bruger du græsensilage i din foderplan?

- ❑ Ja
- ❑ Nej

2.6.1 Har du indkøbt græsensilage?

- ❑ Ja
- ❑ Nej

2.7 Har du brugt eller bruger du ” wrap” i din foderplan?

- ❑ Ja
- ❑ Nej

2.7.1 Har du indkøbt ”wrap”?

- ❑ Ja
- ❑ Nej

2.8 Hænder det at jorden hvor ”wrap” eller hø kommer fra til tider er oversømmet?

- ❑ Der bruges ikke/er ikke blevet brugt hø og wrap
- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

Kommentarer til sektion 2 - På stald

_____

Afgræsning

2.9 Har nogen af dine dyr været på græs i løbet af de sidste 5 år?

- ❑ Ja
- ❑ Nej

2.9.1 Hvilke grupper?

- ❑ Alle dyr
- ❑ Kvier
- ❑ Køer
- ❑ Tyre
- ❑ Kalve under 6 mdr.
- ❑ Andre_____

2.9.1.1 Har dette været den samme praksis de sidste 5 år?

- ❑ Ja
- ❑ Nej

2.9.1.2 Afgræsningspraksis?

Hvordan har afgræsningspraksis ændret sig? _____

Hvornår har afgræsningspraksis ændret sig? _____

2.9.2 Kommer/kom de udliciterede dyr (kvier) på græs?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

2.9.2.1 Har afgræsningspraksis været den samme de sidste 5 år på stedet, hvor dyrene udliciteres til?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

2.9.2.2 Afgræsningspraksis?

Hvordan har afgræsningspraksis ændret sig? _____

Hvornår har afgræsningspraksis ændret sig? _____

2.9.3 Hvor er/var kvæget på afgræsning?

- ❑ Afgræsning på egne marker
- ❑ Afgræsning på andres marker*
- ❑ Fælles afgræsning delt med andre landmænd
- ❑ Beskyttede natur områder eller fredede områder
- ❑ Andet_____

2.9.4 Hænder det at dele af afgræsningsområdet står under vand/er våde, når området afgræsses?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

2.9.4.1 Hvorfra?

- ❑ Vandløb
- ❑ Å
- ❑ Sø
- ❑ Hav
- ❑ Andet_____

2.9.5 På afgræsning kan kvæget da drikke vand fra:

- ❑ Vandløb
- ❑ Å
- ❑ Sø
- ❑ Andet_____

Kommentarer til sektion 2 - Afgræsning

_____

3. Management

Tænk på management på nuværende tidspunkt og i de sidste 5 år.

3.1 Har du anvendt gylle på jord, der i høståret er blevet anvendt til afgræsning eller produktion af hø, græsensilage eller "wrap"?

❑ Ja

❑ Nej

3.1.1 Hvornår?

❑ Hvilket/hvilke årstal? _____

3.1.1.a Hvornår?

Under 3 måneder inden afgræsning	Ja ❑	Nej ❑
Under 3 måneder inden slåning til slæt, hø eller wrap	Ja ❑	Nej ❑

3.2 Har du brugt spildevandsslam på jord, der er blevet anvendt til afgræsning eller produktion af hø, græsensilage eller "wrap"?

❑ Ja

❑ Nej

3.2.1 Hvornår?

	Forår	**Efterår**
Årstid	❑	❑

Årstal_____

3.3 Er der blevet anvendt slamsuger på bedriften i forbindelse med håndtering af gylle?

❑ Ja

❑ Nej

3.3.1 Til hvilket formål og hvornår?

_____

3.4 Anvender du maskinstation eller har du maskinfællesskab/deler maskiner med andre landmænd?

❑ Ja

❑ Nej

Kommentarer til sektion 3 - Management

_____

4. Ansatte og gæster

4.1 Har der de sidste 5 år været ansatte på bedriften ud over evt. medhjælpende ægtefælle?

- ❑ Ja
- ❑ Nej

4.1.1 Hvor mange ansatte har du ca. haft de sidste 5 år? _____

4.1.2 Hvor mange var danske?

- ❑ 0
- ❑ 1-2
- ❑ 3-4
- ❑ 5-6
- ❑ Flere end 6

4.1.3 Hvor mange var udlændinge?

- ❑ 0
- ❑ 1-2
- ❑ 3-4
- ❑ 5-6
- ❑ Flere end 6

4.1.3.1 Hvor kom de udenlandske ansatte fra? _____

4.2. I løbet af de sidste 5 år, er din bedrift eller jord blevet anvendt til/af en eller flere af de følgende aktiviteter/personer?

- ❑ Sport
- ❑ Skolebesøg
- ❑ Turister
- ❑ Jagt
- ❑ Spejdere
- ❑ Hundeluftere
- ❑ Ryttere
- ❑ Opstaldning af heste
- ❑ Militærøvelse
- ❑ Bed and breakfast
- ❑ Lystfiskeri
- ❑ Andet / andre gruppebesøg_____
- ❑ Er ikke blevet anvendt til aktiviteter eller besøg

Kommentarer til sektion 4 - Ansatte og gæster

_____

5. Bedriftens placering

5.1 Er der et rensningsanlæg i nærheden af bedriften?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

5.2 Er der mindre end ca. 200 meter fra bedriftens jord eller afgræsningsområder til:

- ❑ Campingplads
- ❑ Skovtursområde
- ❑ Shelter
- ❑ Festival / koncert område
- ❑ Militært øvelsesområde
- ❑ Parkering / rasteplads

5.3 Er der toilet i stalden?

- ❑ Ja
- ❑ Nej

5.3.1 Er toilettet installeret, så det løber ud i en septiktank eller offentligt kloaksystem?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

5.3.1.1 Hvor løber toilettet da hen?

_____

5.4 Er der nogen med adgang til bedriften gennem de sidste 5 år, der har haft bændelorm?

- ❑ Ja
- ❑ Nej
- ❑ Ved ikke

Kommentarer til sektion 5 - Bedriftens placering

Appendix C

Frequency Analysis imported from SurveyXact® and translated to English
Tables of descriptive statistics and *p*-values of the uni variable analyses**

Following tables presenting an overview of number of respondents and percentages is the "Frequency Analysis" imported from SurveyXact® and translated to English.

****** Tables added to the "Frequency Analysis" are providing descriptive statistics and p-values of Fisher exact tests in the uni variable analyses performed. Numbers in parenthesis behind variable names are referring to the number of the original question.

1. Basic Information

1.1 What is your job position in the farm?

	Respondents*	Percentage
Owner	273 of 308	88.6%
Manager	88 of 308	28.6%
Wife	23 of 308	7.5%
Employee	14 of 308	4.5%
Other	2 of 308	0.6%

*Note that the respondent had several options when answering this question

1.2 Number of people with daily access to the stables and/or the farmland?[1]

Children or teenagers <18 years old	Respondents	Percentage
0	219	71.1%
1	33	10.7%
2	29	9.4%
3	15	4.9%
4	7	2.3%
5	3	1.0%
6	1	0.3%
10	1	0.3%
Total	308	100.0%

1.2 Number of people with daily access to the stables and/or the farmland? [1]

Adults between 18 and 50 years old?	Respondents	Percentage
0	94	30.5%
1	79	25.6%
2	68	22.1%
3	35	11.4%
4	19	6.2%
5	5	1.6%
6	4	1.3%
7	2	0.6%
9	1	0.3%
10	1	0.3%
Total	308	100.0%

1.2 Number of people with daily access to the stables and/or the farmland? [1]

Adults > 50 years old?	Respondents	Percentage
0	107	34.7%
1	149	48.4%
2	47	15.3%
3	2	0.6%
4	2	0.6%
5	1	0.3%
Total	308	100.0%

[1]**Grouped answers:** Question 1.2 was converted into three variables with three levels each. Distribution and p-values are provided in table 1.1.

****Table 1.1.** Descriptive statistics and p-values of Fisher exact test of new variables made based on answers in question 1.2. % of cases represents the percentage of the total number of case herds (75)* and % of controls represents the percentage of the total number of control herds (229)*.

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Daily access to stable or farmland Number of persons < 18 years old (1.2)					
0	56	74.7	159	69.4	
1-2	12	16.0	50	21.8	
> 2	7	9.3	20	8.7	0.581
Daily access to stable or farmland Number of persons 18 to 50 years old (1.2)					
0	26	34.7	64	28.0	
1-3	38	50.7	144	62.9	
> 3	11	14.7	21	9.2	0.129
Daily access to stable or farmland Number of persons > 50 years old (1.2)					
0	20	26.7	83	36.2	
1	39	52.0	110	48.0	
> 1	16	21.3	36	15.8	0.247

*Note there are 4 missing values in these variables due to registrations of zero people in all three variables with daily access to stable or farmland in 4 herds.

1.3 Have you heard about *C. bovis* (beef measles) before you got the invitation letter from the project?

	Respondents	Percentage
Yes	80	26.0%
No	228	74.0%
Total	308	100.0%

1.4 Have you heard about the presence or occurrence *C. bovis* (beef measles) in your area?

	Respondents	Percentage
Yes	6	1.9%
No	302	98.1%
Total	308	100.0%

Comments to section 1 – Basic information are provided in Appendix D

2. Cattle production

2.1 Can you confirm that you have this …… cattle production? Currently, besides this production do you have any other type of cattle production? [2]

	Respondents*	Percentage
Beef	115 of 308	37.3%
Dairy	195 of 308	63.3%
Veal Calves	91 of 308	29.5%
Hobby	4 of 308	1.3%
None	4 of 308	1.3%
Other type[!]	6 of 308	1.9%

*Note that the respondent had several options when answering this question

[!] Answers in 2.1 "other type" are provided in Appendix D

[2]**Grouped answers:** Question 2.1 was converted into a variable with two levels. The categorisation of herds was based on a combination of the answers in question 2.1, information from the Danish Cattle Database, comments in section 2 – cattle production and answers in question 2.2.1 regarding what type of cattle production has been before if the production has changed in the study period. Distribution and p-values are provided in table 2.1.

2.2 Has the cattle production changed in the past 5 years?

	Respondents	Percentage
Yes	42	13.6%
No	266	86.4%
Total	308	100.0%

2.2.1 Which type of cattle production was it before the change?

	Respondents*	Percentage
Beef	13 of 42	31.0%
Dairy	22 of 42	52.4%
Veal Calves	8 of 42	19.0%
Hobby	0	0.0%
None	0	0.0%
Other type[!]	7 of 42	16.7%

*Note that the respondent had several options when answering this question

[!] Text answers in 2.2.1 "other type" are provided in Appendix D

2.3 Have you had any of your animals out stationed for example in a heifer hotel in the past 5 years? [4]

	Respondents	Percentage
Yes	37	12.0%
No	271	88.0%
Total	308	100.0%

2.3.1 Where were the animals out stationed? [4]

	Respondents	Percentage
Heifer hotel	20	54.1%
Other*	17	45.9%
Total	37	100.0%

*Text answers in 2.3.1 "other" are provided in Appendix

[4]**Grouped answers:** Question 2.3 and 2.3.1 was converted into a variable with three levels all text answers in 2.3.1 were considered. Distribution and p-values are provided in table 2.1.

****Table 2.1.** Descriptive statistics and p-values of Fisher exact tests of variables made based on answers in question 2.1, 2.2.1 and information available in the Danish Cattle Database. Also descriptive statistics and p-value of Fisher exact test in the variable made based on answers in question 2.3 and 2.3.1 is provided. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value
Variable and level	**n**	**% of cases**	**n**	**% of controls**	**Fisher exact test**
Type of Herd (2.1 and 2.2.1)					
Dairy and Veal	49	63.6	153	66.2	
Beef and other	28	36.4	78	33.8	0.680
Organic status*					
Organic	15	19.5	20	8.7	
Conventional	62	80.5	211	91.3	0.013
Out stationed animals (2.3 and 2.3.1)					
Yes, taken care of by others	9	11.7	20	8.7	
Yes, not taken care of by others	3	3.9	5	2.2	
No out stationed animals	65	84.4	206	89.2	0.463

***Organic status:** The variable "organic status" in table 2.1 is mainly based on information from the Danish Cattle Database, but also a few comments in "section 2 - cattle production" and text answers from 2.1 and 2.1.1 were taken into consideration. A herd was categorized as organic if it was registered as organic, had ever been organic or if it was becoming organic.

Comments section 2 – Cattle production are provided in Appendix D

In the stable:

2.4 Have you used or currently use fresh grass in your feeding plan?

	Respondents	Percentage
Yes	145	47.1%
No	163	52.9%
Total	308	100.0%

2.5 Have you used or currently use hay in your feeding plan? [5]

	Respondents	Percentage
Yes	176	57.1%
No	109	35.4%
In special situations, for instance for sick animals*	23	7.5%
Total	308	100.0%

*Text answers in 2.5 "in special situations" are provided in Appendix D

[5]**Grouped answers:** Question 2.5 was converted into a two level variable. Distribution and p-values are provided in table 2.2.

2.5.1 Have you purchased hay?*

	Respondents	Percentage
Yes	31	15.6%
No	168	84.4%
Total	199	100.0%

*Further distribution and p-values are provided in table 2.2.

2.6 Have you used or currently use silage from grass in your feeding plan?*

	Respondents	Percentage
Yes	197	64.0%
No	111	36.0%
Total	308	100.0%

*Further distribution and p-values are provided in table 2.2.

2.6.1 Have you purchased silage from grass?*

	Respondents	Percentage
Yes	22	11.2%
No	175	88.8%
Total	197	100.0%

*Further distribution and p-values are provided in table 2.2.

2.7 Have you used or currently use "Wrap" in your feeding plan?*

	Respondents	Percentage
Yes	212	68.8%
No	96	31.2%
Total	308	100.0%

*Further distribution and p-values are provided in table 2.2.

2.7.1 Have you purchased wrap?*

	Respondents	Percentage
Yes	33	15.6%
No	179	84.4%
Total	212	100.0%

*Further distribution and p-values are provided in table 2.2.

2.8 Has the hay or "wrap" come from a farmland that can be flooded?*

	Respondents	Percentage
Hay or "wrap" is not used/has not been used	14	4.5%
Yes	102	33.1%
No	192	62.3%
Total	308	100.0%

*Further distribution and p-values are provided in table 2.2.

****Table 2.2.** Descriptive statistics and p-values of Fisher exact test of variables in the section 2 "in the stable". % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Use of hay (2.5)					
Yes	52	67.5	147	63.4	
No	25	32.5	84	36.4	0.584
Use of purchased hay (2.5.1)					
Yes	8	10.4	23	10.0	
No	44	57.1	124	53.7	
No use of hay	23	32.5	84	36.4	0.839
Use of grass silage (2.6)					
Yes	53	68.8	144	62.3	
No	24	31.2	87	37.7	0.339
Use of purchased grass silage (2.6.1)					
Yes	5	6.5	17	7.4	
No	48	62.3	127	55.0	
No use of grass silage	24	31.2	87	37.7	0.555
Use of "wrap" (2.7)					
Yes	54	70.1	158	68.4	
No	23	29.9	73	31.6	0.887
Use of purchased "wrap" (2.7.1)					
Yes	8	10.4	25	10.8	
No	46	59.7	133	57.6	
No use of grass silage	23	29.9	73	31.6	0.962
Flooding of farmland producing hay or wrap (2.8)					
Yes	26	33.8	76	32.9	
No	46	59.7	146	63.2	
No use of wrap and hay	5	6.5	9	3.9	0.540

Comments section 2 – Cattle production – In the stable - are provided in Appendix D

Grazing:

2.9 Have any of your animals been grazing in the past 5 years? [6]

	Respondents	Percentage
Yes	276	89.6%
No	32	10.4%
Total	308	100.0%

2.9.1 Which group or groups? [6]

	Respondents*	Percentage
All animals	140 of 276	50.7%
Heifers	125 of 276	45.3%
Cows	67 of 276	24.3%
Bulls	6 of 276	2.2%
Calves, below 6 months	29 of 276	10.5%
Other[!]	14 of 276	5.1%

*The respondent had several options when answering this question

[!] Text answers in 2.9.1 "other" are provided in Appendix D

[6]**Grouped answers:** Question 2.9.1 was converted into a variable with three levels based on answers in both question 2.9 and 2.9.1. Distribution and p-values are provided in table 2.3.

2.9.1.1 Has this practice been the same in the past 5 years?

	Respondents	Percentage
Yes	256	92.8%
No	20	7.2%
Total	276	100.0%

2.9.1.2 - How did the grazing practice change?

Text answers are provided in Appendix D

2.9.1.2 - When did the grazing practice change?

Text answers are provided in Appendix D

2.9.2 Do the out stationed animals graze?*

	Respondents	Percentage
Yes	14	37.8%
No	22	59.5%
I don´t know	1	2.7%
Total	37	100.0%

*Further distribution and p-values are provided in table 2.3.

****Table 2.3.** Descriptive statistics and p-values of Fisher exact tests based on answers in question 2.9, 2.9.1 and 2.9.2. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Groups of animals grazing (2.9 and 2.9.1)					
All	47	61.0	110	47.6	
Some	23	29.9	96	41.6	
None	7	9.1	25	10.8	0.127
Grazing out stationed animals (2.9.2)					
Yes	5	6.5	9	3.9	
No	7	9.1	15	6.5	
Do not know	0	0	1	0.4	
No out stationed animals	65	84.4	206	89.2	0.550

2.9.2.1 Has the grazing practice been the same during the past 5 years, at the place where they are out stationed?

	Respondents	Percentage
Yes	11	78.6%
No	2	14.3%
I don´t know	1	7.1%
Total	14	100.0%

2.9.2.2 - How did the grazing practice changed?
Text answers are provided in Appendix D

2.9.2.2 - When did the grazing practice changed?
Text answers are provided in Appendix D

2.9.3 Where do the cattle graze? [7]

	. Respondents*	Percentage
Pasture within the premises of the farm	263 of 276	95.3%
Pasture, not within the farm premises[!]	88 of 276	31.9%
Common pasture area shared with other farms	11 of 276	4.0%
Protected or natural reserve area	117 of 276	42.4%
Other[!!]	7 of 276	2.5%

*Note that the respondent had several options when answering this question
[!] The respondent is not responsible of the farming practice in the land not within his/hers farm premises
[!!] Text answers in 2.9.3 "other" are provided in Appendix D
[7]**Grouped answers:** In question 2.9.3 all text answers in "other" have been grouped in one of the other options. Furthermore 4 variables were created with 3 levels each. Distribution and p-values are provided in table 2.4.

****Table 2.4.** Descriptive statistics and p-values of Fisher exact tests of the variables created based on question 2.9.3. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Animals grazing within farm premises (2.9.3)					
Yes	69	89.6	194	84.0	
No	1	1.3	12	5.2	
No animals grazing	7	9.1	25	10.8	0.330
Animals grazing outside farm premises (2.9.3)					
Yes	23	29.9	65	28.1	
No	47	61.0	141	61.0	
No animals grazing	7	9.1	25	10.8	0.922
Animals grazing in common pasture area shared with other farmers (2.9.3)					
Yes	3	3.9	8	3.5	
No	67	87.0	198	85.7	
No animals grazing	7	9.1	25	10.8	0.911
Animals grazing in protected or natural reserve area (2.9.3)					
Yes	36	46.8	83	35.9	
No	34	44.2	123	53.3	
No animals grazing	7	9.1	25	10.8	0.266

2.9.4 While the cattle are grazing are there parts of the grazing areas flooded sometimes? [8]

	Respondents	Percentage
Yes	135	48.9%
No	141	51.1%
Total	276	100.0%

2.9.4.1 From where? [8]

	Respondents*	Percentage
Stream	43 of 276	31.9%
River	48 of 276	35.6%
Lake	9 of 276	6.7%
Sea	8 of 276	5.9%
Other[!]	53 of 276	39.3%

*Note that the respondent had several options when answering this question

[!] Answers in 2.9.4.1 "other" are provided in Appendix D

[8]**Grouped answers:** Five new variables were created based on the answers in question 2.9.4 and 2.9.4.1. A new option was created called "surface water". Most of the text answers in "other" and those who answered "lake" are in the category "surface water". And finally a dichotomised variable was created. Distribution and p-values are provided in table 2.5.

****Table 2.5.** Descriptive statistics and p-values of Fisher exact tests of the variables created based on answers in question 2.9.4 and 2.9.4.1. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Flooding of grazing area while grazing (2.9.4)					
Yes	35	45.5	100	43.3	
No	35	45.5	106	46.0	
No animals grazing	7	9.1	25	10.8	0.928
Flooding of grazing area from surface water (2.9.4.1)					
Yes	11	14.3	48	20.8	
No	24	31.2	52	22.5	
No flooding	35	45.5	106	46.0	
No animals grazing	7	9.1	25	10.8	0.381
Flooding of grazing area from stream or river (2.9.4.1)					
Yes	22	28.6	63	27.3	
No	13	16.9	37	16.0	
No flooding	35	45.5	106	46.0	
No animals grazing	7	9.1	25	10.8	0.980
Flooding of grazing area from sea (2.9.4.1)					
Yes	3	3.9	6	2.6	
No	32	41.6	94	40.7	
No flooding	35	45.5	106	46.0	
No animals grazing	7	9.1	25	10.8	0.906
Source of flooding of grazing area (2.9.4.1)					
Flooding from potentially risky water	35	45.5	100	43.3	
No flooding or no animals grazing	42	54.5	131	56.7	0.791

2.9.5 When grazing is the cattle allowed drinking water from: [9]

	Respondents*	Percentage
Streams	78 of 276	28.3%
River	54 of 276	19.6%
Lakes	37 of 276	13.4%
Other[!]	214 of 276	77.5%

*Note that the respondent had several options when answering this question

[!] Answers in 2.9.5 "other" are provided in Appendix D

[9]**Grouped answers:** Three new variables were created based on the answers in question 2.9.5. Two new options was created called "surface water" and "no risky water source". The text answers in "other" were mainly placed in one of these two options and lake was categorized as "surface water". And finally a dichotomised variable was created. Distribution and p-values are provided in table 2.6.

****Table 2.6.** Descriptive statistics and p-values of Fisher exact tests of the variables created based on answers in question 2.9.5. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		**Control herds**		***p*-value Fisher exact test**
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Drinking from surface water when grazing (2.9.5)					
Yes	21	27.3	31	13.4	
No	32	41.6	72	31.2	
No risky water source	17	22.1	103	44.6	
No animals grazing	7	9.1	25	10.8	0.00095
Drinking from stream or river when grazing (2.9.5)					
Yes	41	53.3	82	35.5	
No	12	15.6	21	9.1	
No risky water source	17	22.1	103	44.6	
No animals grazing	7	9.1	25	10.8	0.0017
Drinking water source when grazing (2.9.5)					
Risky water source	53	68.8	103	44.6	
No risk or no animals grazing	24	31.2	128	55.4	0.00023

Comments section 2 – Cattle production – Grazing - are provided in Appendix D

3. Management

3.1 Have you fertilized with slurry, pasture areas that will be used for hay, silage or "wrap" production or animals grazing?*

	Respondents	Percentage
Yes	214	69.5%
No	94	30.5%
Total	308	100.0%

* Further distribution and p-values are provided in table 3.1.

3.1.1 When? [10]

	Respondents	Percentage
Which year(s)*	214	100.0%
Total	214	100.0%

*Text answers in 3.1.1 "Which year(s)" are provided in Appendix D

[10]**Grouped answers:** Text answers in 3.1.1 were converted into a new viable with three levels. Distribution and p-values are provided in table 3.1.

3.1.1.a When?

Use of slurry < 3 months before grazing?*	Respondents	Percentage
Yes	105	34.1%
No	109	35.4%
No use of slurry	94	30.5%
Total	308	100.0%

* Further distribution and p-values are provided in table 3.1.

3.1.1.b When?

Use of slurry < 3 months before harvest for silage, wrap or hay?*	Respondents	Percentage
Yes	196	63.6%
No	18	5.8%
No use of slurry	94	30.5%
Total	308	100.0%

* Further distribution and p-values are provided in table 3.1.

****Table 3.1.** Descriptive statistics and p-values of Fisher exact tests of the variables based on answers in question 3.1, 3.1.1 and 3.1.1.a. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value
Variable and level	**n**	**% of cases**	**n**	**% of controls**	**Fisher exact test**
Use of slurry on grazing land or farmland for production of hay grass silage or wrap (3.1)					
Yes	59	76.6	155	67.1	
No	18	23.4	76	32.9	0.153
Period slurry was used on grazing land or farmland for production of hay, grass silage or wrap (3.1.1)					
Every year in study period	54	70.1	145	62.8	
Some of the years in study period	5	6.5	10	4.3	
No use of slurry	18	23.4	76	32.9	0.228
Use of slurry less than 3 months on grazing land before grazing (3.1.1a)					
Yes	34	44.2	71	30.7	
No	25	32.5	84	36.4	
No use of slurry	18	23.4	76	32.9	0.086
Use of slurry less than 3 months on farmland for production of hay, grass silage or wrap (3.1.1b)					
Yes	54	70.1	142	61.5	
No	5	6.5	13	5.6	
No use of slurry	18	23.4	76	32.9	0.276

3.2 Have you fertilized with sewage sludge, pasture areas that will be used for hay or grass silage production, or animal grazing?

	Respondents	Percentage
Yes	4	1.3%
No	304	98.7%
Total	308	100.0%

3.2.1 - Time of year?

	Respondents	Percentage
Spring	2	50.0%
Fall	2	50.0%
Total	4	100.0%

3.2.1 – Which year(s)?
Answers are provided in Appendix D

3.3 Have you used suction machinery (Slamsuger) at the farm for handling slurry?*

	Respondents	Percentage
Yes	90	29.2%
No	218	70.8%
Total	308	100.0%

* Further distribution and p-values are provided in table 3.2.

3.3.1 For what purpose and when? [11]
Text answers are provided in Appendix D
[11]**Grouped answers:** Text answers in 3.3.1 were converted into a new variable with three levels based how often suction machinery had been used. Distribution and p-values are provided in table 3.2.

3.4 Do you share machinery with other farmers or hire contractors?*

	Respondents	Percentage
Yes	288	93.5%
No	20	6.5%
Total	308	100.0%

* Further distribution and p-values are provided in table 3.2.

****Table 3.2.** Descriptive statistics and p-values of Fisher exact tests of the variables based on answers in question 3.3, 3.3.1 and 3.4. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Use of suction machinery for handling slurry (3.3)					
Yes	29	37.7	61	26.4	
No	48	62.3	170	73.6	0.082
Period suction machinery was used (3.3.1)					
Yearly whole study period	10	13.0	25	10.8	
Yearly part of study period	19	24.7	36	15.6	
No use of suction machinery	48	62.3	170	73.6	0.142
Share machinery or hire contractors (3.4)					
Yes	75	97.4	213	92.2	
No	2	2.6	18	7.8	0.179

Comments section 3 – Management – are provided in Appendix D

4. Staff and visitors

4.1 Over the past 5 years have you had employees in your farm, besides the wife or husband?*

	Respondents	Percentage
Yes	155	50.3%
No	153	49.7%
Total	308	100.0%

* Further distribution and p-values are provided in table 4.1.

4.1.1 Approximately how many employees have you had over the 5 years? [12]

	Respondents	Percentage
Number of employees?*	155	100.0%
Total	155	100.0%

*Answers are provided in Appendix D

[12]**Grouped answers:** Answers in 4.1.1 were converted into a new variable with three levels based on number of employees. Distribution and p-values are provided in table 4.1.

4.1.2 How many of those in average were Danish? [13]

	Respondents	Percentage
0	5	3.2%
1-2	75	48.4%
3-4	28	18.1%
5-6	22	14.2%
Above 6	25	16.1%
Total	155	100.0%

4.1.3 How many of those in average were foreigners? [13]

	Respondents	Percentage
0	101	65.2%
1-2	29	18.7%
3-4	18	11.6%
5-6	4	2.6%
Above 6	3	1.9%
Total	155	100.0%

[13]**Grouped answers:** Answers in 4.1.2. and 4.1.3 were converted into a new variable with three levels based on nationality of employees. Distribution and p-values are provided in table 4.1.

4.1.3.1 Where were the foreign employees from?
Text answers are provided in Appendix D

****Table 4.1.** Descriptive statistics and p-values of Fisher exact test of the variables based on answers in question 4.1, 4.1.1, 4.1.2 and 4.1.3. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value
Variable and level	**n**	**% of cases**	**n**	**% of controls**	**Fisher exact test**
Employees (4.1)					
Yes	43	55.8	112	48.5	
No	34	44.2	119	51.5	0.294
Number of employees (4.1.1)					
Low number (1-5)	28	36.4	78	33.8	
High number (> 5)	15	19.5	34	14.7	
No employees	34	44.2	119	51.5	0.444
Nationality of employees (4.1.2 and 4.1.3)					
Foreign and Danish employees	19	24.7	35	15.2	
Only Danish employees	24	31.2	77	33.3	
No employees	34	44.2	119	51.5	0.173

4.2 Over the 5 years has your farm or farmland been used for activities like? [14]

	Respondents*	Percentage
Sports	10 of 308	3.2%
School visits	100 of 308	32.5%
Tourists	55 of 308	17.9%
Hunters	237 of 308	76.9%
Scouts	16 of 308	5.2%
People walking their dogs	108 of 308	35.1%
Horse riders	78 of 308	25.3%
Horse barn	17 of 308	5.5%
Military practices	34 of 308	11.0%
Bed and breakfast	5 of 308	1.6%
Fishery	72 of 308	23.4%
Other / other groups[!]	75 of 308	24.4%
Has not been used for activities or visits	39 of 308	12.7%

*Note that the respondent had several options when answering this question

[!] Text answers in 4.2 "other/ other groups" are provided in Appendix D

[14]**Grouped answers:** Answers in question 4.2 were converted into 7 new variables with two levels each where;

- "leisure activities" is a result of grouping "sports", "barning horses" and "fishery"
- "Tourists" is a result of grouping "tourists" and "bed and breakfast"
- " Outdoor stay" is a result of grouping "scouts" and "military practices"
- "Many people passing by" is a result of grouping "people walking their dogs" and "horse riders"
- "Day visitors" is mainly a result of text answers from "other/other groups"
- "Hunters" was not grouped
- "Has not been used for activities or visits" was not grouped.

Furthermore relevant text answers and comments to section 4 were categorised. Distribution and p-values are provided in table 4.2.

****Table 4.2.** Descriptive statistics and p-values of Fisher exact tests of the variables based on answers in question 4.2. % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value
Variable and level	**n**	**% of cases**	**n**	**% of controls**	**Fisher exact test**
Use of farm or farm land for leisure activities (4.2)					
Yes	28	36.4	66	28.6	
No	49	63.6	165	71.4	0.202
Use of farm or farm land for tourists (4.2)					
Yes	18	23.4	42	18.2	
No	59	76.6	189	81.2	0.323
Use of farm or farm land for outdoor stay (4.2)					
Yes	15	19.5	29	12.6	
No	62	80.5	202	87.5	0.137
Many people passing by farm or farmland (4.2)					
Yes	41	53.3	96	41.6	
No	36	46.8	135	58.4	0.086
Use of farm or farm land for day visitors (4.2)					
Yes	34	44.2	96	41.6	
No	43	55.8	135	58.4	0.692
Use of farm or farm land for hunting (4.2)					
Yes	66	85.7	171	74.0	
No	11	14.3	60	26.0	0.042
Farm or farm land has not been used for activities (4.2)					
Yes	4	5.2	35	15.2	
No	73	94.8	196	84.9	0.028

Comments section 4 – Staff and visitors – are provided in Appendix D

Location of Farm

5.1 Is there a sewage treatment plant in the proximity area of your farmland?*

	Respondents	Percentage
Yes	54	17.5%
No	252	81.8%
Do not know	2	0.6%
Total	308	100.0%

* Further distribution and p-values are provided in table 5.1

5.2 Is there a distance less than approximately 200 meters from your farmland or grazing land for your cattle to: [15]

	Respondents*	Percentage
Camping site	14 of 110	12.7%
Pic-nic area	81 of 110	73.6%
Shelter	13 of 110	11.8%
Festival/concert site	5 of 110	4.5%
Military training area	5 of 110	4.5%
Parking/rest area	48 of 110	43.6%

*Note that the respondent had several options when answering this question

[15]**Grouped answers:** Answers in question 5.2 were converted into 5 variables with two levels each. "Festival/concert site" and " military training area" were grouped, the rest were kept as the original category. Furthermore relevant comments to section 5 were categorised. Distribution and p-values are provided in table 5.1.

5.3 Is there a toilet in the stable? [16]

	Respondents	Percentage
Yes	83	26.9%
No	225	73.1%
Total	308	100.0%

5.3.1 Does the toilet always go to a septic tank or a public sewage system? [16]

	Respondents	Percentage
Yes	68	81.9%
No	13	15.7%
Don´t know	2	2.4%
Total	83	100.0%

5.3.1.1 If no, where does it go? [16]

Text answers are provided in Appendix D

[16]**Grouped answers:** Answers in question 5.3, 5.3.1 and 5.3.1.1 were converted into one variable. Distribution and p-values are provided in table 5.1.

****Table 5.1.** Descriptive statistics and p-values of Fisher exact tests of the variables based on answers in questions in the section " location of farm". % of cases represents the percentage of the total number of case herds (77) and % of controls represents the percentage of the total number of control herds (231).

	Case herds		Control herds		*p*-value Fisher exact test
Variable and level	**n**	**% of cases**	**n**	**% of controls**	
Sewage treatment plant in proximity (5.1)					
Yes	20	26.0	34	14.7	
No	57	74.0	195	84.4	
Do not know	0	0	2	0.9	0.072
Camping site within 200 meters (5.2)					
Yes	4	5.2	12	5.2	
No	73	94.8	219	94.8	1.000
Picnic area within 200 meters (5.2)					
Yes	25	32.5	58	25.1	
No	52	67.5	173	74.9	0.919
Shelter within 200 meters (5.2)					
Yes	7	9.1	6	2.6	
No	70	90.9	225	97.4	0.022
Festival or military area within 200 meters (5.2)					
Yes	3	3.9	13	5.6	
No	74	96.1	218	94.4	0.769
Parking area within 200 meters (5.2)					
Yes	17	22.1	32	13.9	
No	60	77.9	199	86.2	0.105
Presence of toilet in stable and installation (5.3, 5.3.1 and 5.3.1.1)					
Yes installed correctly	20	26.0	48	20.8	
Yes drain into slurry	2	2.6	11	4.8	
Yes do not know where it drains	0	0	2	0.9	
No toilet in stable	55	71.4	170	73.60	0.693

5.4 Has anybody with access to the stables or farmland in the 5 past years been diagnosed with tapeworm (taeniasis)?

	Respondents	Percentage
Yes	2	0.6%
No	101	32.8%
Do not know	205	66.6%
Total	308	100.0%

Comments section 5 – Location of farm – are provided in Appendix D

Appendix D

Comments and text answers imported from SurveyXact®

Kommentar til sektion 1
Havde hørt noget men ikke hvad det var
1.1. Ansvarlig lærer for landbruget på efterskolen
For 20 år siden var der en der havde tømt en septitank på en mark
havde hørt om en mand der havde en slamsuger der sugede septitanke og kørte det ud på egne marker, han fik kasseret flere dyr for ca. 20 år siden. en nabo havde køer til at afgræsse ved siden af rensningsanlæg, måger fløj fra rensningsanlægget og over på marken, han fik også tinter.
havde 4-5 køer der blev kasseret 2008 2009
1.3 Havde et tilfælde af oksetinter i slutningen af 1990'erne. Han har en formodning om maskinstationen var årsag til smitten, da de også tømte septiktanke.
1.1. Ejer men ikke i daglig kontakt med kvægbesætningen. Fungerer som direktør.
Sønnen passer bedriften, men ejer er involveret.
1.1. Medhjælpende hustru
1.1. Konen er lige så involveret i besætningen som ejeren
1.1 hun ville gerne kaldes fodermester
medhjælpende ægtefælle
1.1 Konen ligeså involveret i besætningen
Diftsleder for Kvægproduktionen
1.3. Havde hørt om oksetinten, da der for ca. 25 år siden havde været tilfælde i besætningen, da faren drev ejendommen. Dengang blev mistanken rettet mod oprensning af dynd fra afvandingskanaler, der blev liggende på marken.

2.1 - Anden type
Heste
Stude
studeproduktion (kun egne tyre)
Er under omlægning til økologi
Kviehotel
Stude

2.2.1 - Anden type
Studeproduktion
har sat slagtekalvene ud og er ved at udvidde
overtog besætningen udg. 2008
Stude
indkøbt kælve kvier ca. 150
ohørt med økologi i 2008
Konventionel malkekvæg, begyndt omlæggelse til økologi i august 2007

2.3.1 – Andet
50 stude på studekotel
nabo lade i forbindelse med byggeri
Bortløbet i 2 måneder
Der blev købt nye dyr ind som kom i en tom stald til der var plads efter byggeri
tom ejendom over vinter
udlån af tyr
tom ejendom
opstaldet på tom naboejendom
på tom ejendom
forskellige steder kun denne besætning
ålestrup avlsstation som kom hjem igen
tyr udlejet hvert år
tyr udlejet hvert år
tyr udlejet i 2010
tyr udlejet sommer 2010
tyr var hos nabo sommer 2007

Kommentar til sektion 2
Lånt en tyr ud til naboen
40 køer mere
har haft opstaldet kvier på nabogård der var tom
ihvertfald 2-3 af de dyr der havde tinter havde gået på en eng op til et rensningsanlæg, engen bruges stadig men nu kommer drikkevandet fra en sø i stedet for bækken
2.2.1 Holdt med fedekalveproduktion i 2007
2.2.1. Malkekøer sat ud for 3 år siden, og beholdt derefter de sidste kvier, har aldrig været decideret kødkvægsproducent på trods af registreret som sådan. Var økolog.
2.2.1. Havde herefordbesætning (ammekøer) tidligere. Men har nu kun stude.
2.1. har én ammeko
Står registeret som handelsbesætning, men er kviehotel
2.2.1 stoppede med mælkeproduktion i 2006

2.5 - I særlige tilfælde, f.eks. til syge dyr
syge dyr
Lucernehø
kun hvis de skal lokkes
små kalve
til småkalve
syge dyr
til syge dyr
til småkalve, og syge køer
Til syge dyr
Syge dyr + alle småkalve indtil 2 mdr
til syge dyr
til syge dyr
til kalve i et af årene
syge dyr og lidt til nogle kalve
til kvier, syge dyr
til syge dyr
lidt til kalve + syge dyr
til syge dyr
lidt til til kalve og syge dyr
til enkelte kalve
til syge dyr
syge dyr
til syge dyr og nykælvere

Kommentarer til sektion 2 - På stald
det indkøbte hø kommer fra områder der bliver oversvømmet
Naboens dræn var stoppet.
det kan forekommme at der indkøbes foder
det er ikke oversvømmet siden 2007 da der er blevet drænet
indkøbt hø fra nabo
2.4. Der fodres med afslået græs fra plæner og lignende ude i indhegningningen
2.5 Bruger kun hø til kalve
2.5 Bruger kun hø til kalve

2.9.1 – Andre
Goldkøer
drægtige dyr
Golde
Goldkøer
Golde
køerne er på motionsfold med meget lidt græs
Goldkøer
Kødkvæg
Kødkvæg

Ammekøer med kalve
kun kødkvæget
halte dyr og goldkøer
Enkelste højdrægtige kvier
syge dyr, få goldkøer, 1 kødkvægsko med kalv, stud

2.9.1.2 - Hvordan har afgræsningspraksis ændret sig?
kun sidste år
alle dyr er inde nu
2010
2007
drægtige kvier ude for første gang
fra 2007 har køerne ikke været ude
det er ikke alle år dyrene er på græs
siden 2007 er det kun kvier der er ude
Køer ej ude mere
Kun slagtekalveproduktion indtil 2007, kalvene kom ikke ud
Køer ej ude mere
Køer ej ude mere
køer ej ude mere, kun goldkøer
Kvierne er nu løbealder inden de kommer ud
Køer ej ude mere, kvier holdt inde i to år
Nu kun kvier
Tyrene kommer også ud nu
Nu kun kvier
Nu kommer kun kvier på græs
slagtekalve gik kun inde

2.9.2.2 - Hvordan har afgræsningspraksis ændret sig?
Flyttet
kun ude siden april 2009

2.9.2.2 - Hvornår har afgræsningspraksis ændret sig?
G
2009

2.9.3 Andet
der er 3 dyr kommet tilløbet
kvier i højer marsken indenfor diget dvs. ikke fredet/beskyttet jord, Kun hans kvier i flokken, vedvarende græs, ingen turister
nabo afgræsser marker inden pløjning
bliver betalt for at afgræsse
Sfl
Sfl
kvier højer marsken, men ikke delt med andre landmænd

2.9.4.1 – Andet
naboens drænvar stoppet
trygvand fra bakkerne
Regn
Brøndvand
lavt jord
Moseområde
dårlige drænsforhold
ringkøbing fjord
Regn
lavt jord dræn kan ikke følge med
Regnvand
Regn

der kommer vand løbende fra byen af
Ovenfra
Regn
indlandsvand fra marsken
lavt jord, dræn kan ikke følge med
Regn
regn og grundvand
manglede dræn
Regn
Regn
lav eng
lav bund
Grundvand
Regn
Grundvand
Grundvand
Regn
lavt jord, dræn kan ikke følge med
lavt jord, udrænet
lavt jord udrænet
lavt jord, dræn kan ikke følge med
lavt jord dræn ikke følge med
lavt jord, dræn kan ikke følge med
udrænet jord
lavt jord dræn kan ikke følge med
lavt jord, hvor dræn ikke kan følge med
dræn kan ikke følge med
dræn kan ikke følge med
ingen dræn
Kanaler
dræn kan ikke følge med
dræn kan ikke følge med
dræn kan ikke følge med
dræn kan ikke følge med på engareal
dræn kan ikke følge med
fra dræn
dræn kan ikke følge med
sump ingen dræn
vandet fra bakkerne løber ned i et hul og drænene kan ikke følge med
dræn kna til tider ikke følge med
dræn holdes ikke ved lige, planer om permanenet oversvømmelse

2.9.5 – Andet
Vandvogn
Byvand
naturligt kildevand
Mose
Vandværk
vandværk, mose
Vandhul
Stalden
Byvand
Vandværket
Byvand
Byvand
Byvand
byvand
boring
byvand
mark brønde

byvand
byvand
vandværk
mark boring
kilde
boring
vandværk
byvand
brøndvand
byvand
vandværk
mergelgrav
byvand
kilde, byvand
vandværk
brønd
stalden
dræn
brøndvand
vandboring
stalden
byvand
byvand
byvand
egen boring
vandværk
byvand
vandværk
brønd
byvand
byvand
kilde
byvand
grundvand+vandværk
PRIVAT BORING
vandboring
byvand
byvand
byvand
vandværk
byvand
vandværk
byvand
byvand
byvand
byvand
byvand
byvand
kilde, byvand
byvand
egen brønd
byvand
brønd
byvand
byvand
egen borring
byvand
byvand
nark boring med mulepumpe
boring i marken

boring
byvand
byvand, mark boring
byvand
egen boring
byvand
byvand, dræn
byvand
byvand
Byvand
Byvand
Byvand
Byvand
Byvand
Byvand
Byvand
Byvand
Byvand
Kilder
boring i mark
Boring
egen boring
Byvand
Byvand
Byvand
Brøndvand
Byvand
Byvand
Byvand
eget vandværk
Brønd
mark boring
Btvand
Byvand
Vandværk
Grundvand
Markboring
Vandboring
Byvand
Markboring
eget vandværk
Vandværk
Vandværk
Boring
Vandværk
vandværk, mark boring
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
Boring
Vandværk
markboring + vandværk
Markboring
Byvand
Vandværk

vandboring offentlig
Vandværk
Vandværk
vændværk, boring
Vandværk
Vandværk
grundvand og boring
Vandværk
Vandværk
fra egen boring
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
Vandværk
kildevæld+vandværk
Boring
Vandværk
Vandværk
Vandværk
Vandværk
fra egen brønd
Vandværk
boring, vandværk
fra kildevæld
Vandværk
fra vandværk
kanaler, vandhuller
Vandværk
Vandværk
Vandværk
fra vandværk
fra boring
fra vandværk
fra boring eller vandværk
fra boring
Vandværk
Vandværk
fra kildevæld
fra egen makrvandingsboring
fra egen brønd
fra vandværk
kalve under 6 mdr. fra vandværk
Vandværk
boring ude på skallingen
egen brønd
Vandværk
fra egen brønd
fra vandværk
vandhuller + fra vandværk
vandhul og boring
drænvand opsamles
Fra egen brønd
fra vandværk
Fra vandværk
vandværk, fra dræn
Vandværk
fra vandværk
fra vandværk

fra vandværk
fra vandværk
fra vandværk
Vandværk
fra vandværk
Vandværk
Fra vandværk
vand fra vandværk
vand fra egen brønd
vand fra vandværk
Vand fra vandværk
Fra vandværk
Boring
Kvier: af vandingskanaler 6-7 m brede. Køer: fra egen brønd
fra vandværk
Vand fra vandværk
De fleste fra vandværk

Kommentarer til sektion 2 - Afgræsning
det eneste afløb til åen er fra løvenholm slot
maks 12 kvier pr år
2.9.1 Ved tyre menes stude. Kvier kommer ud fra de er 9 mdr. 2.9.4 Det vedvarende græs, hvor der går kvier kan være oversvømmet fra åen.
indtil 2010 har dyrene kun afgræsset egne tørre marker. fra i år lejet lav eng.
2.9.3. Køer sendes på fælles afgræsning i Værn enge ved Ringkøbing fjord
2.9.3: Nogle kvier er på fællesafgræsning på skallingen
2.9.5. De sidste 2 år er rutinen blevet ændret således, de fleste drikker vand fra vandværk
2.9.3: Fællesafgræsning på tipperne i Ringkøbing fjord
2.9.1 de kødkvæg der er i besætningen går ude det meste af året
2.9.5 Kun nogle få goldkøer drikker vand fra vandløb.
2.9.1 Kun ca. 20% af kvierne kommer på græs
2.9.3. Fælles afgræsning på skallingen
Kvier i tøndermarsken, indenfor diget, ikke fællesafgræsning.
2.9.4.1 Oversvømmes af Hosager lille å

3.1.1 - Hvilket/hvilke årstal?
alle år
altid
alle år
hvert år
alle år
alle år
hver år
altid
altid
altid
2007 og 2010
alle år
alle år
alle år
altid
altid
altid
alle år
alle år
alle år
alle år
2006-2010
alle år

alle år
2010
altid
altid
altid
altid
alle år
2009,02007
2009
altid
altid
alle år
siden 2007
altid
altid
altid
2005-2008
altid
alle år
altid
alle år
alle år
alle år
alle år
2005-2009
hvert år
altid
altid
alle år
altid
alle år
altid
altid
altid
2010
2010
altid
altid
altid
altid
altid
altid
alle år
altid
altid
altid
alle år
altid
altid
alle år
altid
alleår
altid
alle år
alle år
alle år
alle år
2006-2010
altid
alle år

altid
hvert år
2006-2010
altid
altid
altid
alle år
altid
2006-2010
altid
altid
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1. feb hvert år
2006-2010

3.2.1- Årstal
2007
2010
2005
2007

3.3.1 Til hvilket formål og hvornår?
2007 gyllepumpen var i stykker
opsugning af gylle
De suger fra gylle tank. Modtager saft og planter fra de planter (grøde) der skæres i åen, indtil for 2 år siden.
til at flytte gylle,
2007 Tømning af gyllekanal
til at flytte gylle med en vogn der bilver brugt til gylle
Til at tømme ajle beholder
køre gylle ud
maskinstationen suger ajle fra beholoder
Når der er noget gylle der sidder fast 2007-2009-2010
suget gyllekanaler med, alle år
gyllen bliver kørt til biogas anlæg og tilbage igen med slamsuger
tømt ajlebeholder hver år
brugt til at tømme under spalter 2007
gyllekanal der var stoppet 2009
Flytning af gylle om vinteren fra 2005 og indtil han stoppede med at have kvæg i i 2009
hver år til at suge kanaler
2008 da der skulle sættes ny gylle pumpe ned
tømme ajlebeholder eller fortank 1 gang om året
flyttet gylle nov 2008
nødsituationer en gang om året, forventer ikke at bruge det i fremtiden
til flytte gylle med 2010
meget sjældent
Udkørsel hvert år
flyt fra ajlebeholder hvert år
Køre gylle med hver år
2010 iforbindelse med ombygning blev der suget en kanal tom
til udkørsel fra ajle beholder hvert år
da ajlebeholder skulle brækkes ned 2009
Problemer med tilstoppet gylle, alle år
flytter gyllen mellem 2 tanke ca 2 gange om året
bagskyld og suge gylle ud flere gange om året
har sin egen slamsuger bliver kun brugt til ajle
udkørsel hvert år
har selv slamsuger
når systemet stopper, det sker tit
suge vand op.2009
hvert år lev ajle fra kvierne flyttet med slamsuger

flyt gylle hvert år
tømmer kviestald et par gange om året
transport af gylle
til at tømme ajlebeholder en gan ghvert år
Ajle
flytter ajle
flyt gylle
2007 bagskyl
flytte gyllen
2007 flyt gylle
Flytter gylle fra gyllekælder til gylletank hvert år. Kan ikke udelukke at slamsugeren har været brugt til slam.
kan ikke ikke huske præcist årstal, men ikke i 2010 og ellers 2-3 gange i perioden. Flytning af gylle til gylletank
Jan 2010, stoppede gyllekanaler gylle flyttet til gylletank
suger gyllebeholderen tom
hvert år 2 gange om året. Tømmer aljebeholder.
Hvert andet år til tømning af fortank, flyttes til gyllebeholder. Sidst anvendt i 2008.
vinter 2010. På grund af frossen gyllepumpe flyttet gylle til gylletank. Nabos slamsuger der kun bliver brugt til minkgylle
flytter gylle hvert år
flyttet gylle til gylletank i 2008 på grund af ombygning
sommer 2009, flytning af gylle over i gylletank
Tømte stald i 2008, gylle flyttet til gylletank
vinter 2010, flytning af gylle fra stoppede kanaler til gylletank
2005, 2006 gyllevogn med sug, respondent tror ikke den er blevet brugt til andet end gylle
stoppede gyllekanaler flyttet til gylletank , Foregået i 2009 men desuden sket af og til i perioden
flytning af gylle hvert år, respondent mener at slamsugeren kan være brugt til tømning af septiktanke
flyttet gylle, hvert år i perioden
til flytning af gylle, hvert år, men egen slamsuger, anvendes ikke til septiktanke eller slam
Har selv slamsuger bruger den til at flytte gylle. Har indtil for 4 år siden tømt sin egen septiktank og bragt det ud på jord der skulle nedpløjes.
Anvendt hvert år i perioden, flyttet gylle til gylletank, respondent oplyser at denne også tømmer septiktanke
Hvert år i perioden, til flytning af gylle i forbindelse med stoppede gyllekanaler og defekt gyllepumpe
stoppede gyllekanaler,Flytning af gylle til gylletank, sket af og til i perioden men store problemer vinter 2007/2008
gyllevogn med sug, anvendes til gyllekørsel hvert år, respondent mner det er usandsynligt at den har tømt septiktanke.
vinter 2010, stoppede gyllekanaler, gylle blev flyttet til gylletank
april 2010, flytning af gylle fra stald til gylletank
tømt nabostald maj 2010, gyllen overført til gylletank
gylle rendt over i 2007, pumpet op i gylletank
2004, gyllekanaler stoppet, flyttet gylle over gylletank
forår 2007, tømning af gammel stald rest fra fortank, respondent mener det blev flyttet over i gylletanken
efterår 2008, spuling af gyllekanaler
Til flytning af gylle, typisk i forbindelse med gyllepumpe ude af funktion, hvert år i perioden.
ca. 4 år siden, til gyllekørsel, ved ikke om slamsugeren har været brugt til andet end gyllehåndtering
Flytning af gylle, hvert år
2007 og 2008 stoppede gyllekanaler
Slamsuger er blevet anvendt hele perioden. Har selv en slamsuger til flytning af gylle, denne bruges også til tømning af septiktanke.
hvert efterår, tømning af gyllekælder
Hele perioden, men ved den kun bruges til gylle
2006-2010 gyllekørsel, ejeren mener ikke den pågældende maskine bliver brugt til andet end gylle
vinter 2009, til spuling af stoppede gyllekanaler
flyttet gylle sommer 2007
vinter 2010, flytning af gylle fra fortank til gyllebeholder på grund af frossen gyllepumpe
Der er blevet anvendt slamsuger af og til i hele perioden til spuling af gyllekanaler
flyttet et par læs fra én gylletank til en anden i vinteren 2010

Kommentarer til sektion 3 – Management
Kommentarer til sektion 3 – Management
Maskinstation til det grove
fast møg
Det gylle der bliver kørt ud er over 3 mder gammelt
er selv maskinstation
Driver selv maskinstation. der køres fast møg på markerne
driver selv maskinstation, efter at have brugt slansuger til slam gøres den grundig ren inden den bruges til gylle.
Anvender slam fra mejeri
maskinfællesskab med anden landmand
fast møg blliver pløjet ned
Køre slev gylle ud
har udelukkende fodret med bygærtehelsæd
gyllen ligger på lager, så det er min 2 måneder gammel inden det bliver kørt ud
3.2. Anvendt spildevandsslam på jord, hvor der er blevet dyrket korn i samme år, og først flere år efter dyrket græs.
3.1.1. Fast møg og alje
3.1. alje og fast møg, alje kørt ud på græsmarker
3.1. Alje og fast møg. Alje er blevet bragt ud på græsmarker i høståret
3.1 har fast møg og alje, aljen er blevet bragt ud på græsmarker.
3.2.1. Har forpagtet noget jord, respondenten ved der er blevet kørt slam ud på før forpagtningen. Respondenten har ikke dyrket græs på jorden før i 2009
3.1 Har ikke gylle, men har kørt alje ud på jord der afgræsses og tages slæt på
3.1.1.a Der fodres med friskt græs, disse marker får gylle og græsset udfodres ca 5 uger efter på stald

4.1.1 Hvor mange ansatte har du ca. haft de sidste 5 år? Antal:
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4.1.3.1 Hvor kom de udenlandske ansatte fra?
Ukraine
Ukraine
Ukraine
Rumanien, thailand
Ukraine
new zealand
Brasilien
Letland
Ukraine
Rumanien
Ukraine
Ukraine
Rumaner
Ukraine
Ulkraine og brasilien
Ukraine
Ukraine og rumanien
Lithauen
Lithauen og rumanien
letland, rumænien
ukraine og litauen
Ukraine
Ukraine og rumanien
Ukraine
Ukraine
Ukrainer
Ukraine
Ukraine
Polen
Ukraine
Ungarn
ukraine, thailand,japan
ukraine og polen
Ukraine
Ukraine
Ukraine
Ukraine
Ukraine
Ukraine
Rumænien og litauen
Ukraine
Polen
holland + ukraine
ukraine og polen
Brasilien
Ukraine
Ukraine
Ukraine
Polen
Ukraine
Rumænien
Ukraine
holland og ukraine
polen og ukraine

4.2. - Andet / andre gruppebesøg

Naturstier
Åben landbrug
sælger urter til turister
Naturvandring
amerikanerbiler show
10.000 til økodag
Børnehave
i forbinselse med nybygning af stald var der besøg fra udlandet
Motionister
Åben hus
Hundetræning
åben stald
erfa grupper
Åben stald
efterskole, der færdes mange forskellige personer
kommunens folk efterser bækken hver år
hunde træning
firmasport
Åbent hus
markturer for andre landmænd
hundetræning
børnehave
markprøver for hunde
åben stald
landboungdom
åbent hus
slægtsgårdsforeningen har været
avlsbesøg og åben stald
åben hus
nabobørn af og til
erfagruppe
åben stald 2007
åben landbrug/besøgslandbrug
40 mennesker til at lukke køerne ud
gruppebesøg fra norge og frankrig
Åben stald
Åbent hus
landingssted for kanoer
åben stald
køreforening med heste havde lejer på jorden
firmaudflugtstur
institutioner
åben landbrug
aben hus
åben hus
markprøve hvert år (jagthunde)
åben stald
Økodag
børnehave hvert år
økodag i 2006
Økodag
børnehave hvert år
børnehave, landboforeningen
børnehave en gang om året
åbent hus 2009
årsmøde 2008
åbent hus i 2007
ugentlige rundvisninger af både udenlandske og danske gæster i kvægbesætningen
kødkvægsdag maj 2009
åbent landbrug 2009 og 2010

økodag 2006-2010
efterskole som nabo, som af og til bruger arealerne
økodag hvert år
af og til åbent hus
børnehave
bus med pensionister sommer 2010
Af og til grupper fra udlandet
åben stald juni 2010
Parkering af mange biler ca. hvert 5 år
børnehave hvert år
åbent hus næsten hvert år
åbent hus hvert andet år
åbent landbrug 2010
børnehaver
økodag 2 gange i perioden

Kommentarer til sektion 4 - Ejer, familie, ansatte og gæster
Nan kan aldrig vide om der færdes folk på jorden.
Har vikar
før 2010 var der ajle og fast møg og ajlen blev kørt på græsmarkerne
bruger vikarservice
4.1.1 én deltidsmedarbejder 4.2 kun én hundelufter
har brugt husbondafløsning
Bruger vikar ordning
besøg fra udlandet tit
4.1: Vikarer
4.2. Jord ved ejendom anvendes til parkering af mange biler ca. hvert 5. år i forbindelse med organiseret vandretur i skoven beliggende som nabo til bedriften
Har ikke decideret ansatte, men anvender vikar ca. 600-800 timer pr. år. Vurderer der har været ca. 10 forskellige vikarer gennem de sidste 5 år.

5.3.1.1 Hvor løber toilettet da hen?
Gyllekanal
Gyllekanal
gylle kanal, men bruges sjældent
Gyllen
Gyllen
der løber ud i gyllen men har ikke været i brug i mange år
i gylle
i gyllen
i gyllen
I gyllen
i gyllen
i gyllekanalen
i gyllekanaler

Kommentarer til sektion 5 - Bedriftens placering
5.1: 300 meter til rensningsanlæg, der har udløb til vesterhavet, respondenten vurderer det ikke har betydning for hans jord.
der burde tages fat om maskinstationernes anvendelse af slamsuger, hvordan er praksis omkring rengøring af maskinen når den har været brugt til slam.
Har modtaget pulp, der kom med en lastbil som havde været brugt til slam. der løb slam ud da de læssede af.
Der er somme tider brugt husbondafløsning
5.1 Rensningsanlæg 3 km vest for bedriften
har forskellige skoleelever fra københavn der komme og er en uge ad gangen
Der er en golfbane op af jorden.
Dyrene fodres kun med halm og korn og kommer ikke ud. der er fast møg som pløjes ned.
datter og nevø har haft en bændelorm men lægen mente at den kom fra katten.
5.1. Ikke et rensningsanlæg tæt på. Men et bysamfund 1 km væk, der der har direkte udløb fra septiktanke

og trixtanke til vandløb, der løber igennem respondentens jord.
5.1: Rensningsanlæg beliggende 200 meter fra respondentens eng, har udløb til å hvor kvier drikker fra. Engen ligger medstrøms/nedenfor engen.
5.1. Rensningsanlæg 2,5 km fra ejendommen, udløb til år der løber igennem respondentens jord
5.1. Rensningsanlæg nabo til jord med udløb i å der løber 2-3 km langs respondentens jord og afgræsningsarealer
5.1: Rensningsanlæg 6-7 km fra bedriften, anlæggets udløb har forbindelse med åen der løber igennem ejendommens jord.
5.1. Rensningsanlæg placeret som nabo til respondentens jord, har udløb til å der løber langs jorden.
5.1: Rensningsanlæg som nabo. Afstand 150 m. fra ejendommen. Udløb til å der løber igennem noget af ejendommens jord.
5.1. Pilerensningsanlæg 400 meter fra ejendommen
5.1: Har et privat nedsivningsanlæg
5.1. Rensningsanlæg beliggende midt i bedriftens jord med udløb til den å, hvor nogle af kreaturerne drikker.
5.2: Mausing marked på nabomark er betegnet som festival koncert område
5.1. Rensningsanlæg 400 meter fra ejendommen, men han mener det nu fungerer som pumpestation nu. Udløbet var således at strømmen fører vandet væk fra respondentens jord.
5.1: rensningsanlæg 3 km fra bedriften, der har udløb til å hvor kvierne drikker fra
5.2: Cykelsti der grænser op til noget af bedriftens jord
5.1. Hvor kvier drikker fra å er 3-4 km nedstrøms for rensningsanlæggets udløb
5.1: Rensningsanlæg nedlagt sidste år. Men beliggende 200 meter fra eng, hvor kvier græsser. Havde udløb til den å, hvor kvierne drikker fra. Fortæller at ved kraftige regnskyl, kunne det ikke følge med øg løb over, da der også løb drænvand til anlægget.
5.2. Festivalkoncertområdet er nu en golfbane
5.1: Rensningsanlæg nabo til forpagtet jord, men der græsser ingen dyr.
5.1: 300-500 meter til rensningsanlæg, har udløb til å der løber forbi noget af ejendommens jord.
5.2. Lejrskole ved siden af mark hvor kvæget græsser. Derudover anvendes jord der grænser op til respondentens jord hvert år til ø-lejr
5.2. Flugtskydningsbane ved siden af bedriftens jord, der færdes mange forskellige mennesker
5.1. Jord ved siden af rensningsanlægget, men vurderer at det ikke har betydning for hvor kvierne drikker, da strømmen fører væk fra engen.
5.2. lejrskole nabo til mark, hvor kvæget græsser
5.3. 3 km til rensningsanlæg, vuderer at hvortil udløbet er ikke har betydning for bedriftens jord eller afgræsningsområder
5.3.1. Toilettet i stalden har aldrig været i brug, mens ejerne har boet på ejendommen.
5.1. Udløb fra rensningsanlæg lige ved siden af område, hvor kvierne går og drikker vand fra åen hvortil udløbet er.
5.1. 1 Km i luftlinje til rensningsanlæg, vurderer udløb ikke berører bedriftens jord 5.4. En ansat har omtalt hun havde orm, men respondent var ikke 100 % sikker på det var bændelorm
5.2. Hærvejen går forbi noget af bedriftens jord. 5.3.1 Toilet løber ud i septiktank med eget nedsivningsanlæg
5.3: Toilettet i stalden bliver stort set aldrig brugt
5.1 under 1 km til rensningaanlæg
5.1 3-4 km til rensningsanlæg
Leverer gylle til biogasanlæg, og får afgasset gylle retur.
5.1 3 km til rensningsanlæg
5.1 2-3 km til rensningsanlæg
5.1 ligger 2-3 km fra rensningsanlæg, samt ligger nabo til en pumpestation
5.1 3 km fra en pumpestation, der ikke altid kan følge med
5.1.: Rensningsanlæg lige ved siden af afgræsningsområde hvor kreaturerne drikker vand fra å hvortil der er udløb.
5.1 5-6 km til rensningsanlæg 5.2 Bedriften har et stykke jord med græs, hvorpå der afholdes dyrskue og cirkus. Jorden må ikke afgræsses, men der tages slæt af græsset.
5.1 4 km til rensningsanlæg 5.3.1 toilettet løber i en trixtank Har jord op til befærtet amtsvej
5.1 Pumpestation 1 km væk 5.2 Lille skov der grænser op til jorden, som bliver benyttet som rast.
5.1: rensningsanlæg 3 km væk, udløb til å der er forbundet med kanaler, der løber forbi respondentens jord
5.1 rensningsanlæg 1 km væk
5.1. 2 km til rensningsanlæg
5.1. 500 m - 1 km i luftlinje til Agerbæk rensningsanlæg
5.1 5 km til rensninganlæg

5.3.1 toilettet løber ud i septiktank med sivdræn
5.2. Motorcykelklub har træf hvert år på naboens mark, der grænser op til respondentens mark