Questionnaire survey among broiler producers in six European countries

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SUMMARY/ABSTRACT

This report is the result of a questionnaire survey carried out on conventional broiler farms, using a common questionnaire, in Denmark, the Netherlands, Norway, Poland, Spain and the United Kingdom. Great emphasis was put on focusing the questions on factors previously pointed out as possible risk factors and on making the questionnaire as user friendly as possible by making most of the questions "multiple choice" questions. The questionnaire was developed in English and translated into Danish, Dutch, Norwegian, Polish and Spanish.

Conventional broiler farms were randomly selected among all broiler farms within each country, except in Spain, where only farms in the region of Catalonia were selected. Due to the low number of existing broiler farms in Denmark and Norway, questionnaires were sent to all conventional broiler farmers. A minimum of 200 questionnaires was sent out in each country.

A total of 1,714 questionnaires were sent out in the end of 2010 to the beginning of 2011 and 1,126 questionnaires were returned from December 2010 to October 2011. In Norway, Denmark and the Netherlands questionnaires were distributed and returned by mail. In Poland and Spain, questionnaires were filled out by veterinarians or other professionals, and in the United Kingdom the questionnaires were distributed via the involved poultry companies and returned by mail. The overall response rate was approximately 65%, and was clearly affected by the method used for distribution and collection of the questionnaires. The final validated dataset consisted of data from 1,105 questionnaires.

The results of the survey provided insight into a number of variables related to management and biosecurity on the participating broiler farms. Some examples are given below:

The use of and compliance with quality assurance (QA) schemes varied between countries. In some countries it is mandatory for all broiler farmers to comply with a specified QA scheme while farmers comply with such schemes on a voluntary basis in other countries. All of the applied QA schemes have many common features.

The annual production of broilers per year varied considerably among the participating farms. Overall, farms in Denmark, the Netherlands and the United Kingdom had more houses, a higher number of crops per year and a higher stocking density than farms in Norway, Poland and Spain. However, the largest farms, with respect to number of houses were observed in Poland, while the largest production, in terms of average number of birds raised per year, was reported by the United Kingdom.

As part of their biosecurity measures, almost all of the participating farms indicated having an anteroom and/or a physical barrier between the entrance area of the broiler houses and the broiler flocks. The practice of having dedicated footwear and tools for each broiler house varied between countries, and was more common among farms in Denmark, Norway and Poland than among farms in Spain, the Netherlands, and the United Kingdom. With the exception of farmers in Poland, almost all farms reported using an all in/all out system with a mean downtime between each crop varying from eight to 19 days. The use of partial depopulation of flocks was reported in all participating countries, but is used more often in Spain, the Netherlands, Poland and the United Kingdom than in Denmark and Norway.

Also differences in pest controls, ventilation systems, sources of water and use of additives to the water, and presence of other animals on the farms were investigated and discussed.

The data generated by this survey have provided new insight into the broiler production in the participating countries. Some of the observed differences in management may reflect differences in strategies applied for reducing *Campylobacter* in broilers in the participating countries. The results of this survey will also be used, together with climate data and information on *Campylobacter* status of broiler flocks from a subset of the participating farms, in a risk factor analysis aiming to identify external risk factors for flock colonization.

INTRODUCTION

CamCon is a research project under the 7th Framework. The project is carried out by a consortium consisting of 10 participating institutions in seven European countries. The overall aim of the CamCon project is to help improve the control of *Campylobacter* in primary poultry production in various parts of Europe and thereby enabling the production of "low-risk broilers". The project places great emphasis on ensuring quick and effective dissemination of scientific achievements to end-users, in particular the EU poultry industry. CamCon was planned as a 4-year project with a total budget of €4.12 million.

The scientific work within the project has been organized in five different Work Packages (WP): *WP1* will study the epidemiology of *Campylobacter* in broilers in selected regions and climates of the EU and compare the different *Campylobacter* sub-types found in broilers; *WP2* will investigate the effectiveness and efficacy of pre-harvest interventions; *WP3* will implement on-site, telecommunication-based, hands-free detection methods and develop quantitative screening methods; *WP4* will develop "second-generation" farm-to-fork contamination models for more precise quantitative risk assessments; and *WP5* will prepare guidelines, educational videos, Internet-based tools, and propose EU standards for producers, regulators and consumers, which are based on the results of the research carried out in the other Work Packages.

This report is the result of the work carried out in Task 1.1 within WP1 which has focus on identifying external risk factors for flock colonization in different areas of EU (i.e. in specific areas within six countries of the Consortium) including differences in production management and climatic conditions. External risk factors were defined as factors related to the environment, farm management practices (especially biosecurity), construction of houses and climate, etc. To identify differences in broiler production across Europe, a standardized, CamCon-wide questionnaire was generated. The questionnaire was developed in close collaboration with the other WPs. Data to be included regarded environment, farm management practices, house construction (including aspects likely to relate to biosecurity), geography, production type, bird breed, water source, nearness to other livestock, feeding strategies, etc. The farms were to be selected to cover different geographical areas within the countries. The results of the questionnaires were to be analyzed and the results are summarized in the following report. Sections of the questionnaire will also be used in other WPs (principally in WP2 and WP4).

In the CamCon project, focus is on the major poultry production in Europe, namely commercial, indoor/housed broiler production. Furthermore, the project focuses on the thermophilic *Campylobacter* spp. among which *C. jejuni* and to a lesser extent *C. coli* are the most prevalent in broilers.

BACKGROUND

*Campylobacter*iosis has become the most common cause of acute bacterial enteritis in many European countries. Many sources of infection have been reported but the main identified food borne source is poultry meat (Friedman et al. 2004, Wingstrand et al. 2006, Humphrey et al. 2007). In the EU, campylobacteriosis has long been the most commonly reported bacterial zoonosis. In 2009, 198,252 confirmed cases were reported (European Food Safety Authority, 2011), giving an EU-occurrence of 45.6 reported cases per 100.000 inhabitants. The notification rate, however, varies greatly between countries with the highest notification rate in the Czech Republic (193.54 per 100,000 inhabitants) to no cases reported in Latvia.

The reduction of *campylobacter* prevalence and load in live poultry is believed to be one of the most effective ways of reducing the contamination of foodstuffs and the number of human *Campylobacter* cases. For this purpose some European Member States adopted national *Campylobacter* control or monitoring programmes, but a European strategy to reduce *Campylobacter* has yet to be established.

In recent years EFSA has conducted and presented results of a European Union-wide baseline survey as well as a scientific opinion on *Campylobacter* in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain (EFSA 2010a). Furthermore, EFSA has published a scientific opinion regarding source attribution of *Campylobacter* infections, stating that handling, preparation and consumption of broiler meat may account for 20% to 30% of human cases of *campylobacter*iosis, while 50% to 80% may be attributed to the chicken reservoir as a whole (EFSA 2010c).

The European Union-wide baseline survey from 2008 (EFSA 2010a) found that at the Community level, the prevalence of *Campylobacter*-colonized broiler batches was 71.2% and that of *Campylobacter*-contaminated broiler carcasses was 75.8%. The Member State prevalence varied greatly, as did the counts of *Campylobacter* on broiler carcasses. The risk factor study which was part of the baseline survey showed that a *Campylobacter*-colonized broiler batch was about 30 times more likely to have the sampled carcass contaminated with *Campylobacter*, compared to a non-colonized batch. Also, a higher *Campylobacter* count on carcasses was strongly associated with *Campylobacter* colonization of the batch and processing late in the day increased the risk of *Campylobacter* contamination of carcasses. The risks for *Campylobacter*-contaminated carcasses/colonized batches increased with the slaughter age of the broilers as well as during certain months of the year (highest risk during July-September). Also, batches originating from previously thinned flocks were more at risk of being colonised with *Campylobacter* (EFSA 2010b).

The risk factors for flock colonization have also been explored in review of 159 international articles (Adkin et al., 2006). The most frequently identified risk factors were: depopulation schedule, hygiene barriers, multiple houses, parent company/abattoir, season of rearing, disinfection foot baths, outside access, no. of staff, water disinfection, presence of other animals, age at sampling, flock stress, down-time and cleaning routine.

The Scientific opinion on *Campylobacter* in broiler meat production (EFSA 2011) concluded that strict implementation of biosecurity in primary production and GMP/HACCP during slaughter may reduce colonization of broilers with *Campylobacter*, and contamination of carcasses. In addition, the use of fly screens, restriction of slaughter age, or discontinued thinning may further reduce consumer risks, but have not yet been tested widely. After slaughter, a 100% risk reduction can be reached by irradiation or cooking of broiler meat on an industrial scale. More than 90% risk reduction can be obtained by freezing carcasses for 2-3 weeks. A 50-90% risk reduction can be achieved by freezing for 2-3 days, or by using hot water or chemical carcass decontamination. Moreover, novel strategies, specifically targeting *Campy-*

lobacter control at pre-harvest level, are in progress. Such strategies include administration of probiotics, bacteriophages or bacteriocins and vaccination (EFSA, 2011).

The Scientific opinion also concluded that the public health benefits of controlling *Campylobacter* in the primary broiler production are expected to be a greater than control at a later stage in the food chain, because the bacteria may also spread from farms to humans by other pathways than broiler meat (EFSA 2011).

Some interventions have only been demonstrated to have an effect on *Campylobacter* prevalence in some countries, for example fly screens which have only been tested in Denmark and Iceland. It is therefore relevant to explore if interventions effective in some countries will also be effective in other countries. For this purpose, an overview of production- and management systems in different countries in different regions of the EU is very important as is an overview of the risk factors related to the various production and management systems.

Broiler production

In 2008, approximately 5,300 million broilers were slaughtered in the 26 EU Member States that participated in the baseline study (EFSA 2010). The United Kingdom had the largest slaughtered broiler population (about 800 million) followed by France (about 700 million), Spain (about 600 million), and Poland (550 million).

As can be seen in Table 1 there is a substantial difference in the size of broiler production between the six countries participating in the questionnaire survey.

Table 1: Overview of the broiler production in Europe livestock numbers, 2009 and slaughter data from Baseline study, 2008

Country	Broilers Livestock	Slaughter-houses	Flocks/ *Holdings	Broilers slaughtered in 2008 (Baseline data)
Denmark	21,993,093	4	3,717	101,966,833
Netherlands	-	17	*698	451,544,937
Norway	-	5	4,800	62,234,900
Poland	722,503,630	157	16,481	557,329,015
Spain	201,304,169	38	-	594,734,107
United Kingdom	133,412,443	25	2,177	816,216,431

Source: The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2009; EFSA Journal 2011; 9(3):2090 and Analysis of the baseline survey on the prevalence of *Campylobacter* in broiler batches and of *Campylobacter* and *Salmonella* on broiler carcasses in the EU, 2008, Part A: *Campylobacter* and *Salmonella* prevalence estimates. EFSA Journal 2010; 8(03):1503).

Denmark

Approximately 100 million broilers are raised in Denmark annually and all broilers used in conventional broiler farms are imported from one company (Aviagen Swechick). There are approximately 170 farmers, all of which are independently owned. The density of farms varies between the different regions of the country with the majority of farms situated in Jutland. There are two main companies (Läntmannen Danpo and Rose Poultry A/S) that produce > 98 % of the Danish broilers at three different slaughterhouses and a few smaller companies. The farmers typically produce broilers according to contracts with one or the other broiler processing company. All broilers produced within the conventional broiler production are Ross hybrids 308/708. In addition to the broilers raised and produced for Läntmannen Danpo and Rose Poultry A/S, approximately 12 million broilers are raised on 15 farms and exported for slaughter in Germany and the Netherlands. The photos below show the interior and exterior of a typical conventional broiler house in Denmark.

Photos: Birthe Hald

Netherlands

As in Denmark and Norway, the farms in the Netherlands are independently owned and do not belong to processors, hatcheries or feed companies. However, the farmers may have contracts with one or the other company, for certain periods of time or for a certain number of deliveries. Furthermore, there are a number of farmers who are completely independent and sell to the best offer. As in Denmark, there is a difference in density of farms in different areas of the Netherlands. The photos below show the interior and exterior of a typical conventional broiler house in the Netherlands.

Photos: Nico Bolder

Norway

In Norway, approximately 60 million broilers are raised annually and all broilers used in conventional broiler farms are imported from one company (Aviagen Swechick). There are approximately 600 farms. Although the farms are independently owned, the majority of the farmers have a contract with one of the three main companies; Nortura Prior, Cardinal Foods and Norsk Kylling. These three companies produce > 98 % of the Norwegian broilers at four different slaughterhouses. The density of farms varies between the different regions of the country with the majority of farms situated in three regions; Trøndelag, Rogaland and Østlandet. In addition there are two smaller companies that have their own slaughterhouses. All farmers that deliver broilers to the major slaughterhouses are required to follow the guidelines set by the Norwegian Agricultural Quality System (KLS). All broilers produced within the conventional broiler production are Ross hybrids 308. The photos below show the interior and exterior of a typical conventional broiler house in Norway.

Photos: Karianne Fuglerud Ingerø and Thorbjørn Refsum

Poland

Most broiler farms in Poland are independently owned and only a few of them are associated in big companies. The majority of farmers that are not federated sell chickens to the best offer on the market. In Poland, the density of poultry farms is almost the same throughout the country area. In the last several years, the Polish broiler production has been increasing. The photos below show the interior and exterior of a typical conventional broiler house in Poland.

Photos: Pawel Kusyk

Spain

The broiler production in Spain is mostly integrated. The farmers own the farm and have a contract with the integrator company who provides the farmer with the chickens, services and sells these chickens. Depending on the company, there are distinct degrees of integration. In this sense, there are companies that integrate all the production levels including breeding farms, hatchery, slaughterhouses, shipping and shops. Other companies only integrate part of this, for example the breeding farms and hatchery or only the poultry farms. In 2010 the total meat production in Spain was 1.086.604 tonnes and the major poultry producing areas are Catalonia, Andalucía, Comunidad Valenciana, Galicia and Castilla-León. The photos below show the interior and exterior of a typical conventional broiler house in Catalonia.

Photos: Marta Cerdà and Roser Dolz

United Kingdom

Broiler production in the United Kingdom is almost completely undertaken by large integrated companies. Each company will have a mix of company and contract farmers. With the former, the farm is generally owned by the company. With the latter, the farmers own the farm and have a contract with the integrator, which provides the farmer with the chickens, services and sells the animals after slaughter. The degree of integration varies between companies. Some companies integrate all the production levels including feed mills, breeding farms, hatchery and slaughterhouses. Other companies only integrate part of this, for example the breeding farms and hatchery or only the poultry farms. In 2010, the total number of broilers reared was approximately 850 million. All parts of the UK have broiler farms but the highest density production is in the Midlands and East Anglia.

Photos: Bristol University

Campylobacter action plans

Not all of the countries participating have an official action plan or strategy for reducing *Campylobacter* in broilers. The Netherlands, Poland and Spain have no official action plans for *Campylobacter* at this time. However, in Denmark, Norway and the United Kingdom action plans have been in place for a number of years and these are described below.

Denmark

In 2003, a voluntary action plan against *Campylobacter* in broilers was adopted in Denmark. It was developed in collaboration between government, non-governmental organizations and the poultry industry. The action plan focused primarily on improvement of biosecurity in the primary production, scheduling of *Campylobacter* positive broiler flocks to frozen production (where practical and possible), reduction of the *Campylobacter* concentration on broiler meat at slaughterhouses by freezing, and reduction of cross-contamination in domestic kitchens through consumer campaigns. In 2008, a new four year action plan was initiated with the aim to further decrease the prevalence and the concentration of *Campylobacter* in broilers and broiler meat. The key initiatives directed against the Danish broiler production included the development and implementation of an industry code of practice for famers. The aim was to increase focus on biosecurity measures, develop fly protection for broiler houses, which have proven very effective in preventing introduction of *Campylobacter* in the broiler houses under Danish conditions (Hald et al., 2007), optimize ante-mortem sampling to improve the scheduling of flocks, investigate applicable methods for decontamination and improved hygiene at the plant, and finally develop a sourceaccount and launch consumer information campaigns and develop educational material for school children to improve awareness on kitchen hygiene. Surveillance results from 2002-2007 and effects of the *Campylobacter* strategies have been published (Rosenquist et al. 2009)

Norway

The action plan regarding *Campylobacter* in Norwegian broilers was implemented in the spring of 2001. The objective of the action plan is to reduce the human exposure to *Campylobacter* through Norwegian broiler meat products. The action plan is a joint effort involving several stakeholder groups from "stable-to-table" such as the Norwegian Food Safety Authority, the National Veterinary Institute, the Norwegian Institute of Public Health, the Norwegian School of Veterinary Science, the Centre for Poultry Science, and the poultry industry. The action plan consists of three parts; a surveillance programme including all Norwegian broiler flocks slaughtered before 50 days of age, a follow-up advisory service on farms with *Campylobacter* positive flocks, and surveys of broiler meat products.

The sampling strategy has been revised since the implementation in 2001. In 2010, pre-slaughter samples are taken from all flocks slaughtered (before the age of 51 days) in the period 1 May – 31 October. Carcasses from positive flocks are either heat treated or frozen for a minimum of three weeks before being marketed. Results from 2002 – 2004 have been published (Hofshagen and Kruse, 2005) and a description of the action plan and the results are published on the Internet at www.vetinst.no

United Kingdom

In the United Kingdom, a *Campylobacter* risk management programme has been developed to reduce levels of *Campylobacter* in chicken. The joint government and industry target to reduce *Campylobacter* in the United Kingdom produced chickens by 2015 was published in December 2010.

The programme encompasses a range of Government/industry partnership led projects coordinated through a Joint Action Plan on *Campylobacter* and is targeted at different points across the food chain. To measure progress on the effectiveness of the programme it has been agreed that a new target for the reduction in levels of *Campylobacter* in the United Kingdom produced raw chicken, is to be achieved in a phased approach by April 2015.

There are three categories of contamination levels and, currently, 27% of birds are in the highest category. The new target is for the industry to reduce the numbers of these most contaminated birds in United Kingdom poultry houses from 27% to 10% by 2015. It is estimated that achievement of this target could mean a reduction in *Campylobacter* food poisoning of up to 30% – about 90,000 cases per year. Further description of the action plan (2010) can be found at www.food.gov.uk

METHODS AND MATERIALS

Questionnaires

A Camcon questionnaire was drafted in collaboration with all involved institutions. The questionnaire contained 42 questions concerning farm level factors that could potentially influence the occurrence of *Campylobacter* on the farm (Appendix 1). The chosen questions were based on previous experience from questionnaire surveys in the broiler production and the conclusions of already performed risk factor studies. Great emphasis was put on focusing the questions on factors previously pointed out as possible risk factors and also on making the questionnaire as user friendly as possible by making most of the questions "multiple choice" questions.

The questionnaire was developed in English and translated by the involved institutions. Each institution selected the farmers to be invited to participate in the survey within their country, and collected the filled-in questionnaires from the farmers within their country. The farmers were randomly selected among broiler farmers all over the country in all participating countries. An exception to this was Spain, where the invited farmers were selected among farmers in Catalonia, in order to ensure similar climatic conditions for all participating Spanish farms. Due to the low number of existing broiler farms in Denmark and Norway, the questionnaire was sent to all conventional broiler farmers. At least 200 questionnaires were sent out in each of the six participating countries, in some countries more questionnaires were sent out in order to increase the number of returned questionnaires (Table 2).

In some countries, farmers were anonymized and only identified by their postal code or part of their postal code. This decision was based on an estimate that it would affect the response rate negatively, if it was possible to identify the respondent. Thus, no farmers can be identified specifically in any presentations of data from this survey.

In Denmark, Norway and the Netherlands the questionnaires were mailed directly to the producers who were asked to fill out the questionnaire and return it by mail. In the Netherlands a reward of 10 EURO was offered in return for a filled out questionnaire. In the United Kingdom, questionnaires were distributed to broiler farms via the involved poultry companies and returned by mail, while in Poland and Spain the questionnaires were filled out by veterinarians or other professionals visiting the individual farms. Each of the participating institutions sent the filled-in questionnaires to The Technical University of Denmark (DTU). Two different approaches were applied for entering data. The questionnaires from four countries (Denmark, Norway, Poland and Spain) were scanned using the program ReadSoft Forms 3.5. After scanning of the questionnaires, it was checked twice that data was read correctly. Results of the rest of the questionnaires were entered manually using a Microsoft InfoPath formula designed for this specific purpose, as these questionnaires for various reasons were not suitable for scanning. The full data set containing results from all six countries was stored in an Access database, and all went through the same data validation process. Data validation included logical checks and check of outliers and missing values. Only questionnaires from conventional broiler farms were included in the validated dataset. Contents of free text fields were translated into English by the participating institutions.

Geocoding and mapping

The British, Danish, Dutch, Norwegian, Polish and Spanish postal codes were geocoded with data downloaded from http://www.geonames.org/. This dataset contains the attributes, latitude and longitude in the format WGS84 (World Geodetic System 1984). For those postal codes not represented in the downloaded dataset the geocodes were created manually by looking up values for latitude and longitude using Google Earth 6.0.3. All 1105 validated questionnaires contained sufficient information to geocode.

The datasets were joined using Microsoft® Office Access 2007. The British results were merged with the geocode data using the outward codes. For the Dutch results only the two first digits in the postal code were collected in the questionnaire. Therefore these two ciphers were used to merge the datasets. To avoid a majority of overlaying points, the Dutch farms were distributed randomly between all available geocodes within each postal code area. For all other countries the maps showing the distribution of farms were created by using coordinates from a postal code or outward code. To prevent overlaying points with farms sharing the same postal code, overlaying points were distributed around the circumference of a circle with an angle of 36 degrees apart. For the maps showing the annual production, a summary table at postal code level were created summing up the annual production within each unique postal code or outward code, and plotted using the matching geocodes. All maps were plotted with the GIS software ESRI® ArcMap™ v.9.3.1.

RESULTS

In the following section, the results of the questionnaire survey are presented. In the tables and figures "N" represents the number of farmers that have ticked one or more answers for the specific question. Since multiple answers were allowed for some questions, the sum of percentages for different responses may therefore exceed 100%.

A total of 1,714 questionnaires were sent out at the end of 2010/beginning of 2011. A total of 1,126 questionnaires were returned. The overall response rate was approximately 65%, but the response rate was clearly affected by the chosen method for distribution and collection of the questionnaires. The response rates varied between 45% and 61%. The number of questionnaires returned and the response rates for the different countries are shown in Table 2. The final validated dataset consisted of 1,105 questionnaires. A total of 21 questionnaires were excluded from the dataset, because they were either from organic farms, from farms that no longer produced broilers, or because the questionnaires were returned with all questions unanswered.

Table 2: Number of distributed/returned questionnaires and response rate.

Country	Questionnaires	Number of questionnaires distributed	Number of questionnaires returned	Response rate (%)
Denmark	Sent to producers by mail	205	119	58.0
Netherlands	Sent to producers by mail	550	254	46.2
Norway	Sent to producers by mail	309	183	59.2
Poland	Questionnaire filled out by veterinarian	250	249	99.6
Spain	Questionnaire filled out by veterinarians/university staff	200	200	100
United Kingdom	Distributed/returned via poultry companies	200	121	60.5

Geographical distribution

The geographical distribution of the participating farms is shown in Figure 1. In Denmark, the Netherlands, Norway and Poland questionnaires were distributed randomly among broiler farmers. In Denmark and Norway questionnaires were sent out to all broiler farmers, but due to unforeseen circumstances, farmers in the Rogaland region in Norway did not receive any questionnaires. The geographical distribution of the respondents reflect differences in the density of broiler farms in different regions of the countries.

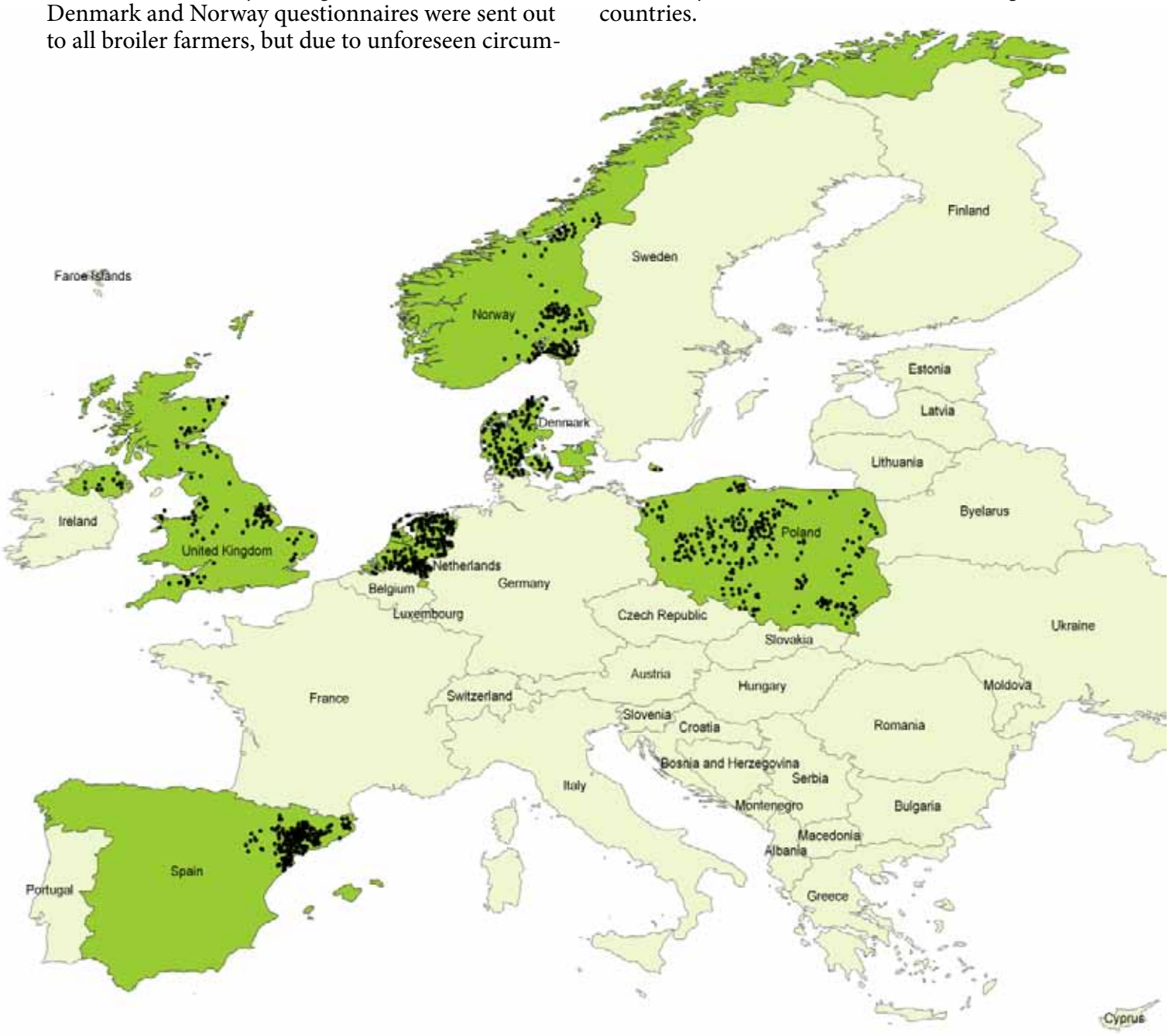


Figure 1: Geographical distribution of farms participating in the Camcon questionnaire survey 2011, at the European level. Only postcode information was provided for a number of farms, all farms have been plotted according to postcode information and the dots do therefore not represent the exact geographical location of the farms

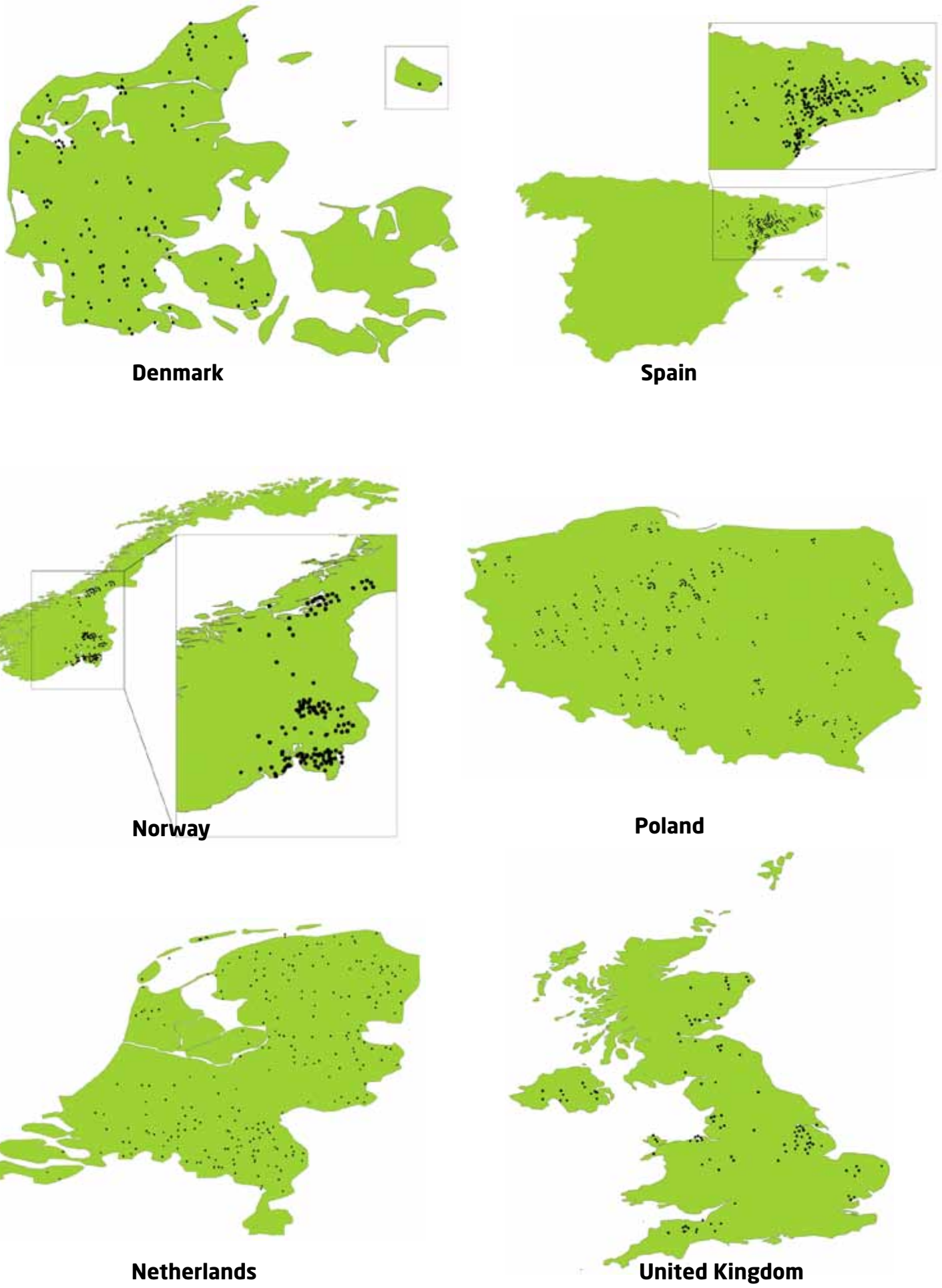


Figure 2: Geographical distribution of farms participating in the Camcon questionnaire survey 2011, at the European level. Only postcode information was provided for a number of farms, all farms have been plotted according to postcode information and the dots do therefore not represent the exact geographical location of the farms

General information (production scheme and size, chicken houses, breed)

Questions

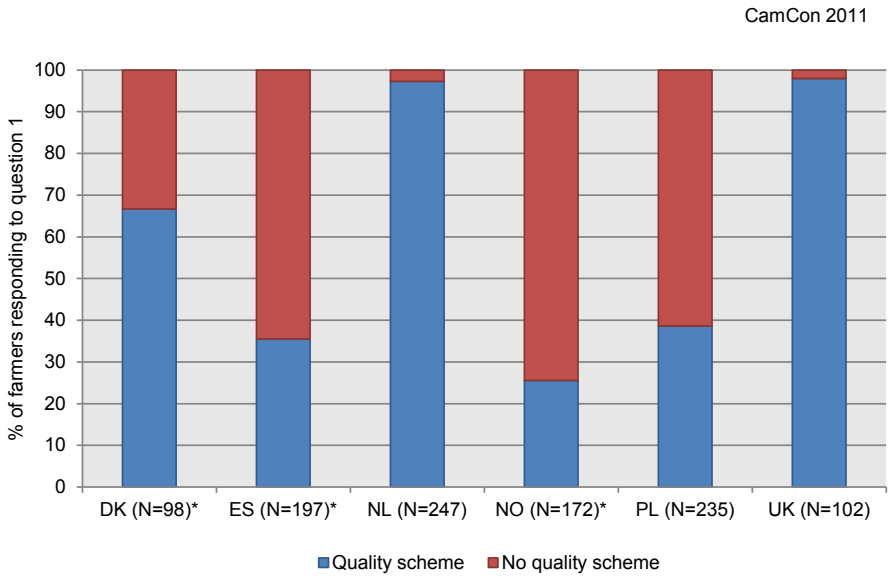
1. Are flocks reared according to a (Company or industry) quality scheme/standard?
2. What is the number of houses on this holding?
3. Are there houses of different ages on this holding?
4. What is the age of the oldest house on this holding?
5. What is the age of the newest house on this holding?
6. What is the average number of crops per house per year on this holding?
7. What is the stocking density on this holding?
8. What is the average number of birds slaughtered annually?
9. What hybrid of birds is raised on this holding?

Quality schemes/standards

The participating farmers were asked whether or not the broilers on the farm were reared according to a specific quality scheme or standard. Figure 3 shows the percentage of producers responding that their broilers are produced according to such a scheme.

Almost all of the responding farms in the Netherlands and the United Kingdom indicated rearing their broilers according to a company quality scheme, while less than half of the responding farms in Spain, Norway and Poland followed such schemes. However, it appears that the question was interpreted differently in the different countries and that respondents did not consistently record whether or not they followed a mandatory assurance scheme. Therefore the response to this question should be interpreted with great care.

Figure 3: Percentage of participating farmers responding to question 1: "Are flocks reared according to a (Company or industry) quality scheme/standard?"



Note: *In Norway, all broiler farmers are obliged to follow obliged to follow the Norwegian Agricultural Quality System. *In Denmark all farmers should have responded that they reared broilers according to the the KIK-scheme (quality assurance in the broiler production). * In Spain all producer should follow the governmental guidelines for good production practices for in the broiler production

Denmark

In Denmark, 50 of the 75 farmers responding to question 1 indicated that they produced broilers according to "Kvalitetssikring i Kyllingeproduktionen" (quality assurance in the broiler production) the so called KIK-scheme.

The KIK system was introduced by the Danish poultry industry and is an integrated system involving all stakeholders (from hatchery, farmer and abattoir to cleaning companies and suppliers of chicken feed) within the Danish broiler production. The main objective for establishing the system was "to create the best and most well-documented broiler chickens in the world".

Farmers producing broilers in accordance with KIK, systematically report every detail of the broiler chicken's life into a common database, including information on details concerning broiler house cleaning, and details on capture and slaughter of the broilers. The system has been designed to help ensure that the broilers are produced in accordance with the national legislation and provide documentation for both customers and authorities that the industry focuses on food safety, animal welfare and health. The system also helps follow the production on different farms and thereby facilitates helping farmers with specific problems with e.g. footpad lesions or *Salmonella* infections. The system not only helps ensure a high quality of broiler chickens for the Danish consumers, but also provides the type of documentation required by some of the large international customers and thereby helping Danish producers to be more competitive on the international marked. Farmers that are not certified through the KIK system are paid less for their broilers than farmers that have obtained KIK certification. By the end of 2010, all farmers delivering broilers to the two main companies (Danpo and Rose Poultry - 98% of the production) had been KIK certified by the Bureau Veritas. This leaves only the approximately 15 conventional farmers producing broilers for Germany and the Netherlands without KIK certification.

Netherlands

In the Netherlands 175 out of 179 farmers responding to question 1, indicated they reared broilers in accordance with "Integrale Keten Beheersing" (IKB), which is the Integral Quality System for meat production poultry, developed by the Dutch Product Board for Poultry and Eggs. If farmers want to deliver to IKB certified processors they are obliged to produce broilers accordingly. The majority of Dutch farmers are members of this system and produce according to IKB guidelines, even though it is not mandatory. Non members of IKB frequently export their live broilers.

IKB poultry meat is a quality assurance system, which covers all chains (breeding, hatcheries, feed producers etc.) that are involved in poultry meat production. The IKB regulations include requirements for traceability, feed, hygiene, the use of drugs on animals, as well as transport and animal welfare. The requirements imposed go well beyond the statutory minimum requirements. Besides the IKB system, Dutch meat companies also work with other quality systems, such as ISO, hygiene codes and HACCP.

The first issue of IKB was launched in 1996, and since then demands from markets, society and poultry sector have changed, which led to actualizing of the regulation. April 1 2007 IKB-meat was launched as a "renewed" regulation with roughly the same contents, but the structure and prescriptions were stronger and more to the point.

Norway

In Norway 47 of the 178 responding farmers indicated that they followed a quality assurance programme. All farmers are in fact obliged to follow the Norwegian Agricultural Quality System (Kvalitetssytem i landbruket, KLS), and the received responses indicate that this question was misunderstood by many of the responding farmers.

In order to be allowed to deliver their animals to slaughter, the broiler producer must conform to a list of requirements set out by the KSL guidelines. The KSL-system has been designed to help ensure that the broilers are raised in accordance with the national legislation and to provide documentation for both customers and authorities that the industry focuses on food safety, animal welfare and health. In addition, following the KSL guidelines helps to improve production on the individual farm.

In addition to KSL a few farmers indicated following company specific assurance programmes, such as Prior, Nortura, McDonalds, Ross – however, this implies that they produce in accordance with the KLS guidelines.

Poland

In Poland, 83 of the 239 respondents replied that they produced broilers according to a quality assurance scheme. In contrast to responses from other countries with referral to specific mandatory guidelines or company assurance schemes, the responses from the Polish farmers generally referred to unspecified Good management practices and HACCP programmes. This difference may be a reflection of the fact that the Polish

farms typically are not associated with any specific company.

Spain

In Spain, 70 out of 200 farmers indicated producing broilers according to the quality assurance scheme associated with Pollastre groc català. This is a brand created by the Catalan slaughterhouses and requires the broilers to be fed a diet containing a minimum of 65% of cereals in the feed. These broilers are all hatched and grown in Catalonia. Farms producing this brand, rear the broilers according to specified guidelines and are audited and certified by LDG, a certifying agency authorized by the Catalan government.

In addition to the scheme for Pollastre groc català, the Spanish government, in association with poultry producers, published a handbook with guidelines for good production practices for broilers. In theory all Spanish producers should follow these guidelines. However, the guidelines have no specific QA scheme name and farmers may therefore not have considered these when responding to the question. Finally, most of the companies involved in broiler production also have internal handbooks with the guidelines for broiler rearing. The companies that sell their products to large stores such as Carrefour, Mercadona, Eroski, McDonalds also have to comply with their quality assurance demands and are subjected to audits regarding good management and welfare procedures.

United Kingdom

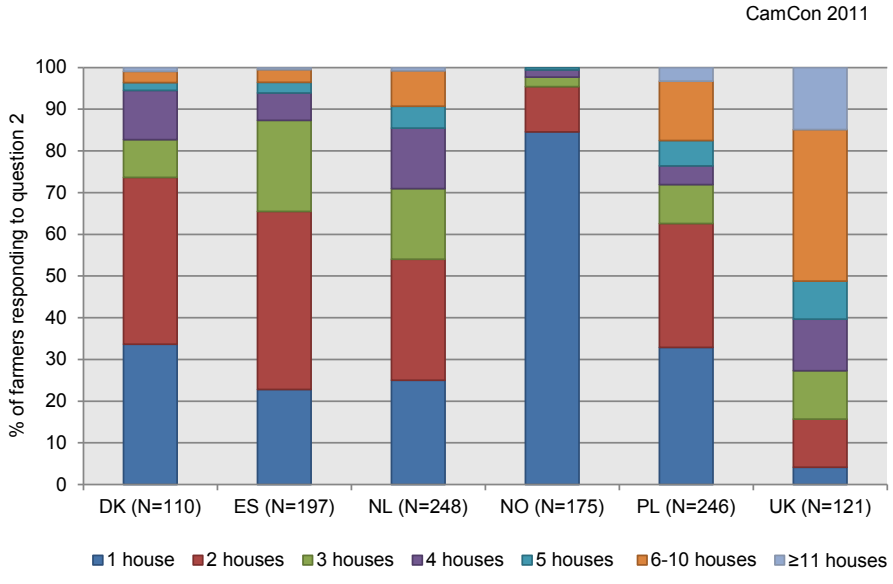
In the United Kingdom the Red Tractor Standard was the quality assurance most commonly reported by respondents with a quality assurance programme, 75 out of 97.

Assured Food Standards is a British organisation that promotes and regulates food quality. It licenses the Red Tractor quality mark, a product certification programme that comprises a number of farm assurance schemes for food products, animal feed and fertilizer. The Red Tractor scheme was launched in 2000 by the National Farmers Union (NFU), with the logo originally known as the Little Red Tractor, and also the British Farm Standard. The Red Tractor Farm Assurance standards for poultry provide an integrated assurance chain to internationally recognised standards. The Red Tractor Farm Assurance Poultry Scheme sets out to maintain, develop and promote Assurance standards within the poultry industry. The aim is to provide consumers and retailers with confidence about product quality attributes including food safety, animal welfare and environmental protection.

Other general information

Information concerning the number of houses on the broiler farms was provided in 1,097 of the 1,105 validated questionnaires. The number of houses on the participating farms per country is shown in Figure 4. Denmark, the Netherlands, Poland and Spain share common features as to the number of houses on the individual farms, with 1-4 houses on 75-95% of the farms. In contrast, the majority of the participating farms in Norway (85%) have only one house and there was only one farm with 5 houses and no farms with more than 5 houses. In the United Kingdom more than 50% of the participating farms had 6 or more houses. Only Poland and the United Kingdom had participating farms with 11 or more houses, including farms with 15 (1), 16 (6), 17 (1), 20(1) and 22(1) houses, respectively.

Figure 4: Percentage of participating farmers responding to question 2: "What is the number of houses on this holding?"



The farmers were also asked whether or not there were houses of different ages on the farm. For the 719 farms with more than one house, more than half (67 %), indicated having houses of different ages on the premises. The age of the houses were also registered and it is clear that the majority of the houses in use on the participating farms are 10 years or older. Overall, Spain and the United Kingdom seem to have the largest proportions of houses older than 15 years on participating farms, while Norway has the overall largest proportion of farms with houses built within the last 10 years, Figures 5 and 6.

Figure 5: Percentage of participating farmers responding to question 4: "What is the age of the oldest house on this holding?"

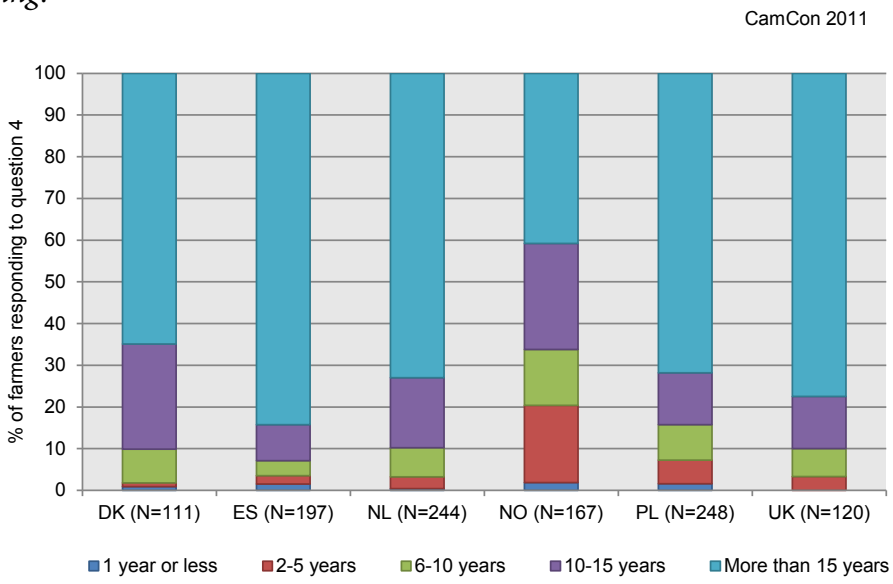
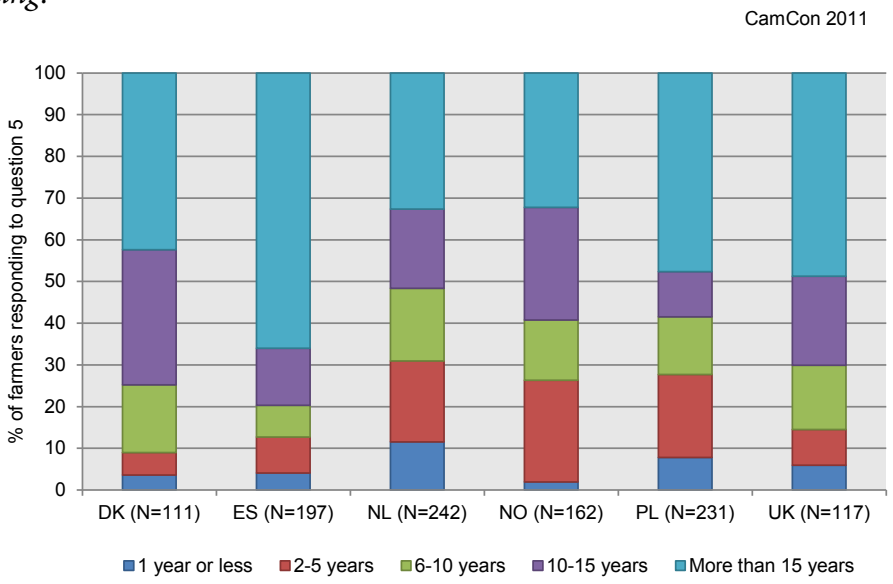
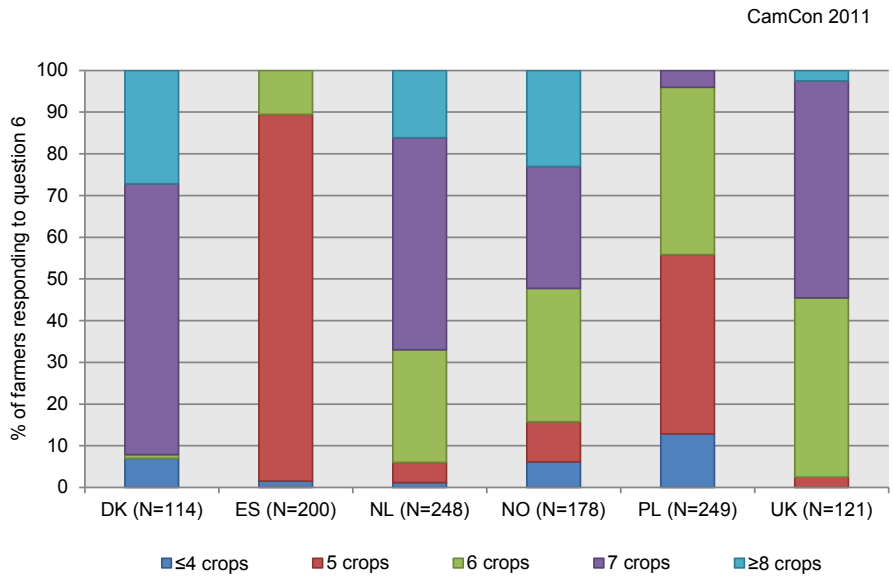


Figure 6: Percentage of participating farmers responding to question 5: "What is the age of the newest house on this holding?"



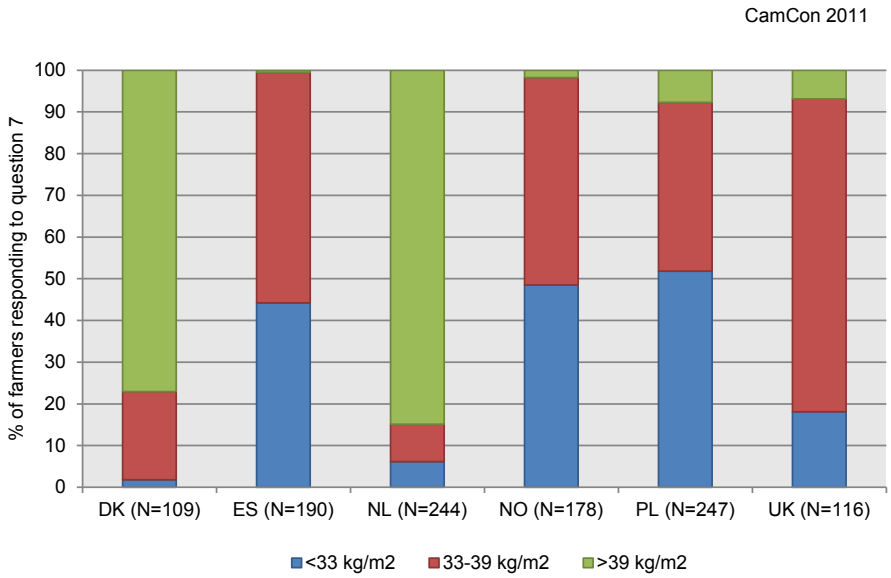
The number of crops per house was recorded for 1,088 of the participating farms. The participating farmers indicated having between 4-8 crops per house per year, Figure 7. There were clear differences between the participating countries. In Spain for example, 88% of the farms had 5 crops per house per year. This was different from the productions in any of the other countries and indicates that the production in Spain is less intensive than in the other countries. Poland also has a considerable percentage of farms producing 5-6 crops per house per year. In contrast, the production on the participating farms in Denmark was characterized by almost all farms producing 7-8 crops per house per year. Also farms in the Netherlands, Norway and the United Kingdom indicated an intensive production with 7-8 crops per year per house for more than 50% of the participating farms.

Figure 7: Percentage of participating farmers responding to question 6: "What is the average number of crops per house per year on this holding?"



Information on the stocking density within the houses was recorded for 1,082 of the farms and is presented in Figure 8. Also here clear differences were observed with the highest stocking densities in houses in Denmark and the Netherlands with 76% and 85%, respectively, of the farms indicating an in house stocking density of more than 39 kg/m^2. In contrast, in Spain only one farm indicated this level of stocking density. In Spain, Norway and Poland 44-52% of the farms used stocking densities of less than 33 kg/m^2, 41-55% used stocking densities of less than 33-39 kg/m^2, and only a few farms (0.5-8%) used stocking densities of more than 39 kg/m^2. In the United Kingdom, the majority of farms (74%) used stocking densities of 33-39 kg/m^2.

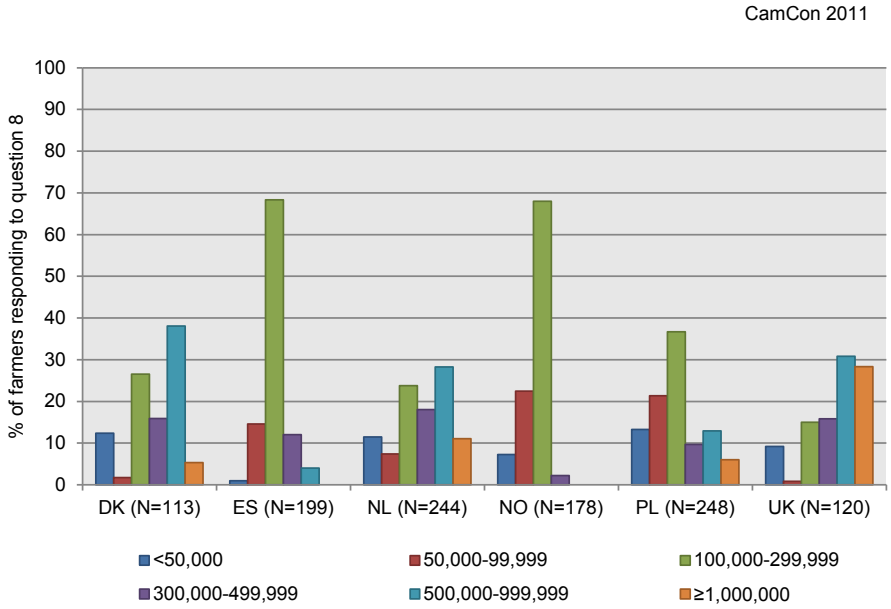
Figure 8: Percentage of participating farmers responding to question 7: "What is the stocking density on this holding?"



Foot note: For double answers the highest reported density has been included

Participating farmers were asked to indicate the average number of birds slaughtered annually. This information not only gave an indication of the size of the farms participating in the survey, but also gave an indication of what fraction of the annual production within the participating countries was represented in the study. Response to this question was received from 1,102 farms and the responses are summed up in Figure 9 and Table 3. The Netherlands and the United Kingdom had the highest percentages of farms producing ≥1,000,000 broilers annually, while the participating farms in Norway and Spain had a much smaller annual production.

Figure 9: Percentage of participating farmers responding to question 8: "What is the average number of birds slaughtered annually?"



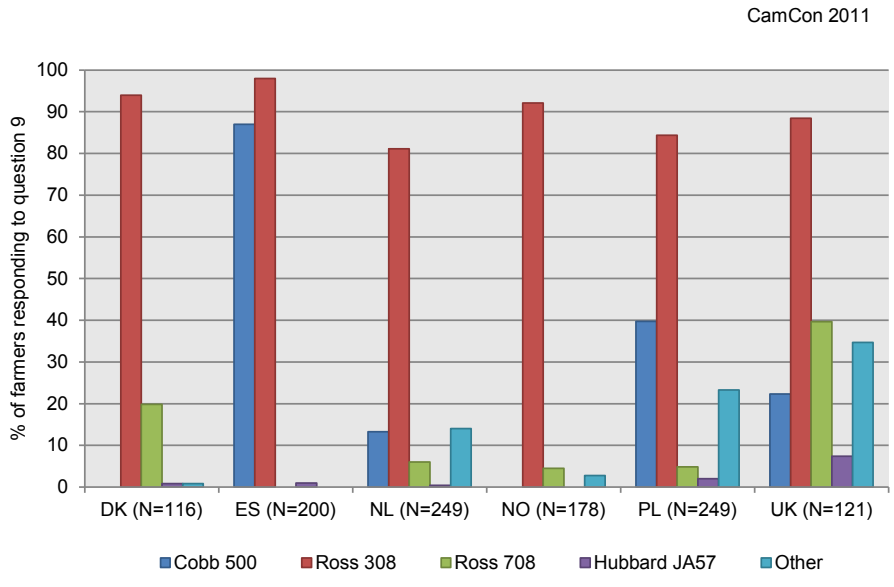
Using the responses in the Camcon questionnaire and the numbers for annual production of broilers from the baseline survey, the % of the national production represented in the Camcon questionnaire survey was calculated, Table 3. The percentage of the annual production represented by the questionnaire survey varied between countries and reflected not only the different methods applied to distribution and collection of the questionnaires, but also the very large differences in size of production within the different countries.

Table 3: Percentage of annual broilers slaughtered represented in Camcon, based on information on annual production of broilers (Baseline, 2008) and the responses to the Camcon questionnaire

Country	Sum of average no. of birds slaugthered (Camcon)	Broilers slaughtered in 2008 (Baseline survey)	% of national production represented
Denmark	58,206,791	101,966,833	57%
Netherlands	124,096,468	451,544,937	27%
Norway	19,641,582	62,234,900	32%
Poland	78,486,927	557,329,015	14%
Spain	39,691,700	594,734,107	7%
United Kingdom	130,861,556	816,216,431	16%

For all of the participating countries the ROSS 308 hybrid was clearly the broiler hybrid most commonly used for broiler production. However, while this is almost the only hybrid used in Denmark, the Netherlands and Norway, other hybrids were also regularly used in Spain, Poland and United Kingdom. The second most commonly encountered hybrid was the COBB 500 followed by ROSS 708 and different HUBBARD hybrids, Figure 10.

Figure 10: Percentage of participating farmers responding to question 9: "What hybrid of birds is raised on this holding? (All that apply within the last 12 months)"



Biosecurity and management

Questions

10. Is an anteroom, service area or physical barrier (e.g. door or low wall) present at the entrance of each poultry house?
11. Is an anteroom or service area shared between any houses?
12. Do you have dedicated boots for each house?
13. Are foot dips available at the entry of each poultry house?
14. Do you have dedicated tools for each house?
15. Do you have a downtime between all crops on this holding?
16. What is the average downtime between crops in days?
17. Do you have a cleaning and disinfection programme for the houses?
18. Are the houses disinfected between each crop?
19. Do you have a programme for rodent control?
20. Is this maintained by a professional pest control company?
21. At which intervals?

Having an anteroom and or a physical barrier at the entrance of broiler houses is one of the prerequisites for maintaining a high level of biosecurity on the farm. Almost all of the participating farms indicated having an anteroom (69-94%) and/or a physical barrier (17-58%) at the entrance of all the broiler houses, figure 11. Furthermore, most (65-94%) of the participating farms, with anterooms, had separate anterooms for each broiler house, Figure 12.

Figure 11: Percentage of participating farmers responding to question 10: "Is an anteroom, service area or physical barrier (e.g. door or low wall) present at the entrance of each poultry house?"

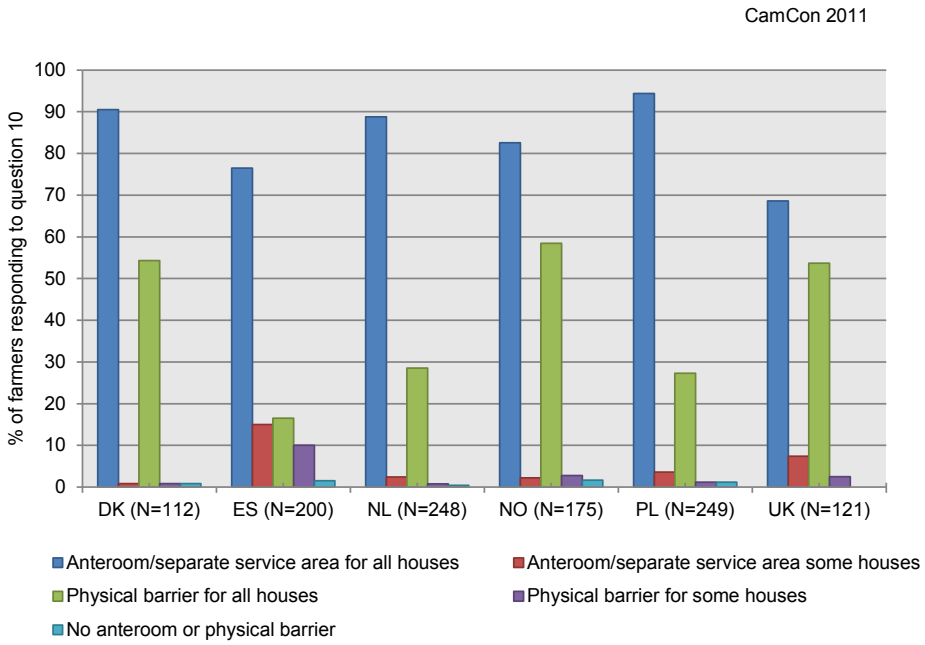
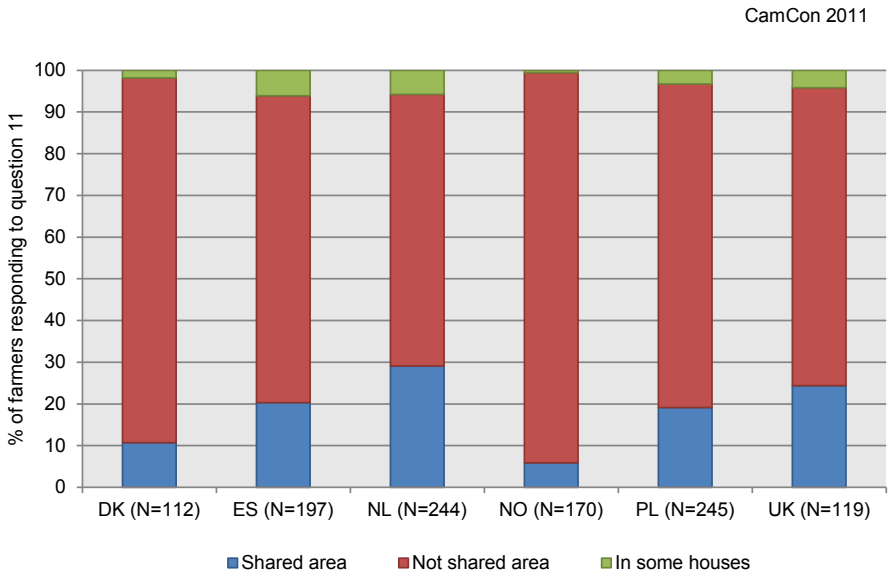
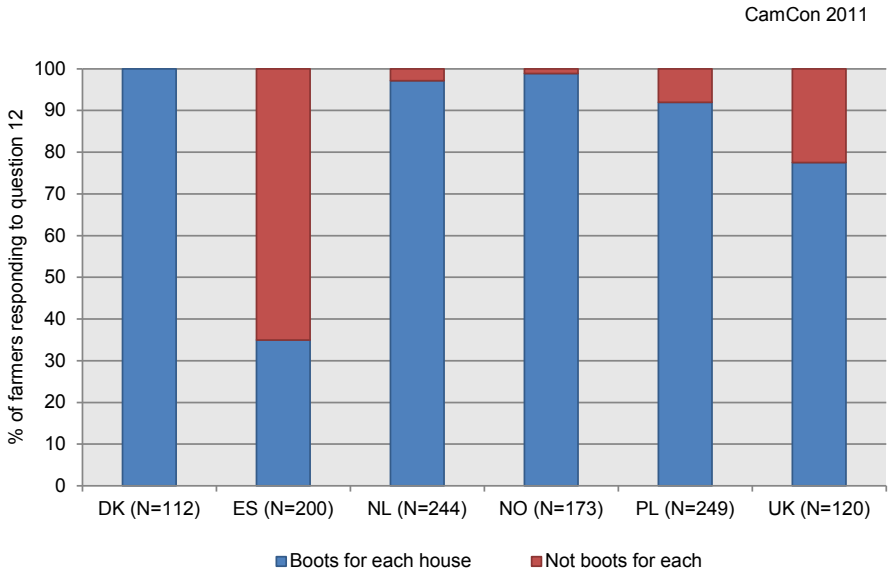


Figure 12: Percentage of participating farmers responding to question 11: "Is an anteroom or service area shared between any houses?"



Farmers were also asked whether or not they have boots and tools that are dedicated to specific broilers houses. Using the same boots or tools in several broiler houses increases the risk of spreading bacteria between houses and thus having dedicated boots and tools has become common practice on many farms with a high level of biosecurity. This was the case for the majority of the participating farms in this survey, Figure 13. In fact, the use of dedicated boots seems to be common practice in all the participating countries with the exception of Spain, where only 35% of the farmers indicated using dedicated boot for each house. For the remaining countries 78% or more of the responding farmers use dedicated boots in the broiler houses.

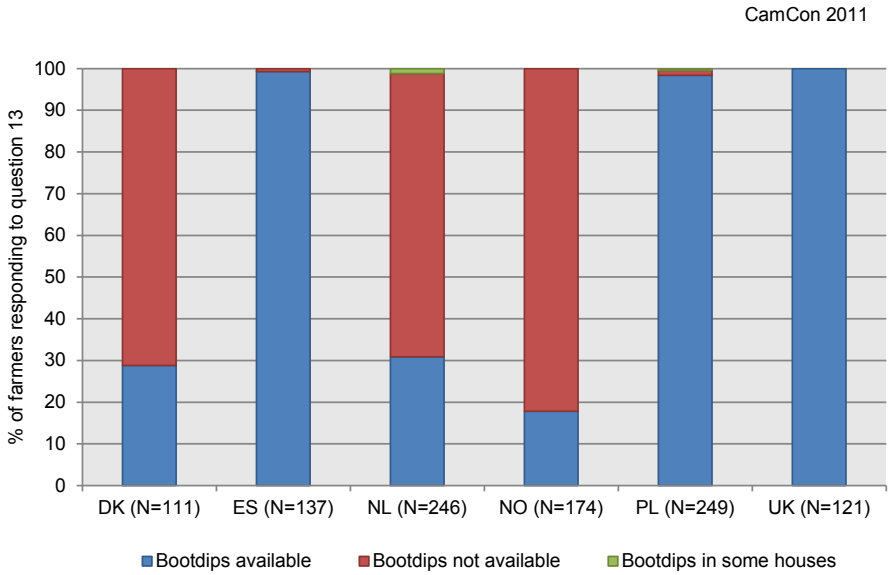
Figure 13: Percentage of participating farmers responding to question 12: "Do you have dedicated boots for each house?"



It should be noted that 378 farms had only one broiler house and 355 of these farmers answered yes to this question, and 19 answered no. For farms with only one house, and where the respondent has ticked "no", it is unclear whether or not the boots are dedicated for use in the broiler house or may be used elsewhere on the farm.

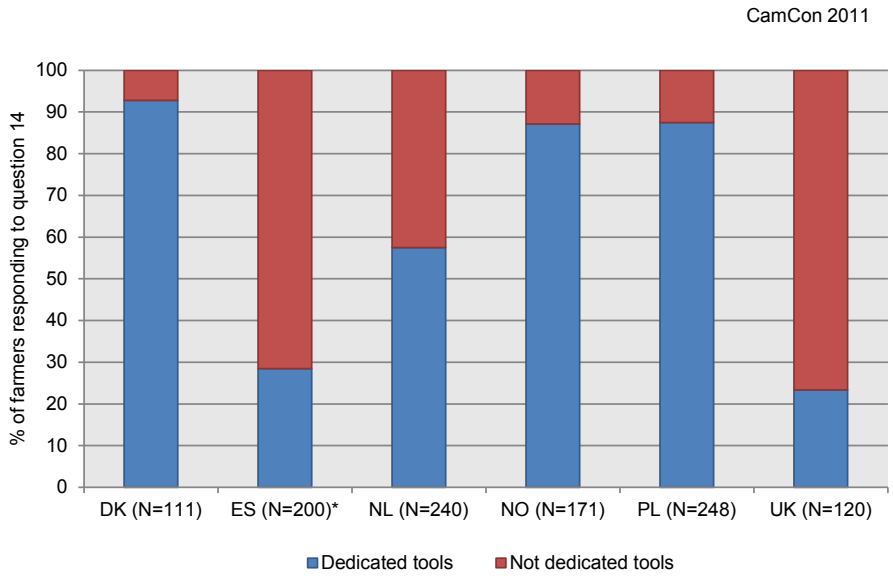
The practice of having boots dips at the entrance of the broiler houses varied quite a bit between the participating countries, Figure 14. On farms responding to the question regarding boot dips, almost all of the farms in Poland, Spain and the United Kingdom had boot dips at the entrance of the broiler houses. In Denmark, the Netherlands and Norway this was much less frequently used. However, the responses to this questions fits very nicely with the response to the question concerning dedicated boots, thus if dedicated boots are used, boot dips are not so common and vice versa.

Figure 14: Percentage of participating farmers responding to question 13: "Are boot dips available at the entry of each poultry house



The practice of having dedicated tools, such as brooms, wrenches, hammers etc. for each broiler house also varied between the countries, Figure 15, and was much more common practice on participating farms in Denmark, Norway and Poland (87-93%) than in the Netherlands, Spain and the United Kingdom (23-58%). The low proportion of Spanish farms indicating having dedicated tool may well be the result of the misunderstanding that dedicated tools included tractors for removing the bedding in the broiler houses after depopulation.

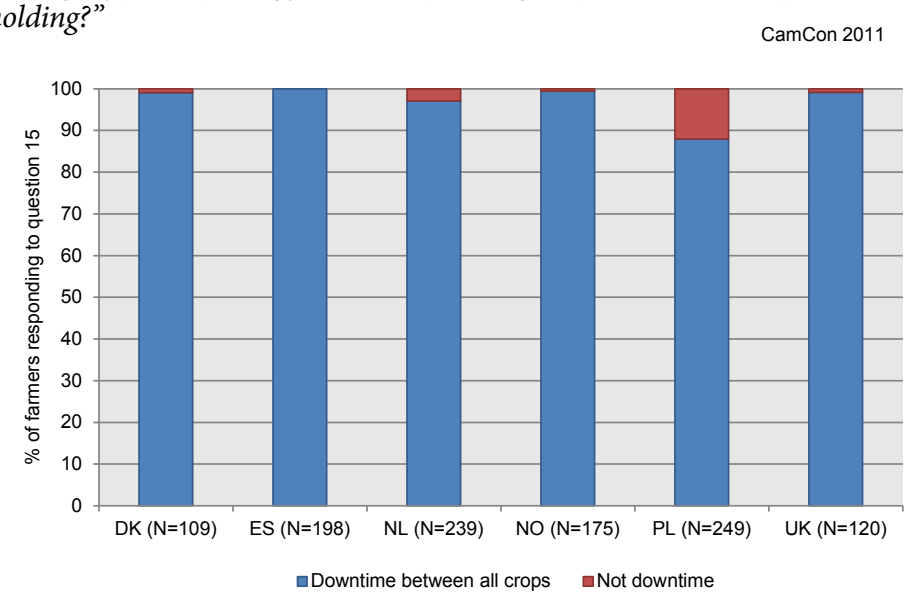
Figure 15: Percentage of participating farmers responding to question 14: "Do you have dedicated tools for each house?"



It should be noted that 378 farms had only one broiler house, 335 of these farmers answered "yes" to having dedicated tools, whereas 34 answered "no" to this question. For those that answered "no", it cannot be concluded whether the answer was "no" because they had only one house or because the tools were also used elsewhere.Note: *In Spain the question was interpreted to include tractors for removing the bedding after depopulating, hence the low proportion of farmers with dedicated tools.

Almost all farmers participating in the survey applied an all-in all-out approach, with a downtime period between all crops, Figure 16. There was very little variation between countries. However, in Poland, only 88% of the respondents answered that they have downtime between all crops, which is quite a bit lower than in the other countries where 98-100% answered they have downtime between all crops.

Figure 16: Percentage of participating farmers responding to question 15: "Do you have a downtime between all crops on this holding?"



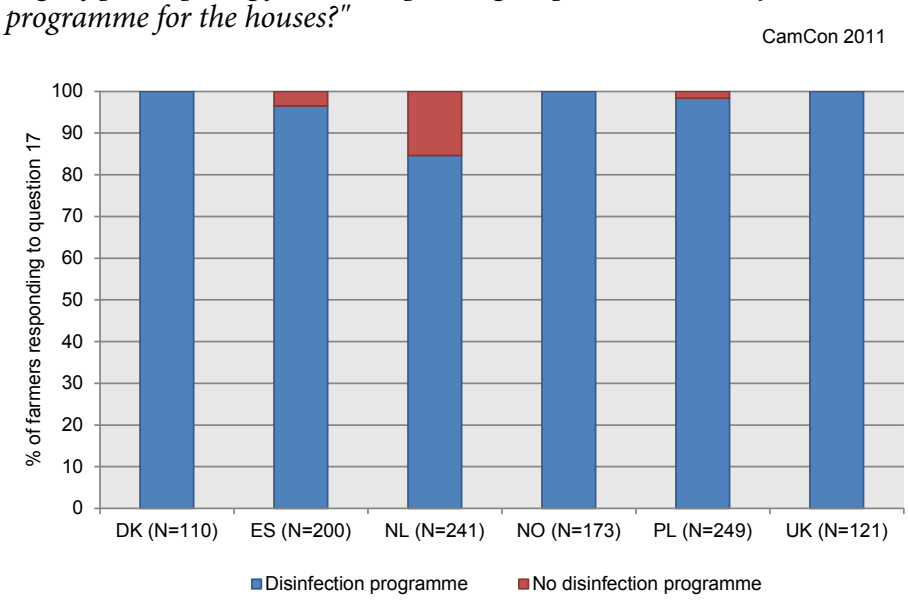
Furthermore, 1,016 of the 1,050 farms with downtime between all crops provided information on the length of downtime between crops, Table 4. In Denmark, the Netherlands and the United Kingdom, the average downtime is a period of 7-8 days, whereas the downtime periods applied in Spain, Norway and Poland may be twice as long. However, data in Norway and Poland are influenced by a few farms recording some unusual long downtimes between crops, e.g. 50 and 70 days, respectively.

Table 4: Average downtime between crops/days

Country	N	Mean	Std Dev	Minimum	Maximum	Median
Denmark	104	8.0	3.0	3	24	7.0
Netherlands	227	8.0	3.0	1	30	7.0
Norway	166	19.0	7.0	1.5	50	18.0
Poland	205	18.0	10.0	7	70	14.0
Spain	198	15.0	4.0	3	30	15.0
United Kingdom	116	7.0	2.0	2	14	7.0

The results, concerning whether a cleaning and disinfection programme has been established for the broiler houses on the participating farms are presented in Figure 17 and clearly show that the majority of the participating farms all have such programmes. However, 15% of the participating farms in the Netherlands and a few farms in Spain and Poland indicated that they do not make use of such programmes.

Figure 17: Percentage of participating farmers responding to question 17: "Do you have a cleaning and disinfection programme for the houses?"



Almost all farmers indicated that the broiler houses are disinfected between crops, Figure 18. In the Netherlands and Norway 17% and 19% of the farms respectively do not disinfect between each crop whereas for Denmark, Spain and the United Kingdom only a very small percentage (6% or less) indicated not disinfecting houses between different crops.

The question on whether or not the farmer have a rodent control programme was answered in 1,098 of the 1,105 validated questionnaires and except for a very small fraction of farmers in Spain, the Netherlands, Norway and Poland all of the participating farms have implemented a rodent control programme, Figure 19.

Figure 18: Percentage of participating farmers responding to question 18: "Are the houses disinfected between each crop?"

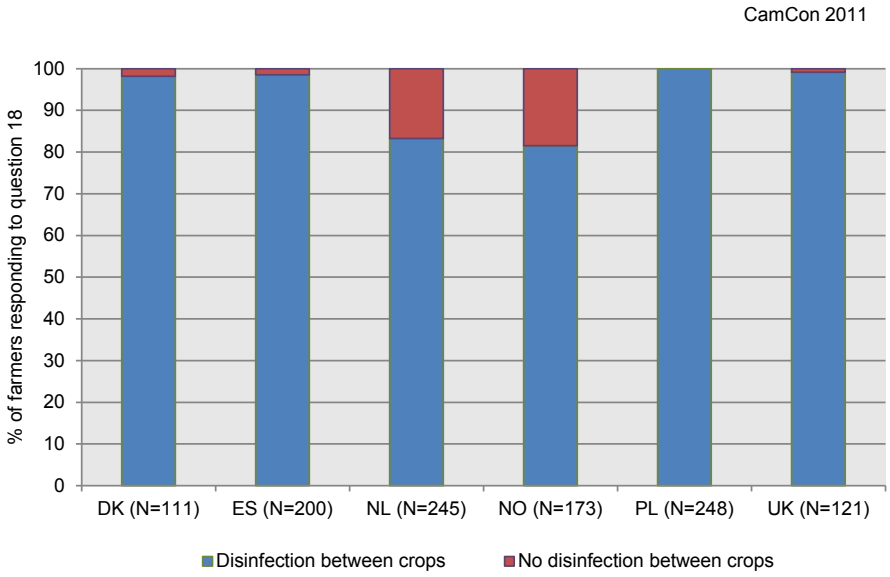
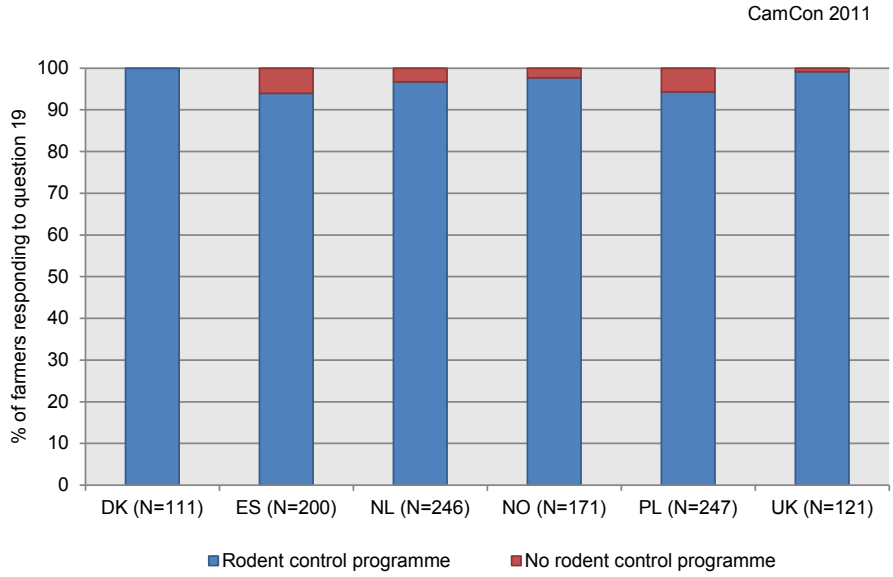
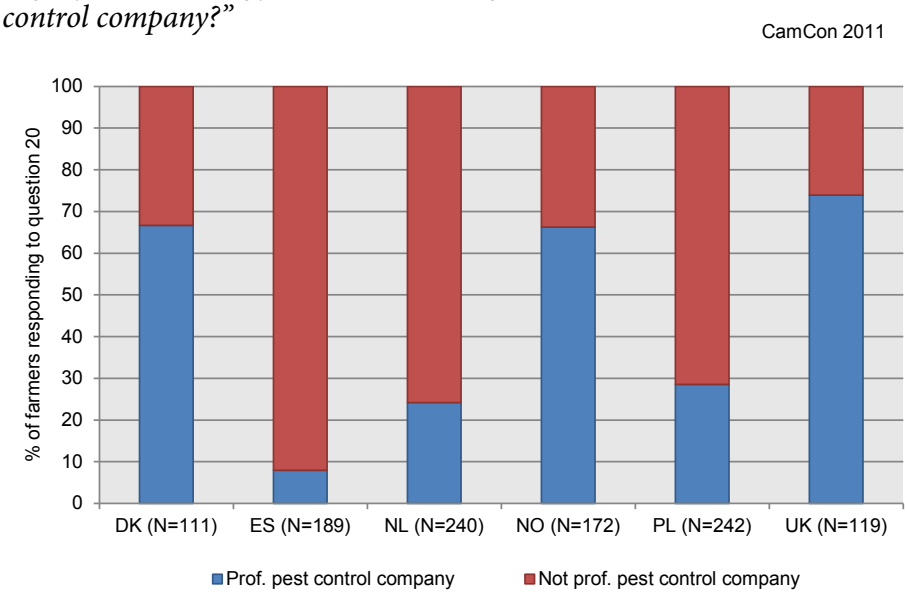


Figure 19: Percentage of participating farmers responding to question 19: "Do you have a programme for rodent control?"



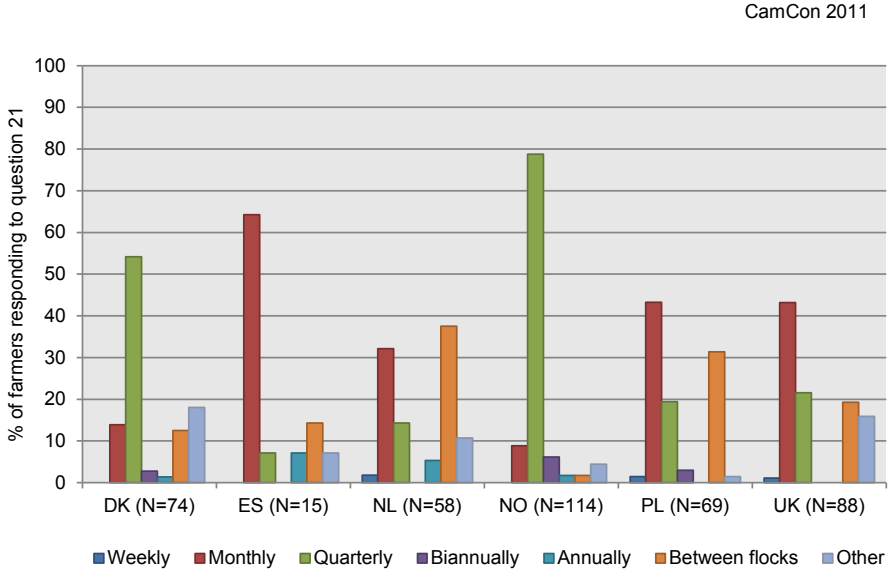
The farmers were asked whether or not their rodent control is carried out by a professional pest control company. In Denmark, Norway and the United Kingdom, the majority of the farms (66-74%) have hired a company to maintain pest control, while this percentage is much smaller (8-29%) on participating farms in Spain, the Netherlands and Poland, Figure 20.

Figure 20: Percentage of participating farmers responding to question 20: "Is this maintained by a professional pest control company?"



The farmers that used a professional pest control company (410 farms) were also asked how frequently the control was carried out, Figure 21. In Denmark and Norway a majority of the farms choose to have quarterly inspections, while in Spain, the Netherlands, Poland and the United Kingdom the results indicate that monthly visits or a rodent control between flocks were more frequently used. In the category of "other" the responses varied from every one and a half month to every fourth month.

Figure 21: Percentage of participating farmers responding to question 21: "At which intervals is rodent control maintained? (Only farmers with professional pest control)"

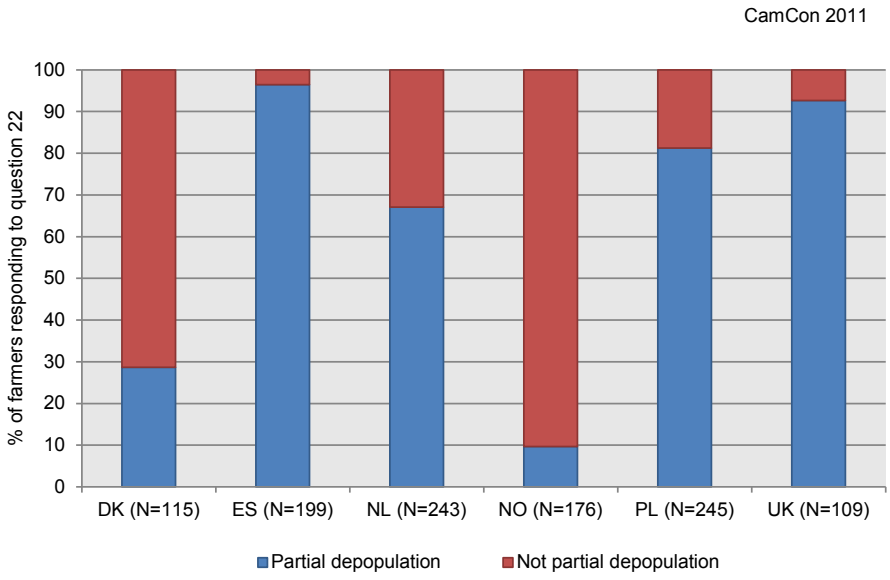


Questions

22. Do you practice partial depopulation?
23. How long does it take to remove birds from one house during the first partial depopulation?
24. On average, what is the number of days between first partial depopulation and final depopulation?
25. How long does it take to depopulate one house during clearance?
26. Approximately how many people, on average, enter the house (or have direct contact) with a flock during one crop cycle?
27. Where/how is manure disposed of?

The question whether or not the farmers practice partial depopulation (thinning) was answered in 1,087 of the 1,105 validated questionnaires and the responses indicated that the majority of the farms in Spain, the Netherlands, Poland and United Kingdom practice partial depopulation of their broiler flocks, Figure 22. In Denmark and Norway this practice is not common and was only reported on 29% and 10% of the participating farms, respectively.

Figure 22: Percentage of participating farmers responding to question 22: "Do you practice partial depopulation?"



The responses to the question concerning the time used for removing birds from one house during the first partial depopulation are presented in Table 5. A relatively large variation was observed both between farms within one country, but also between different countries. For Denmark, Spain, the Netherlands and Norway the average number of hours spent varied from 1.2 hours to 3.9 hours. In the United Kingdom and Poland, however, the average number of hours taken was about the double, but both the standard deviations and the maximum values clearly indicate that the answers for these two countries are spread over an unexpected wide range of values.

The results regarding the number of days between first partial depopulation and final depopulation are shown in Table 6. They show that the time span varies from 2 to 50 days, but 50 days seems an unrealistically long time span from partial depopulation to final depopulation. For all countries, on average, there is 7.4 days between the first and the final depopulation. The results indicate that the Spanish producers, on average, have a longer time period between the first and the final depopulation compared to producers in other countries.

Table 5: Time (hours) used for removing birds during the first partial depopulation

Country	N	Mean	Std. Dev.	Min.	Max.	Median
Denmark	33	2.1	1.9	1	10	1.0
Netherlands	163	1.2	2.5	0.15	20	1.0
Norway	17	2.2	1.1	0.5	4	2.0
Poland	199	3.6	11.7	1	96	2.0
Spain	192	1.6	1	0.4	6	1.5
United Kingdom	101	3.9	13.2	0.33	96	2.5

Table 6: Number of days between first partial depopulation and final depopulation

Country	N	Mean	Std. Dev.	Min.	Max.	Median
Denmark	33	5.3	2.2	2	11	4.5
Netherlands	163	7.7	1.7	3	15	7.0
Norway	17	5.1	1.7	2	7	5.0
Poland	199	7.1	2.9	3	30	7.0
Spain	192	11.2	2.8	5	18	12.0
United Kingdom	101	7.8	5.3	3	50	7.0

The time used for depopulating one house are shown in Table 7. These results differ from one to 168 hours with a mean below 12 hours for each individual country. Again the answers indicate that different production conditions, especially the number of birds per house, may account for the large standard deviations.

The number of people entering the houses during one crop cycle is shown in Table 8. The results show that on average two to four people are entering the house or have direct contact with a flock. Again the responses reflected the differences in production, with the largest number of people registered in countries with the largest farms. However, a larger number of staff on farms may also reflect other aspects than the size of the farms, i.e. the more automated systems on the farm, the less staff needed on a daily basis.

If the data concerning depopulation (Table 5-7) are to be used further for a risk factor study, it must be clarified whether or not the very high values are correct, or whether the response is a result of a misinterpretation.

Table 7: Time (in hours) used for depopulating one house

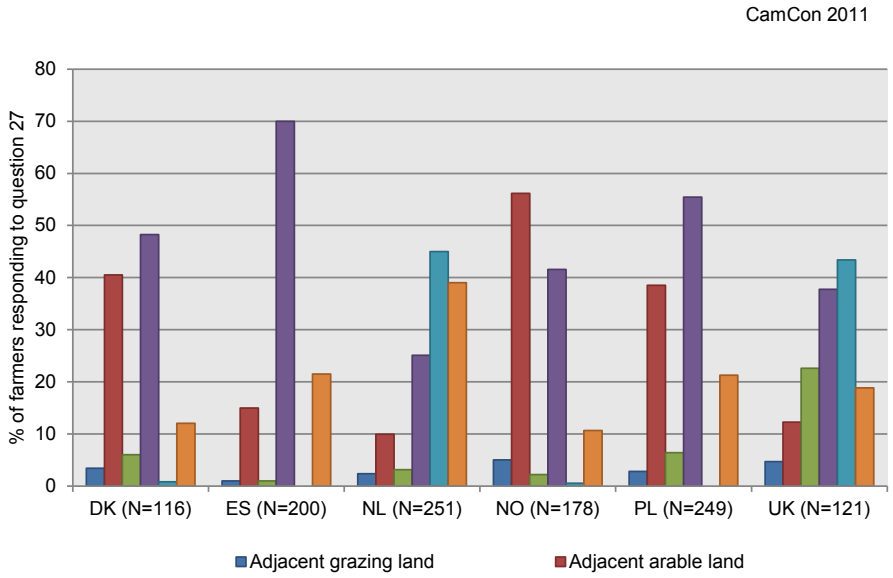
Country	N	Mean	Std. Dev.	Min.	Max.	Median
Denmark	108	5.7	2	1	20	6.0
Netherlands	238	4.1	6.7	0.45	90	3.0
Norway	173	3.8	2.6	1	32	4.0
Poland	241	10.1	19.3	2	168	6.0
Spain	199	11.7	18.7	1	96	4.0
United Kingdom	118	6.2	15.1	1.5	120	4.0

Table 8: Number of people, on average, having access to the house (or having direct contact) with a flock during one crop cycle

Country	N	Mean	Std. Dev.	Min.	Max.	Median
Denmark	110	2	1	1	8	2.0
Netherlands	240	3	2	0	10	3.0
Norway	173	2	2	0	10	2.0
Poland	247	3	3	1	23	2.0
Spain	200	4	2	1	11	3.0
United Kingdom	121	4	2	1	16	3.0

In the questionnaire the farmers were asked where or how they dispose manure, since it may be of importance if manure from a *Campylobacter* infected broiler flock is in the close vicinity of a broiler house. The responses to this question are shown in Figure 23. For Denmark, Spain, Norway and Poland the majority of the farms dispose of manure on adjacent arable land or arable land not bordering the site. Above 40% of the Dutch and British farmers dispose the manure by incineration, whereas this method is not used or used very little (<1%) in other countries. The category of others account for selling the manure, composting and fertilizer production. Interestingly, in the Netherlands, Poland, Spain and the United Kingdom several farms reported selling manure specifically as manure for growing mushrooms.

Figure 23: Percentage of participating farmers responding to question 27: "Where/how is manure disposed of?"



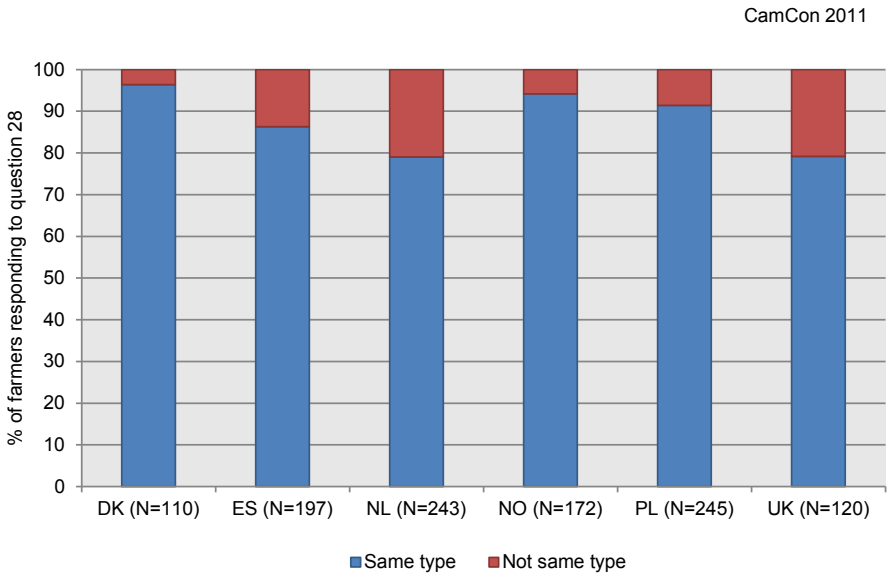
Ventilation

Questions

28. Do all houses on the holding have the same type of ventilation?
29. Please indicate the types of house ventilation.
30. Inlet ventilation (air in)
31. Outlet ventilation (air out)
32. Are all ventilation sites tightly closed during downtime?
33. If you have fans, do you reverse them in summer?

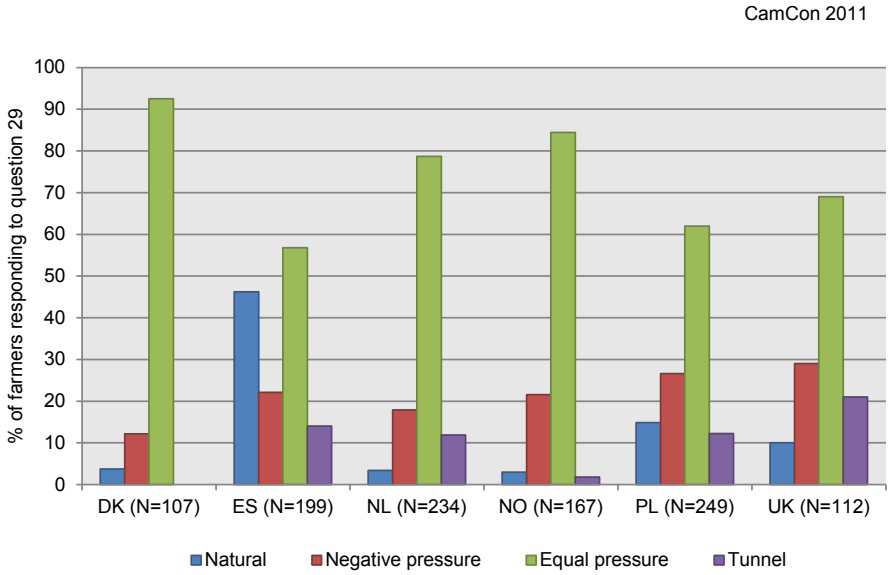
A series of questions concerning ventilation of the broiler houses was added to the questionnaire in order to get an overview of different types of ventilation systems and practices on the participating farms in different countries. Overall, 87% of the participating farms had the same type of ventilations systems in all houses on the farms. However, variations between countries were observed. In Denmark, Norway and Poland a higher percentage of the participating farms reported having the same ventilations system than in the Netherlands, Spain and the United Kingdom, Figure 24.

Figure 24: Percentage of participating farmers responding to question 28: "Do all houses on the holding have the same type of ventilation?"



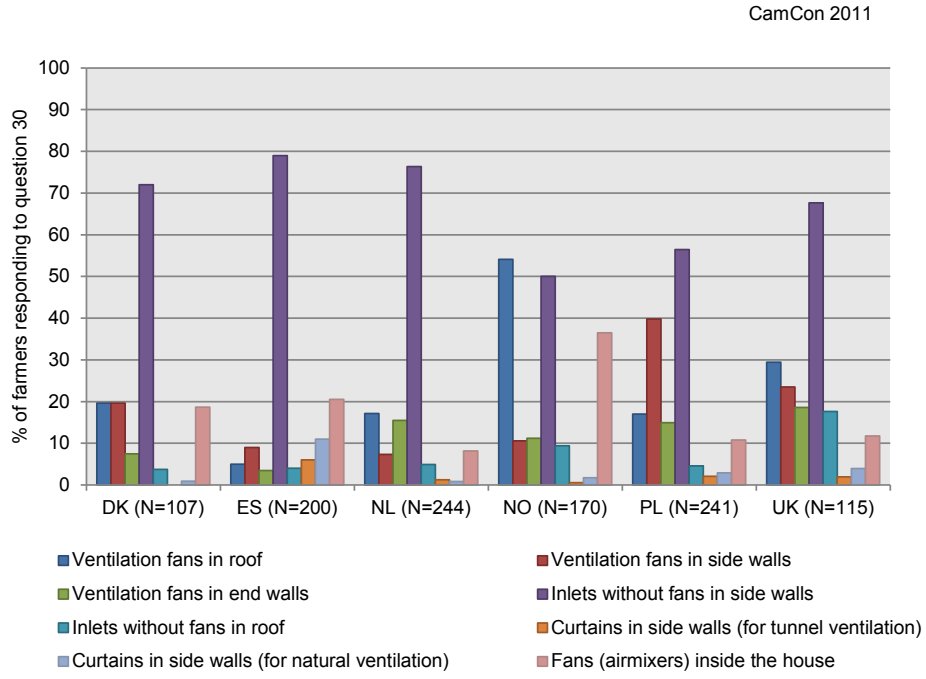
Farmers were also asked to indicate the type of ventilation in the houses on the farm. For those farms with different types of ventilation in the houses the farmers were asked to record the ventilation in place in the newest houses on the farm. Results are shown in Figures 25, 26 and 27. Based on the received responses, mechanical ventilation with equal pressure in the broiler houses was the ventilation type most frequently encountered, followed by mechanical with negative pressure, Figure 25. Tunnel ventilation was only used on a small percentage of the participating farms. Natural ventilation was used more frequently on participating farms in Spain than in any of the other countries.

Figure 25: Percentage of participating farmers responding to question 29: "Please indicate the types of house ventilation"



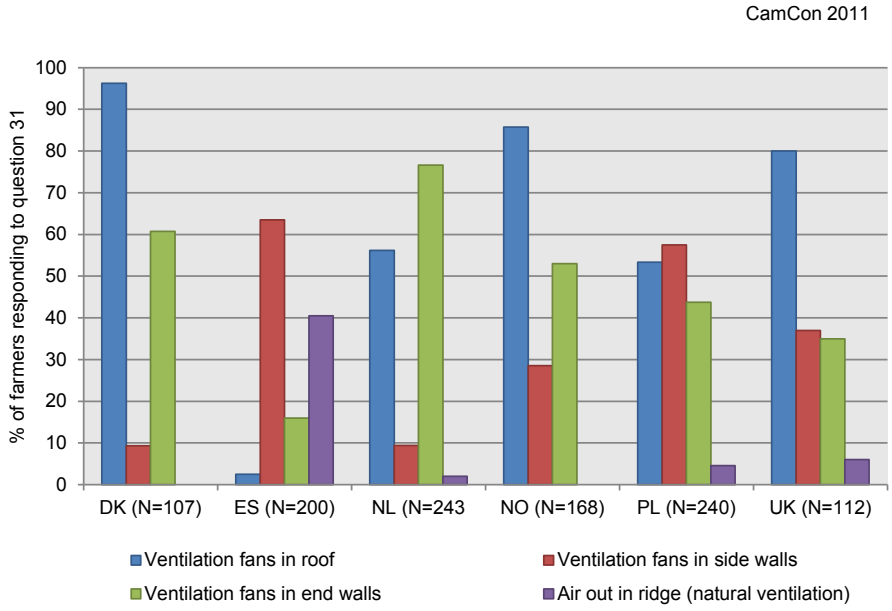
The types of ventilation inlets and outlets in houses on participating farms are shown in Figures 26 and 27. Overall, the most common type of inlets was inlets without fans along the side walls. In Norway, however, ventilation inlets with fans in the roof were the most common type of inlets (54% of participating farms) and in Poland inlets with ventilation fans in the sidewalls was quite common (40%). The presence of airmixers in the broiler houses varied from 8% in the farms in the Netherlands to 36% of the farms in Norway.

Figure 26: Percentage of participating farmers responding to question 30: "Inlet ventilation (air in)"



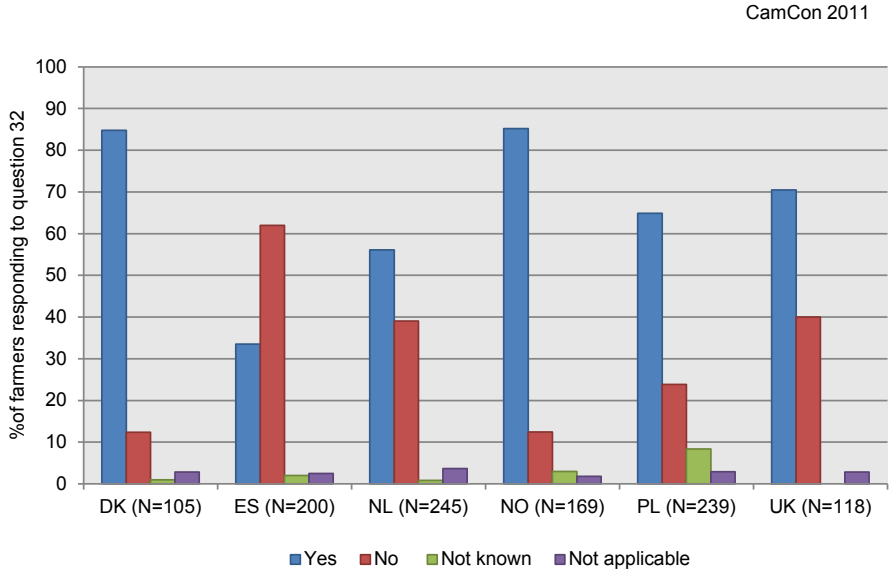
As for the air outlets, the systems seem to differ quite a bit between the countries, Figure 27. For Denmark, the Netherlands, Norway and the United Kingdom outlets with ventilations fans in the roof and outlets with ventilation fans in the end walls were most common. However, in Poland and Spain ventilation outlets with fans along the side walls were more common. In Spain, it was also common practice to have air outlets without fans, which correlates well with the fact that Spain reported the highest percentage of farms with natural ventilation.

Figure 27: Percentage of participating farmers responding to question 31: "Outlet ventilation (air out)"



Closing off all ventilation sites during downtime was common practice on more than half the participating farms in all countries except Spain, Figure 28. In Denmark and Norway, almost all farms close the ventilation sites during the downtime, while in the Netherlands, Spain and the United Kingdom, quite a large percentage (39%, 62% and 40%, respectively) of the farms do not close the ventilation sites during downtime. It should be noted that some of the Spanish farmers may mistakenly have indicated not closing off their ventilation sites, because these are kept open until cleaning and disinfection of the houses has been completed. This issue needs to be clarified for farms that will participate in the future risk factor study.

Figure 28: Percentage of participating farmers responding to question 32: "Are all ventilation sites tightly closed during downtime?"



The participating farmers were also asked if they ever reverse the fans in summer, which is a practice used to prevent over-heating in the broiler houses. This is not commonly used in any countries. In Denmark, the Netherlands and Norway only 2-3% of the farms reported using this. However, in Poland, Spain and the United Kingdom it was a little more common, used on 8%. 9% and 13% of the participating farms, respectively (data not shown).

Other animals

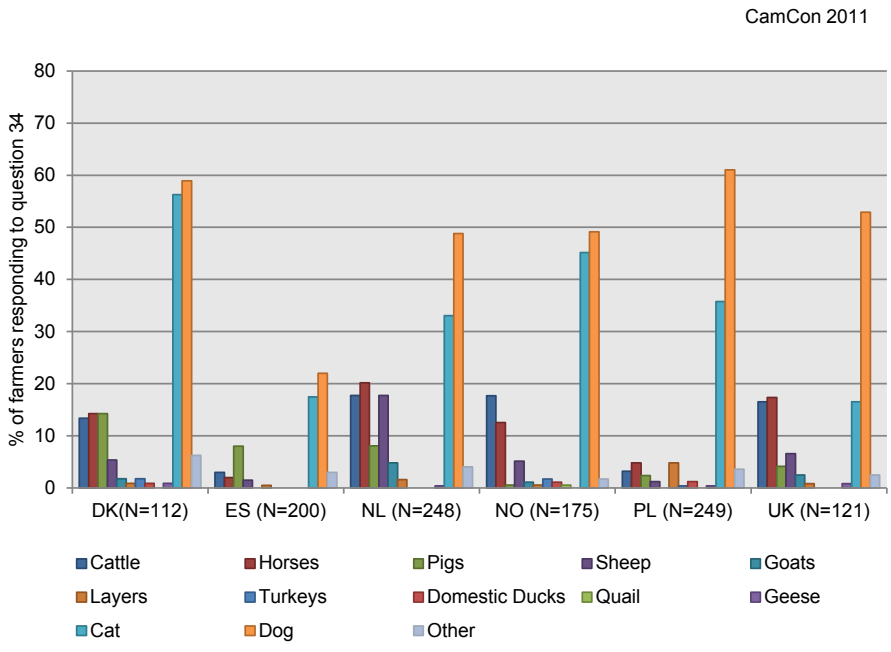
Questions

34. Are any of the following animals kept at the same location as the broilers?
35. Which species are bordering the holding or are 'across the road' from your holding, excluding your own farm?
36. If you have ticked (k) for cats in question 34: Do cats have access to broiler houses?
37. If you have ticked (l) for dogs in question 34: Do dogs have access to broiler houses?

For questions 34 and 35, it was not possible to indicate that none of the mentioned animals were kept on the broiler farm or the neighbouring farm. Therefore, all returned questionnaires were included and if no options had been ticked off, the response was interpreted as a "no" for question 34 and "none" for question 35 (see questions above).

Information regarding animals on the same location as the broilers is presented in Figure 29. Generally, the animals most frequently encountered on the broiler farms are pets such as cats and dogs. Interestingly, much fewer of the participating Spanish farmers indicated keeping dogs or cats on the farm compared to farmers in the other participating countries. Focusing on production animals (domestic animals only), cattle, pigs, sheep and horses are the species most frequently kept on the farms. Comparing data from the participating countries (without including poultry), the responses to the survey show that with the exception of pigs, production animals are more often kept on farms in Denmark, the Netherlands, Norway and the United Kingdom compared to Spain and Poland. Overall, less than 7% of the participating farms had other poultry (incl. layers, turkeys, domestic ducks, quail and geese) on the same location as the broiler flocks. The category of "other" includes mink, ostriches, rabbits and pheasants.

Figure 29: Percentage of participating farmers responding to question 34: "Are any of the following animals kept at the same location as the broilers?"



The information concerning the animal species kept on neighbouring holdings is shown in Figure 30. In general, the listed animal species were much less common on neighbouring farms in Spain than in any of the other participating countries.

Except for Spain, pets such as cats and dogs, as well as domestic animals such as pigs, cattle and horses were commonly found on neighbouring holdings. Especially in the United Kingdom a large proportion of the participating broiler farms have neighbour holdings that keep cattle (56%) and sheep (41%). Compared to the other countries, these percentages are remarkably higher, indicating a higher production of cattle and sheep or a higher density of farms. The percentage of neighbouring farms with broilers or layers is generally low, ranging from 0-11%. However, looking at poultry in general (broilers, layers, turkeys, domestic ducks, quails and geese), the percentages varied between countries. The lowest percentage was seen in Spain (5.6%) and the highest in Poland (48.4%). In Denmark, the Netherlands, Norway and the United Kingdom, the percentages were 12.7%, 22.5%, 27.0% and 14.1%, respectively.

The questions regarding whether dogs and cats have access to the broiler house have been summed up in Table 9.
The responses to the survey clearly indicate that the majority of dogs and cats have no access at all or they have access when the house is empty, but only before cleaning and disinfection.

Figure 30: Percentage of participating farmers responding to question 35: "Which species are bordering the holding or are 'across the road' from your holding, excluding your own farm?"

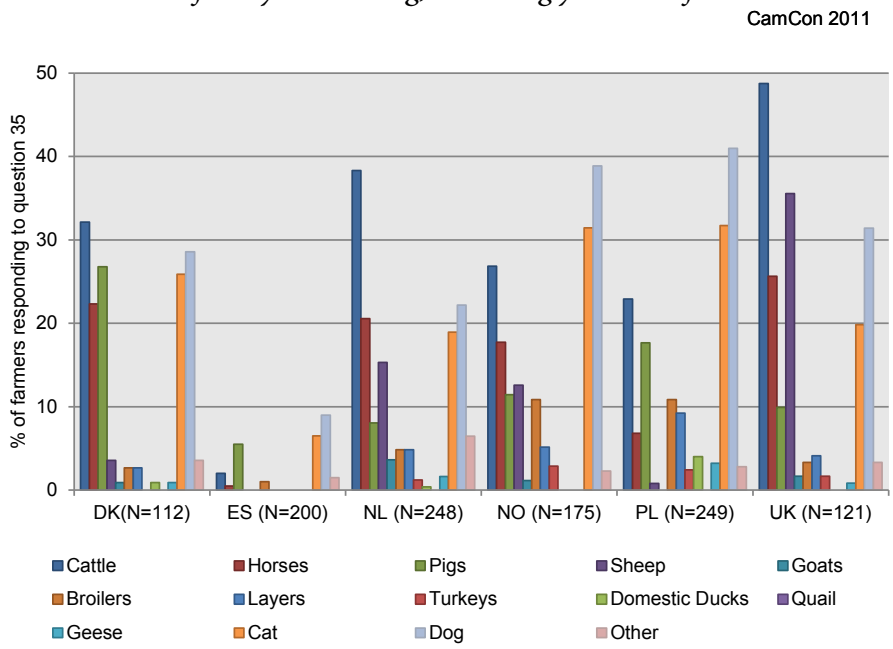


Table 9: Response to question regarding whether or not cats and dogs have access to the broiler houses (%)

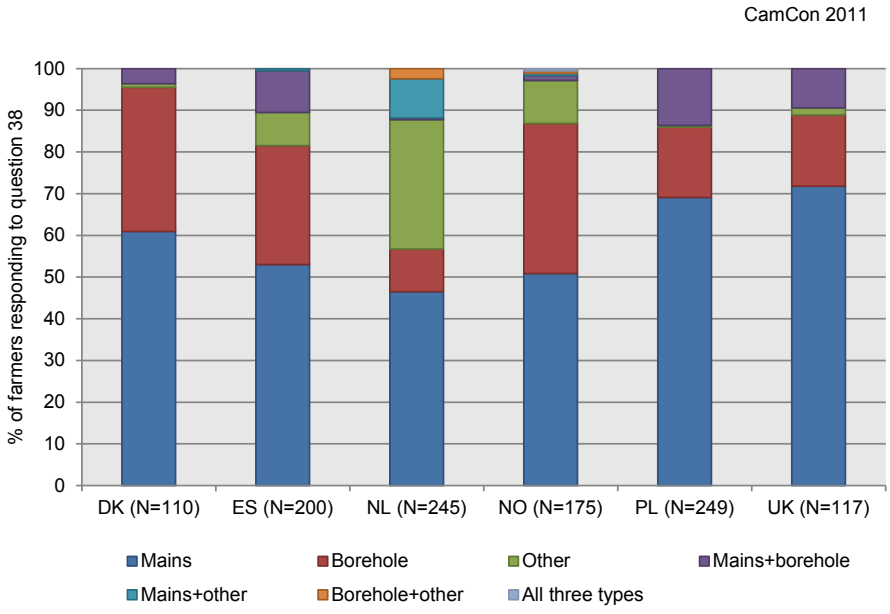
Do cats have access to broiler houses?	**DK (N=72)**	**ES (N=36)**	**NL (N=117)**	**NO (N=88)**	**PL (N=110)**	**UK (N=41)**
Always	0	0	0	0	2	0
When empty, but only before cleaning and disinfection	6	17	7	11	20	5
When empty, before and after cleaning and disinfection	3	3	4	0	3	0
Never	92	81	89	89	75	95
Do dogs have access to broiler houses?	**DK (N=73)**	**ES (N=45)**	**NL (N=150)**	**NO (N=36)**	**PL (N=158)**	**UK (N=83)**
Always	3	0	1	0	0	1
When empty, but only before cleaning and disinfection	12	16	11	11	5	6
When empty, before and after cleaning and disinfection	3	7	3	0	1	1
Never	82	78	85	89	94	92

Questions

38. What source of water do you use?
39. What products/methods do you use to treat this water with?
40. What type of drinkers are used on the holding?

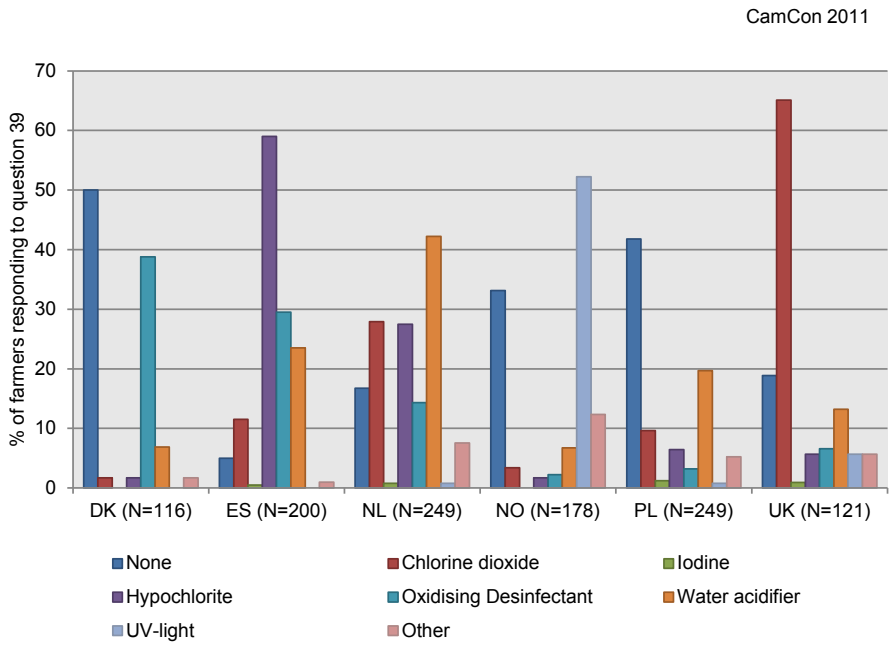
Information concerning what type of water source is used was provided by 1,096 of the 1,105 validated questionnaires. The majority of the farms use either mains or borehole or both in combination as water source, Figure 31. In total 103 of 245 (42%) of the Dutch respondents use well water as another type of water source, either alone or in combination with mains or borehole. For Norway and Spain, 10% and 8% of the respondents respectively ticked other water source whereas for Denmark, Poland and United Kingdom 0.4 - 2% uses water from other sources. These other water sources used are mainly surface water from canals, rivers, springs, brooks and reservoirs. Also private well water and water from private waterworks are included in this category.

Figure 31: Percentage of participating farmers responding to question 38: "What source of water do you use?"



The results from the question on which products/methods are used to treat the drinking water are shown in figure 32. For Denmark and Poland around 50% of the farms use chemical water treatment such as acid and oxidising disinfectants. In Spain, the Netherlands and United Kingdom the percentage of farms using water treatment varies between 81% and 95% and the methods used are primarily chemical treatment. In Norway, 67% use water treatment. Here a large fraction of the used methods is mechanical treatment, because over half the Norwegian farmers use UV-light for water treatment.

Figure 32: Percentage of participating farmers responding to question 39: "What products/methods do you use to treat this water with?"



The "Other" group covers mechanical treatment methods like reverse osmosis and various filter techniques. In Spain, the Netherlands, Poland and United Kingdom only a very little fraction (<1%) use iodine for water treatment.

The question on what types of drinkers were used on the holding was answered by 1,094 of 1,113 validated questionnaires. The results show, that for all countries 96% or more of the farms use either nipple or nipple with cup or both types in combination. The remaining fraction of farms uses bells alone or bells in combination with nipples.

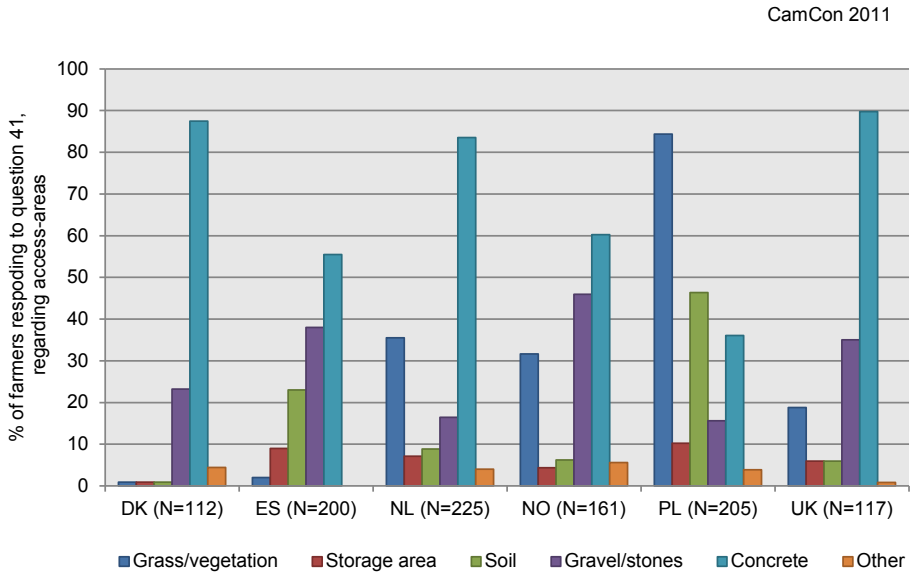
Surroundings

Questions

41. What are the surroundings of the poultry houses?
42. Does a water course (stream, river, lake) run through your land or within 20m/yards of it?

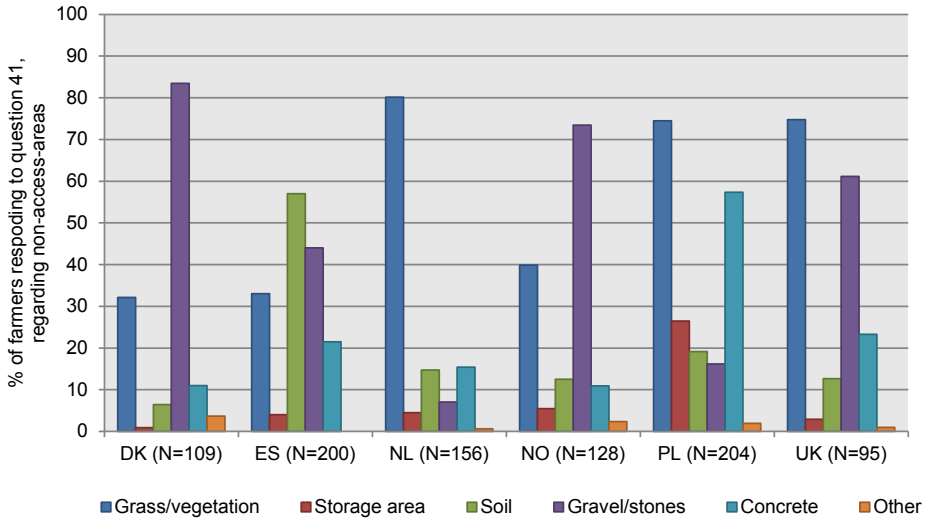
The questions concerning the type of surroundings around the poultry houses were split up into access and non access areas. An example of an access area is the area in front of a door or gate to leading into the broiler house, and typical non-access area could be a side of the broiler house without any entrances. The results are shown in Figure 33 and Figure 34. For Denmark, Netherlands and the United Kingdom 80% or more of the farms have concrete in access areas. In Denmark and Spain grass is less common, whereas in Poland grass is the dominating material in access areas. For Norway and Spain the majority still have concrete for the access areas, but here also gravel or stones are used more frequently compared to other countries.

Figure 33: Percentage of participating farmers responding to question 41: "What are the surroundings of the poultry houses? (Regarding access areas)"



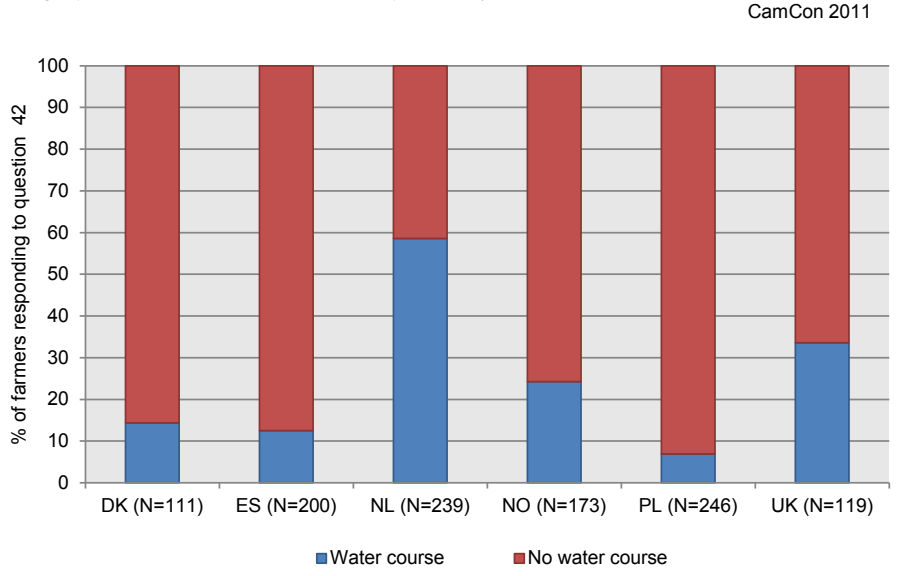
For the non-access areas all types of materials are used, but for all countries the results indicate a natural shift towards cheaper materials around non-access areas. For Poland, concrete is more often used in non-access areas. The answers show that in Poland, non-access areas are more frequently used as storage areas compared to other countries. This could be the explanation for the increased use of concrete in non-access areas in Poland. The category of others covers asphalt, pavement and seashells for both access and non-access areas.

Figure 34: Percentage of participating farmers responding to question 41: "What are the surroundings of the poultry houses? (Regarding non-access areas)"



The question concerning information about whether a water course (stream, river and lake) runs through the premises or within 20m/yards of it was answered in 1,088 of the 1,105 validated questionnaires. The results are shown in Figure 35. The Netherlands has the highest fraction of farms (59%) where a water course runs through the land or nearby. For Norway and United Kingdom, this percentage is 24% and 34 %, respectively, whereas for Denmark, Spain and Poland less than 15% have water courses that run through the farm or within 20m/yards of it. These results reflect the geography of the different countries quite well.

Figure 35: Percentage of participating farmers responding to question 42: "Does a water course (stream, river, lake) run through your land or within 20m/yards of it?"



DISCUSSION AND CONCLUSION

The purpose of the Camcon questionnaire survey was to collect data from 200 farms in Denmark, the Netherlands, Norway, Poland, Spain and the United Kingdom in order to obtain detailed information and identify similarities and differences regarding management practices on conventional broiler farms in these countries.

With the exception of a recent baseline study carried out by the European Commission, describing a limited number of potential risk-factors (EFSA 2010 b), this is the first comprehensive standardized questionnaire survey carried out simultaneously in several European countries. The baseline study provided insight into the broiler production and an overview of the prevalence of *Campylobacter* in broiler batches at slaughter within the participating European countries. In the six European countries that participated in the Camcon survey, the *Campylobacter* baseline prevalence was found to be (in ascending order); 3.2% in Norway, 19.0% in Denmark, 24.4% in the Netherlands, 75.3% in the United Kingdom, 78.9% in Poland, and 88.0% in Spain (EFSA 2010a).

The baseline study concluded that the differences in prevalences could be explained by a number of factors, many of which could be associated with the climate in different regions of Europe. For example, moist climates in the temperate EU Member States provide conditions favouring environmental *Campylobacter* survival. In colder climates the broiler houses need to be thermally insulated, which also prevents the access of wild birds or rodents to the houses from the outside. Also, implemented strategies to control *Campylobacter* in broilers (in for example Denmark, Norway and Sweden) have likely influenced the prevalence of *Campylobacter* in broilers and broiler meat in these countries (EFSA 2010b, Rosenquist et al, 2009).

Data concerning climate and data on the *Campylobacter* status of flocks have not yet been sought in Camcon questionnaire data. However, it is the intention that detailed flock management data from a subset of the farms participating in the Camcon survey, along with climate data and data on the *Campylobacter* status of flocks over a two year period, will be used in an analysis aiming to identify external risk factors for flock colonization. It will be of great interest to see if the future risk factor study can help explain the differences in *Campylobacter* prevalences in the different countries.

Even though conssiderable efforts were made to make the Camcon questionnaire easy to understand and as user-friendly as possible, some misinterpretations occurred. For instance, not all farmers in countries with mandatory quality assurance programmes responded that they produced broilers according to a quality assurance programme. Interpretation of the data and comparison of data between the countries requires detailed knowledge of the productions in the different countries and in this case the participating institutions were consulted for correct interpretation of the received answers. Nevertheless, results should be interpreted with care, especially in Denmark, the Netherlands and the United Kingdom, where the questionnaires were filled out and returned by the farmers themselves. For those farms that will later be included in the risk factor analysis it is important that any uncertainty connected to collected data is clarified ahead of the analysis.

In a recent systematic review of 159 peer reviewed papers concerning risk factors for *Campylobacter* infection in broilers, all factors with a positive relevance score were ranked in the following order based on their estimated relevance for the British poultry industry (Adkin et al, 2006): Depopulation schedule, hygiene barriers, multiple houses, parent company/abattoir, season of rearing, disinfectant foot baths, outside access, number of staff, water disinfection, presence of other animals, age at sampling, flock stress, down time, cleaning routine. Similar risk factors were identified in the EU baseline study where climate (greatest risk of positive batches from July-September), increased age at slaughter and thinning were all found to be associated with increased risk of carcasses being colonised with *Campylobacter* (EFSA 2010b). With a few exceptions, such as climate and age at sampling, all of these factors were addressed in the Camcon questionnaire.

In the following, the most important findings of the survey will be discussed, in the same order as they were described in the results; general information, biosecurity and management, ventilation, other animals, water and surroundings.

Flock size, age at slaughter (risk increases with age), and a period of less than 9-14 days between depopulation and restocking are all factors that have been associated with increased risk of *Campylobacter* colonization of broiler flocks (Barrios, et al 2006, Berndtson et al 1996, Bouwknegt et al, 2004, Guerin et al, 2007, Lyngstad et al, 2008, Nather et al, 2009). Detailed information on flock sizes and the age of the broilers at slaughter was not provided by the Camcon questionnaire, since all the questions in the survey were related to the farm level and not the flock level. It is possible that these parameters could be estimated by using the information on the number of houses on the individual farms, the total number of crops per year and the overall annual production. These calculations have not been carried out, but may be useful in the future risk factor study. Overall, the production in Spain appeared to be less intensive (fewer crops per year and lower stocking density) than in the other participating countries. It will be of great interest to see if the farms with a more intensive production and shorter down-times have a higher risk of infection.

A number of studies have shown that the lack of hygiene barriers and poor hygiene measures (i.e low standard of biosecurity) are risk factors for *Campylobacter* colonization of broiler flocks (Berndtson et al, 1996, Hald et al, 2000, van de Giessen et al, 1996, Heuer et al, 2007) and that farms with the best hygiene measures are less likely to become colonized (Johnsen et al, 2006). The Camcon questionnaire survey showed that on the majority of participating farms, a number of practices related to a high level of biosecurity were already in place, for instance the use of ante-rooms or physical barriers at the entrances to the broiler houses. However, different approaches were applied in different countries, for example in countries where farmers were less likely to have boots dedicated for specific houses; they were more likely to have boot-dips at all entrances.

The practice of thinning was widely used, except in Denmark and Norway. This practice has been associated with an increased risk of *Campylobacter* infection of the flocks (Berndtson et al, 1996, Hald et al, 2000). Furthermore, for those farms in Norway and Denmark, where thinning was used, the time span from the first partial to final depopulation was generally shorter than in the other countries. These observations may be explained by the fact that both Norway and Denmark have action plans for reducing *Campylobacter* in broilers, and in this context, partial depopulation is discouraged. The length of down-time (time between depopulation and restocking) varied between countries and was generally longer in Spain, Norway and Poland than in the other participating countries.

There are indications that certain types of ventilation systems may influence the number of flocks that become infected with *Campylobacter* (Guerin et al, 2007, Gibbens et al, 2001, Rushton et al, 2009).The number of flocks that become infected by *Campylobacter* may be influenced by whether the broiler house is equipped with vertical/horizontal ventilation shafts, whether or not the side vents have fans or whether the house is ventilated using natural ventilation. Furthermore, increased ventilation in the summer may be associated with a greater risk of infection, since this leads to more contact with the outside environment (Newell et al, 2003) and to a higher influx of flies which is correlated with the flow of ventilation air and outdoor temperature (Hald et al, 2008). The Camcon questionnaire revealed that a large number of different ventilation systems are used in the participating countries and showed that even on the same farm, different systems are used in different houses. It is unlikely, given the large variety in data, that it will be possible to identify which type of ventilation system, if any, could be associated with an increased or reduced risk of *Campylobacter* infection.

Several studies have identified the presence of other farm animals at the broiler farm as a risk factor for *Campylobacter* colonization of broilers (Bouwknegt et al, 2004, Ellis-Iversen, 2009, van de Giessen et al, 1996, Nather et al, 2009). One study found the presence of animals other than chickens to be a risk factor on farms without a hygiene barrier (Hald et al, 2000), while another study indicated the presence of domestic livestock at the farm to be a protective factor (Guerin et al, 2007). Studies have also identified farms with poultry (Berndtson et al, 1996,) or other animals nearby as a risk factor (Bouwknegt et al, 2004). Results of one study specifically pointed at a distance of less than 2 km to the nearest pig farm as being a risk factor (Lyngstad et al, 2008). In another study of 15 farms, matching genotypes of *Campylobacter* were found in cattle, pigs and laying hens and subsequently found in broilers from the same farm

and in one case genotypes found in broilers were subsequently found in cattle (Zweifel et al, 2008). On the farms, participating in the Camcon survey, only few farms (less than 7%) had other poultry on the farm. For other types of production animals, these were much less frequently found on the Polish and Spanish broiler farms compared to farms in the other participating countries. Concerning animals on neighbouring farms, quite clear variation could be observed. For poultry, many more farms in Poland had neighbouring farms with poultry than in other countries and in the United Kingdom a higher percentage of farms had cattle or sheep in the close vicinity of the broiler farm than any other country.

The Camcon survey also provided details as to the source of drinking water, and how the water was treated. The majority of farms used mains and/or boreholes as the source of drinking water. However, the methods of treating drinking water varied between countries, as did the percentage of farms using additives to the water. The use of chemical treatment of the water was more widespread in the Netherlands, Spain and the United Kingdom than in other countries. In Norway the use of UV-treatment is common. Results of several studies have indicated that use of chlorinated (Ellis-Iversen et al, 2009), official or officially treated drinking water (Guerin et al, 2007) have a protective effect compared to using undisinfected water or water from a private source (Kapperud et al, 1993, Lyngstad et al, 2008). On the other hand, results from France (Refregier-Petton et al, 2001) indicate that acidification of drinking water is a risk factor for colonization with *Campylobacter,* possibly because the use of acidification reflects poor quality of the drinking water in general. Since there are specific differences in how the water is treated, the risk factor analysis may allow not only a comparison of treated and non-treated water, but also a comparison of the increased/reduced risk associated with chemical versus physical treatment of drinking water.

In conclusion, the data generated by the survey have provided a detailed and useful insight into conventional broiler production in the participating countries and several differences in management practices were observed. A number of the observed differences may reflect the different structures within the national productions, such as the extent of integration between farms and broiler companies. However, the observed differences may also be a reflection of the differences in strategies applied for reducing *Campylobacter* in broilers in the participating countries. It will be of great interest to see if the results of the future Camcon risk factor study will provide new insight into importance of the management of farms and the implementation of, official action plans in the context of infecting broiler flocks with *Campylobacter*. Furthermore, it will be interesting to see how the different climatic conditions in the participating countries affect the risk of introducing *Campylobacter* into broiler flocks.

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LINKS

The European Commission (EU): http://ec.europa.eu/
The European Food Safety Authority (EU): http://www.efsa.europa.eu/
The European Centre for Disease Prevention and Control (EU): http://ecdc.europa.eu/
Association of Poultry Processors and Poultry Trade in the EU Countries: http://www.avec-poultry.eu/
World's Poultry Science Association: http://www.wpsa.com/
The International Poultry Council: http://www.internationalpoultrycouncil.org/
The Danish Agriculture and Food Council (DK): http://www.agricultureandfood.dk/
Danpo A/S (DK): http://www.danpo.dk
Rose Poultry A/S (DK): http://www.rosepoultry.com/
Product Boards for Livestock, Meat and Eggs (NL): http://www.pve.nl
Nortura (NO): http://www.nortura.no/?lang=en_US
Assured Food Standards (UK): http://www.redtractor.org.uk/
Vion Food Group LTD (UK): http://www.vionfood.co.uk/
Pollastre Groc Catalá (ES): http://www.pollastregroccatala.cat/

APPENDIX I
Questionnaires