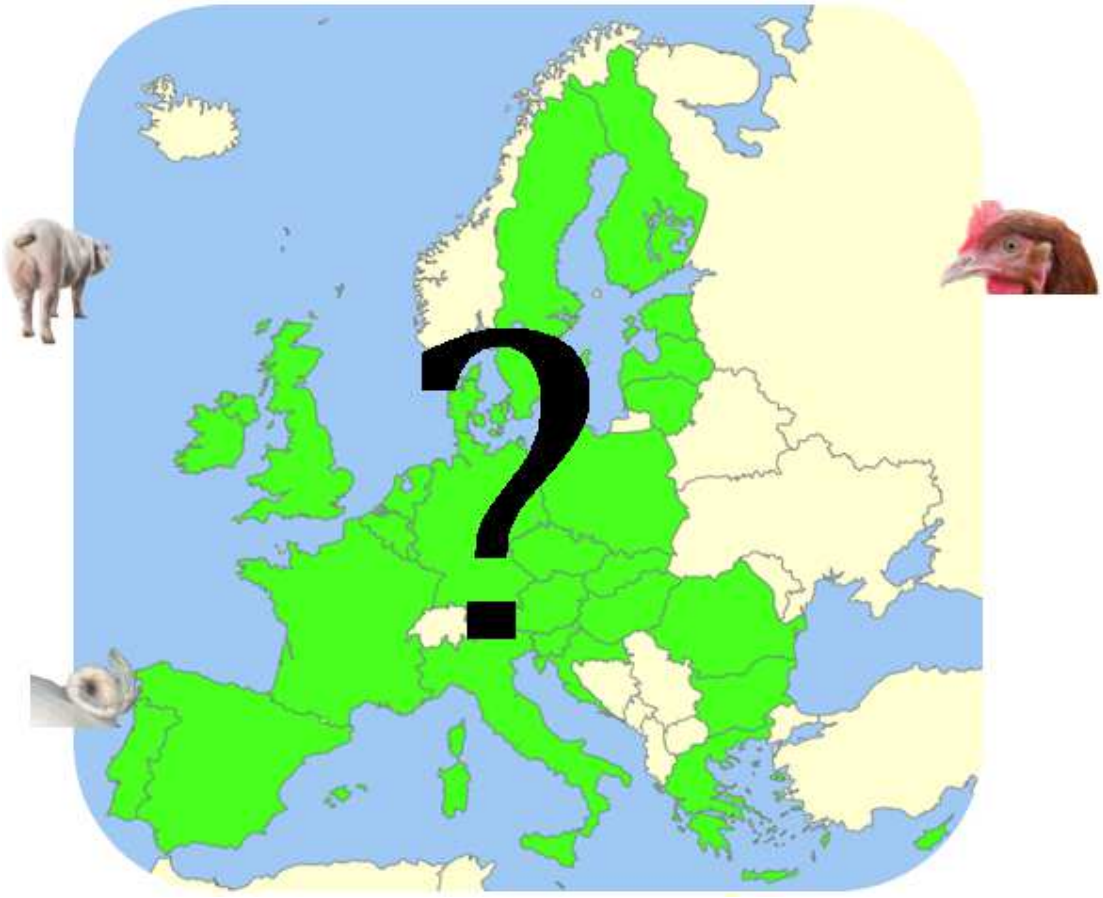
Which of the European member states have the potential to join the four front-runners?

The European member states that have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce surgical castration of male pigs, tail docking of pigs and beak trimming of laying hens within the European Union



Thesis
S.E.J. van Zanen
March 11, 2016
Adaptation Physiology Group
Wageningen University & Ministery of Economic Affairs

Which of the European member states have the potential to join the four front-runners?

The European member states that have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce surgical castration of male pigs, tail docking of pigs and beak trimming of laying hens within the European Union

Thesis

Author: S.E.J. van Zanen
Registation number: 920715983070
Course code: ADP-80439 (39ECTS)
Supervisor: Bart Gremmen
March 11, 2016
Adaptation Physiology Group
Wageningen University & Ministery of Economic Affairs

Disclaimer:
This is a graduation thesis and an advice written by a graduate student of Wageningen University commissioned by the Ministry of Economic Affairs. The conclusions in this thesis do not necessary reflect the official opinion of the Ministry of Economic Affairs.

Foreword

"Time flies when you're having fun"

I would like to thank my supervisors Eric van der Sommen (ministery of Economic Affairs) and Bart Gremmen (Wageningen University) for their great tips and instructions during my study. Thanks to your positive and stimulating but challenging supervision, I was able to get the most out of myself. It was not always easy for me to switch roles between the ministery and the university, but thanks to you it has never become a problem. Furthermore, I am extremely grateful for having had the opportunity to work with the team of 'DAD Landbouwhuisdieren' of the Ministery of Economic Affairs. An inspirering, trustworthy and knowledgeable team. You welcomed me with open arms and gave me the opportunity to develop skills related to policy-making, thank you. Finally, I would like to thank my boyfriend Benedict Arens. You have been very understanding, helpful and patient along this period, thanks a lot.

Kind of regards,
Sanne van Zanen

Wageningen, March 2016

Executive summary

In order to get animal welfare higher on the European agenda The Netherlands, Germany and Denmark reached an agreement on several animal welfare related mutilations in 2014. Sweden joined the trilateral agreement in 2015. It is expected that by means of a joint European approach the biggest win for improving animal welfare can be reached within the European context. The main *research question* in this study is: which European member states have the potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden in order to reduce surgical castration procedures in male pigs, tail docking procedures in pigs and beak trimming procedures in laying hens? Other research questions are about the influence of the individual member states in the European Union and the key success factors and the biggest obstacles in realizing a reduction of each of the three mutilations within several geographic regions.

This study starts with a desk research that sketches the concept of animal welfare across the European Union. The result is a framework of factors that influences the importance attached to animal welfare and is used to explain the results of the following two studies within the broad concept of animal welfare across the European Union. A second desk research focuses on retrieving in-depth information on the current situation of the member states regarding the three mutilations. Thirdly, a questionnaire was set up to get insights into which actions have the greatest chance of success and what are the biggest obstacles in reducing the number of mutilations in animals. The questionnaire was spread, by means of an introducing email, to scientific researchers, veterinarians, policy makers/officers, NGO's, employees in a slaughterhouse, farmers and students across the European Union. In total 130 respondents filled out questions about at least one of the three mutilations across 16 member states (Cyprus, Bulgaria, Greece, Luxembourg, Latvia, Czech Republic, Hungary, Estonia, Lithuania, Malta, Romania and Slovenia have not taken part in the questionnaire).

Germany, France, Italy and the United Kingdom are the most influential member states within the European Union. Furthermore, these member states, together with the Netherlands, Denmark, Spain and Poland are the biggest egg and pig producing states and or the greatest exporting countries of porkmeat.

A legislative approach by the national government is seen by each geographical region as the most successful factor for reducing the number of surgical castrated pigs, except the central European region (remains unknown). The majority of the pigs raised in the United Kingdom, Ireland, Spain and Portugal are entire boars. In contrast to these member states, the restrictions imposed by the Parma ham industry force the Italian pig market (and small parts of the Spanish and Portuguese pig production) to slaughter their pigs at heavy weights, which makes surgical castration the most desired option. Consequently, the restrictions imposed by the Parma Industry and the sensitivity for boar taint are the biggest obstacles for reducing surgical castration for the Mediterranean region. The Eastern European and Central European region do also nearly all surgically castrate their pigs and consider the restrictions imposed by the Parma Industry and or boar taint sensitivity as an obstacle(s). The Northern European and Scandinavian regions have already made some efforts on reducing the number of surgical castration practices by means of non-legislative initiatives. However, the biggest problem for realizing a complete stop in these regions (and an additional problem of the Central and Eastern European regions) is related to the absence of (inter)national acceptance of non-castrated pigs or immunocastrated pigs, which is crucial for these

exporting countries. Consequently, on-line detection methods on the slaughter line of boar taint is of high importance. It is suggested that the United Kingdom has the highest potential to be a coalition partner of the Netherlands, Germany, Denmark and Sweden in order to reduce the number of surgical castrated pigs within the European Union.

The majority of the geographic regions consider a legislation approach by the national government as the most successful factor for realizing a reduction of tail docking of pigs. The Central European region is an exception, because they think of a wholesale price increase by retailers as most succesfull. Tail docking of pigs is forbidden by national law in Sweden, Finland and Lithuania. The Northern European region does carry out this procedure on pigs, but an increasing number of legislative and non-legislative initiatives within this region show the urgency of phasing out this mutilation. The other European regions raise also pigs with docked tails, but no active initiatives could be found that aim for a reduction of this procedure. These regions consider a lack of political interest and or consumer willingness to pay for more animal friendly products as obstacles for realizing a reduction. Moreover, each region considers large stocking densities of groups of pigs, floor type of housing system used and absence and or insufficient enrichment as animal-production based obstacles for realizing a reduction of tail docking. It is expected that Finland has the highest potential to be a coalition partner of the Netherlands, Germany, Denmark and Sweden in order to reduce the number of tail docking procedures in pigs within the European Union.

The Mediterranean region considers a legislative approach by the national government as the factor with the greatest chance of success in realizing a reduction of beak trimming procedures (Northern- and Eastern European regions remain unknown). The Central European region considers the influence of large multinationals as most successful. Furthermore, the questionnaire results of the Eastern European region could not be used, it is expected that this region is not ready (yet) to reduce the number of beak trimming procedures. Beak trimming of laying hens is already forbidding in Sweden, Finland, Austria and Denmark either by means of national legislation or as a voluntary ban by the poultry sector. Legislative and non-legislative initiatives aim for a stop in the near future or a reduction of beak trimming procedures within the Northern European region. The other regions do not show a sense for urgency of reducing beak trimming of laying hens. A lack of willingness to pay of consumers and political interest are seen as obstacles for reducing beak trimming within these regions. Furthermore, the husbandry systems of these regions are not ready yet to raise hens with intact beaks, because large stocking densities, breed and the housing system used are seen as the most frequent additional obstacles. Austria and Finland are suggested to have the highest potential to be coalition partners of the Netherlands, Germany, Denmark and Sweden in order to reduce the number of beak trimming procedures in laying hens within the European Union.

Table of contents

1. General introduction

The concept of animal welfare gets more and more attention in the European society. The increased attention can be explained by the fact that over the years the role of animals has changed in society. European consumers considered animals as a way to produce food, which changed to the idea that animals are important to fulfill other key social goals like, among others, food safety, sustainability, and the treatment of animals in a proper way (Fraser, 2005; Horgan & Gavinelli, 2006; European Commission, 2007; Kjærnes, 2007; Blokhuis et al., 2008; Phillips et al., 2012). Moreover, the development of having a pet as a companion animal instead of a farm animal has also contributed to the increased attention for animal welfare (Hopster, 2008). A second explanation for the rising attention is the increased level of concern for animal welfare by European consumers (Roex & Miele, 2005; European Commission, 2007; Kjærnes et al., 2007; Napolitano et al., 2010; Phillips et al., 2012). Results from a survey held among European citizens, show this increased level of concern. TNS Opinion & Social conducted this survey; they have interviewed 29.152 European citizens in 25 member states (Bulgaria, Romania and Croatia were not yet part of the European union in 2007)(European Commission, 2007). The majority of the European respondents (60%) believed that animal welfare has improved in their country in the last 10 years. However, 48% of these respondents said that the changes made are only a slight improvement. Additionally, the protection of farm animal welfare needs to be further improved according to 77% of the respondents (European Commission, 2007). The recent disease outbreaks (e.g. avian influenza and foot-and mouth disease), the negative effects of intensive farming combined with an increasing wealth of western countries have contributed to more concern (Horgan & Gavinelli, 2006; Broom & Fraser, 2007; Blokhuis et al., 2008; Napolitano et al., 2013).

As a consequence, several governments of European member states devote more of their time on animal welfare. An example of governmental efforts on animal welfare is the animal welfare conference that was held in the Netherlands in December 2014. The Netherlands, Germany and Denmark are front-runners when it comes to animal welfare. For this reason, the conference, organized by the Netherlands, was held in collaboration with Germany and Denmark (Bhikhie, 2014; S.A.M. Dijksma, personal communication, December 14, 2014). The aim of this conference was to get animal welfare higher on the European agenda. Consequently, the three countries reached an agreement on, among others, several animal welfare related mutilations (Sweden joined the trilateral agreement in 2015) (Joint declaration, 2014; S.A.M. Dijksma, personal communication, December 14, 2014). According to the Raad voor Dieraangelegenheden (2013), mutilations are:

"physical modifications, often carried out by means of surgery" (RDA, 2013, p.1)

Significant body parts of animals are cut off or measures are taken to prevent it from growing, like tail docking of pigs and beak trimming of laying hens (EFSA, 2007a; RDA, 2013). Sharon Dijksma (former state secretary of the Dutch Ministry of Economic Affairs) explained the importance of the conference by saying: "Europe is not putting enough effort to promote animal welfare in the European Union" (Bhikhie, 2014, p.1). This study was set up as a result of the animal welfare conference.

The Ministery of Economic Affairs expects that by means of a joint European approach the biggest win for animal welfare can be reached, and as a result the ultimate goal of improving animal welfare in the European context. In order to succeed in this, several

approaches can be used to influence this process of lifting the importance of animal welfare to a higher European level (Ministerie van Economische Zaken, 2015). First of al, The Netherlands has taken over the role of European Presidency of the European Union of Luxembourg during the first half of 2016. However, this position in the European Union mainly involves leadership aspects and requires an objective attitude and a neutral position. Furthermore, the European agenda for the Dutch European Presidency period was already more or less determined (no agenda-points on animal welfare are considered on this agenda) before the presidency period started. Additional ways of influencing the European agenda is by means of other parties (e.g. non-governmental organizations like: Eyes on Animals, CiWF or Copa-Cogeca) or the 'sidekick-event' (conference) on animal welfare. The Eurogroup for Animals will hold this conference in March 2016 (Ministerie van Economische Zaken, 2015). The results of this study will be used by the Dutch delegates during the 'sidekick-event' (conference) about animal welfare. The Eurogroup for Animals is the leading animal welfare organization at European level, not only for animals kept in homes, laboratories and farms, but also the animals living in the wild (Eurogroup for Animals, 2015). The conference will focus on production related mutilations (for example prohibition of or stricter measures for tail docking of pigs and beak trimming of laying hens) in order to improve the welfare of animals. All member states will be invited to this conference.

It is currently unknown which European member states are willing to join the Netherlands, Germany, Denmark and Sweden, in order to increase the importance of animal welfare in the European Union. However, for a successful joint European approach it is of high relevance to know this. For this reason, the outcome of this study can be used during the sidekick-event (conference) by the Dutch delegates. The results of this study relate to which European member states are potential coalition partners that can lift, together with the Netherlands, Germany, Denmark and Sweden, the importance of animal welfare to a higher European level. However, animal welfare is a very broad concept (Cohen et al., 2009). For this reason, this study will focus on the following mutilations throughout the European Union:

1. Surgical castration of male pigs
2. Tail docking of pigs
3. Beak trimming of laying hens

During a meeting with Wageningen UR, the ministery of Economic Affairs and a representative of De Dierenbescherming and the Eurogroup for Animals it was decided that these three mutilations should be the focal point of this study. The decision was based on the current national political interest, initiatives and media attention across the European Union (personal communication, September 8, 2015).

This leads to the main research question of this study:

Which European member states have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce the following three mutilations within the European Union:

1. *Surgical castration procedures of male pigs?*
2. *Tail docking procedures of pigs?*
3. *Beak trimming procedures of laying hens?*

The following sub questions will also be addressed in this study:

1. *Which member states have the most influence in the European Union?*

2. *What is the key success factor for reducing the procedures of surgical castration with or without the use of analgesia and or anesthesia in male pigs in each geographic region?*
3. *Which of the two factors form the biggest obstacles in realizing a reduction of the procedures of surgical castration with or without the use of analgesia and or anesthesia in male pigs in each geographic region?*
4. *What is the key success factor for reducing tail docking procedures of pigs in each geographic region?*
5. *Which of the two factors form the biggest obstacles in realizing a reduction of tail docking procedures in pigs in each geographic region?*
6. *What is the key success factor for reducing beak trimming procedures of laying hens in each geographic region?*
7. *Which of the two factors form the biggest obstacles in realizing a reduction of beak trimming procedures in laying hens in each geographic region?*

It is important to mention that this study will look at two types of factors, namely: country-based factors and animal production based factors. From a scientific point of view, it is interesting to look at the interpretation of the success factors and obstacles. It is hypothesized that countries of Northern Europe are more likely to become a coalition partner to reduce the number of mutilations on animals compared to countries in Southeastern Europe. This expectation is based on the assumption that Northern European countries tend to consider animal welfare of more importance than Southeastern European countries do (European Commission, 2007).

As a result of the forenamed conference on animal related mutilations, it might be possible to create a joint declaration on animal welfare, which will make it easier to get specific mutilations in respect to animal welfare on the agenda of the Dutch European Presidency period. As a consequence, the specific mutilations will get appropriate attention on the European level. Ultimately, this can lead to a 'standard' of laws and regulations concerning specific mutilations in order to improve animal welfare in the European Union.

2. Theoretical background

The following three paragraphs concern background information on the concept of animal welfare, ways to improve the welfare of animals (by means of implementing legislation and or non-legislative initiatives) and the concept of animal welfare across the European Union. The background information was retrieved by means of a literature study. Scientific papers found on Wageningen UR Library and PubMed were used. This information will contribute to answer the research question, because the results found in this study (Chapter 4) can be placed in the context of animal welfare across the European Union.

2.1 Concept of animal welfare

The general introduction made clear that animal welfare is of increased importance in Europe. However, animal welfare is a complex concept. This can be explained by the varying interpretations and values between individuals regarding this concept. The variation can be explained by differing cultures and religions (Cohen et al., 2009; Kupper, 2009). Additionally, the context of which an individual is in is also of high influence (Knight et al., 2003; Kupper, 2009). Knight et al. (2003) have shown that an individual is able to adapt its values to the context. Additionally, values are created by several factors like: education, science, legislation, religion and culture (Fraser, 1999). Furthermore, the values that individuals have vary in time and are dynamic (Cohen et al., 2009). As a consequence animal welfare is interpreted in multiple ways, which makes it difficult to define (Fraser, 2008; Ohl & van der Staay; 2012).

Several researchers have defined animal welfare. According to Ohl & van der Staay (2012) the welfare status of an animal is in between a negative (bad) welfare status or on a positive (good) welfare status. Secondly, the Brambell Committee defined animal welfare by formulating the five freedoms:

1. Freedom from hunger, thirst or inadequate food
2. Freedom from thermal and physical discomfort
3. Freedom from injuries or diseases
4. Freedom from fear and chronic stress
5. Freedom to display normal, species-specific behavioral patterns.

These five freedoms include aspects that need to be met in order to have a positive welfare state (Brambell Committee, 1965). Worldwide the five freedoms still serve as basis for a positive animal welfare state, for example the European Union uses the freedoms (Ohl & van der Staay; 2012; European Commission, 2014). However, the five freedoms do not take into account that animals have developed the ability to adapt and to cope with a changing environment over the years (Ohl & van der Staay; 2012). Furthermore, the five freedoms focus on negative aspects of animal welfare (Ohl & van der Staay; 2012; McCulloch, 2013). Consequently, Spruit et al. (2001) consider also the positive aspect of animal welfare:

> "Welfare is defined as the balance between positive (reward, satisfaction) and negative (stress) experiences or affective states." (Spruit et al., 2001, p.159)

Moreover, according to the Farm Animal Welfare Council (2010) the five freedoms are formulated as ideals for animal welfare. As a consequence, it does not involve specific guidelines that show when the status of the welfare is acceptable and when it is not, making it a fixed framework (McCulloch, 2013; Farm Animal Welfare Council, 2010). A more flexible way to define animal welfare is thought of by Fraser (1997).

He developed three perspectives of animal welfare (Fraser, 1997):

(1) Animals should lead natural lives through the development and use of their natural adaptations and capabilities (natural-based)

(2) Animals should feel well by being free from prolonged and intense fear, pain, and other negative states, and by experiencing normal pleasures (feeling-based)

(3) Animals should function well, in the sense of satisfactory health, growth and normal functioning of physiological and behavioral systems (functional-based).

This study will use the definition of animal welfare of Fraser (1997). Animal welfare is considered as a combination of natural living, affective state and biological functioning, but they change according to the context of the animal.

2.2 Three ways to enhance the welfare of animals

Legislation set by the European Union, national legislation or initiaties set by the private sector are three distinct ways that are most frequently used to enhance the welfare of animals. Each of the three will be discussed in the following three subparagraphs.

2.2.1 Legislative procedure of the European Union

The legislative procedure of the European Union consists of three main institutions, namely: the European Commission, European Council and European Parliament. A team of 28 European commissioners (one from each member state) forms the European commission; as a result they make sure that the interest of the whole European Union is taken care of. The European Council includes government ministers from each of the 28 European member states. Consequently, the council is the voice of the individual member states. The final decision-body, European Parliament, looks after the interest of the European citizens. The parliament consists of 750 members and one president, which are chosen by means of European elections each five years (Veissier et al., 2008; European Parliament, 2013; European Union, 2015a).

The decision-making procedure of the European Union, as is illustrated in Figure 2.1, can be divided into two phases. First of al, the 'ordinary legislative procedure' starts with a legislative initiative by the Commission, which will be send to the Council and Parliament. The Commission turns to stakeholders like non-governmental organizations, local authorities and expert groups for information and advice on new initiatives. These groups are called the voices of the European Union. Moreover, an impact assessment is set-up and the public is also allowed to express their opinion by means of a website on public consultations. As a result, the initiative is an interplay between the Commission, the voices of the European Union and the public. Additionally, in this way the Commission meets the needs and wishes of the interested parties and the information received will increase the value of the proposed initiative. However, a new initiative needs to be founded on a treaty. As a consequence, in case the involved policy area of the new initiative is not mentioned in a treaty, the commission is not able to request for new legislation in that particular area. The council and parliament review the proposed initiative and after acceptance and notification the new law applies to all inhabitants of the European Union. However, this process takes time due to possible rejections or amendments made by the council and parliament (European Parliament, n.d-a). Generally, the new legislation involves rather broad principles and goals than strict guidelines (Veissier et al., 2008). For this reason, the secondary law is involved to achieve the objectives set by the new legislation by means of different types of legal acts

(Veissier et al., 2008; European Union, 2015a). These legal acts are: regulations, directives, decisions, recommendations and opinions. The acts are not all binding in terms of legislation and do not have to be implemented in every member state (Veissier et al., 2008; European Union, 2015b). For example, a regulation is binding for each member state, while a decision is only binding for the member state (or company) to which it refers to. Moreover, a directive is not binding, but the European Union has set out a particular goal that needs to be met by the individual member states. However, the member states are free to choose how they do it (Veissier et al., 2008; European Union, 2015b). As a result, multiple interpretations of the same directive are implemented in the national legislation of Member States (de Simone & Serratosa, 2005; Veissier et al., 2008). The final two legal acts, recommendations and opinion, are not binding, nor is it addressed to a particular country. It is often used as a way to express an opinion of the European institutions (European Union, 2015b).

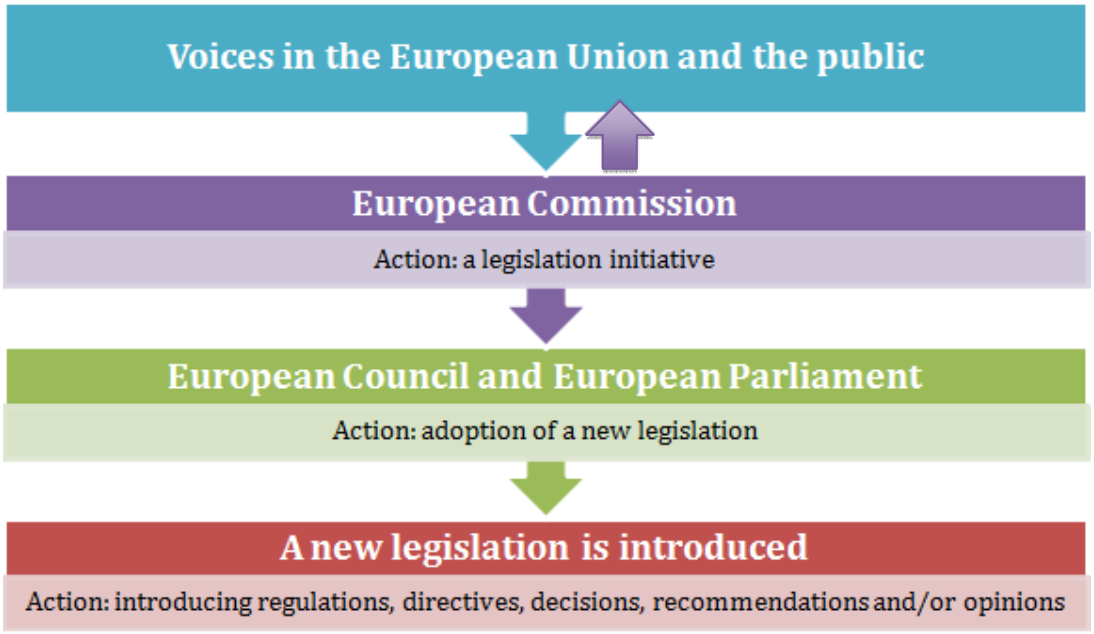


Figure 2.1. Decision-making procedure of the European Union.

2.2.1.1. Responsibilities of the member states and the Commission

As is previously described, member states are responsible to correctly implement directives for the European Union in the national legislation. Furthermore, they need to make sure that the legislation is properly executed by means of control activities. The Commission checks whether the member states have implemented the new legislation in a correct way. Additionally, they need to provide information on how the introduced legislation can be implemented (Horgan & Gavinelli, 2006; European Commision, 2015).

2.2.1.2 Influence of individual European member states

The treaty of Lisbon defines the number of seats each member states can nominate in the European Parliament. The number of members is based on the population in each country and is defined by degressive proportionality. This concept involves two principles. First of al, a country with a larger population will get more seats compared to a country with a smaller population. Secondly, more citizens will be represented by one seat in a country with a large population compared to a country with a small population (Florek, 2012). Consequently, Malta holds one seat for every 69.352 inhabitants where Germany has one seat for every 852.539 inhabitants (European Parliament, 2013).

Germany has the most (96) members in the European Parliament. Second in line are France, The United Kingdom and Italy with respectively 74 and twice 73 members in the parliament (European Parliament, n.d.-b).

2.2.1.3. Legislation set by the European Union regarding animal welfare

The European Committee has worked on improving the welfare of farm animals for over 40 years. In 1998 an important step was made when introducing the protocol for a better protection of animals kept for farmer purposes. This protocol, named as the Council Directive 98/58/EC, involved general rules about the production of wool, skin, fur or food or other farming purposes (European Commission, 1998; European Commission, 2014). Important to mention is that these rules are derived from the five freedoms of Brambell and are still active as minimum standards for the European legislation on animal welfare (de Simone & Serratosa, 2005; Horgan & Gavinelli, 2006; Napolitano et al., 2010; European Commission, 2014). The years after introducing the general protocol, more European rules were created for specific animal categories, like: laying hens, pigs and calves (European Commission, 1999; European Commission 2008a European Commission, 2008b; Napolitano et al., 2010). More recently, in 2009 the treaty of Lisbon started to perceive animals as sentient beings (de Simone & Serratosa, 2005; Horgan & Gavinelli, 2006; European Commission, 2007; Napolitano et al., 2010; European Commission, 2014). Legislation set by the European Union regarding the performance of mutilations on animals is limited, which is why other ways are used to introduce more stricter regulation or a ban on procedures, like: beak trimming of laying hens.

2.2.2. National legislation

Legislation set by the European Union involves minimum standards regarding the welfare of animals. Additionally, as is mentioned before, a legislation that is introduced by means of a directive involves general principles. Consequently, national governments are allowed to make the legislation stricter and or can give their own interpretation in the directive (de Simone, 2005). This can result in a new national law that is only binding for own inhabitants unless the laws are notified and accepted in European Union (e.g. tail docking of pigs is forbidden in Sweden, while it is allowed in the European Union (EFSA, 2014)). However, the room for own interpretation leads to multiple ways of how a directive is implemented in the European Union. This makes it difficult to realize a common standard for animal welfare across the entire European Union (de Simone, 2005).

2.2.3. Non-legislative initiatives

A third frequently used method to enhance the welfare of animals, by creating stricter measures for welfare, is by means of initiatives proposed by private sectors. The involved sector, non-governmental organizations and retailers could launch these initiatives. Sometimes they join forces and form collaborations. These collaborations could even include a governmental agency, like: Werkgroup Krulstaart, which will make the initaitive a combination of a non-legislative and legislative initiative (de Simone & Serratosa, 2005; Veissier et al., 2008; Werkgroup Krulstaart, 2013). Werkgroep Krulstaart aims for a ban of tail docking in the Netherlands, which is a collaboration with the ministery of Economic Affairs, pig sector, research institute and an animal welfare organization (Werkgroup Krulstaart, 2013).

2.3 Concept of animal welfare across the European Union

2.3.1 Differences in the European Union

Animal welfare has increased in level of importance by European countries. However, the countries differ in the extent to which they consider animal welfare as important and will be discussed in this chapter (European Commission 2007; Kjærnes et al., 2007; Philips et al., 2012; Ghione et al., 2013; Kallas et al., 2013). TNS Opinion & Social conducted a survey on the attitudes of European citizens towards animal welfare, which was commissioned by the European Union in 2007. They interviewed 29.152 European citizens in 25 member states (Bulgaria, Romania and Croatia were not yet part of the European union in 2007) (European Commission, 2007). The main results regarding the question 'how important is it to protect the welfare of farm animals?' that was used as an indicator for the matter of importance of animal welfare by the member states are illustrated in Table 2.1. The Table illustrates the member states that are of most interest for this study. Table 2.1 is based on the study of European Commission (2007).

Table 2.1. Overview of how much importance is attached to animal welfare by some of the member states.

European member state	Importance attached to animal welfare on a scale of 1 to 10*
Sweden	9.0
Finland	8.7
Malta	8.7
Greece	8.6
Denmark	8.6
Germany	8.1
Portugal	8.0
France	7.8
Italy	7.8
United Kingdom	7.8
Austria	7.7
Belgium	7.7
Netherlands	7.6
Czech Republic	7.5
Hungary	7.3
Lithuania	6.9
Spain	6.9

*1: 'not at all important' and 10: 'great importance'

European Commission (2007) has concluded that mainly Scandinavian and Northeastern Mediterranean countries consider animal welfare of great importance. On the other hand, Eastern European countries and Spain score the importance of animal welfare as relatively low compared to Scandinavian and Northeastern Mediterranean countries (European Commission, 2007). Moreover, Philips et al. (2012) have explored the attitudes of European and Asian students on animal welfare and rights. They have found that Macedonia and Serbia consider animal welfare as an important issue and show to have concerns about animal welfare (respectively 87,6% and 85,4% of the respondents) (Philips et al., 2012). This is in line with the results of European Commission (2007), indicating that Northeastern Mediterranean countries consider animal welfare of high importance (European Commission, 2007; Philips et al., 2012). The results of a more recent research of Ghione et al. (2013) on meat

consumption and welfare of animals in the European Union, shows similar results to the survey conducted among the European citizens in 2007 (European Commission, 2007). Animal welfare is of high interest according to Scandinavian countries, and other North European countries, like: the Netherlands, Ireland and Germany. The Netherlands and Ireland agreed to be interested in animal welfare for respectively 99% and 95% of the respondents (percentage of interest of the Scandinavian countries and Germany is unknown). Additionally, Spain and Italy showed to have a much lower interest in animal welfare (respectively 58%, agreed to be interested in animal welfare) (Ghione et al., 2013). Other studies that relate to animal welfare do also confirm the high level of caring for animal welfare by Northern European citizens (Department for Environment, Food and Rural Affairs, 2011; Makdisi & Marggraf, 2011). A study conducted in the United Kingdom showed that 76% of the British respondents think of the importance of producing meat and eggs to high animal welfare standards as 'very/quite important' (Department for Environment, Food and Rural Affairs, 2011). In Germany, results of a survey showed that 85% of German consumers are willing to buy certified farm animal welfare products and the majority of them (95%) are willing to pay extra for these products (Makdisi & Marggraf, 2011). The demand of animal-welfare produced products is expected to confirm the thought of an increased level of concern (Blokhuis et al., 2008; Kehlbacher et al., 2012).

Figure 2.2 illustrates a force field analysis that is made to give an overview of the importance given to animal welfare of the different European member states. A force field analysis is an insightful and decision-making tool and will be explained in detail in Chapter 3 (Sub-subparagrah 3.3.2. "Force field analysis") (Toolkits, 2009). The analysis shows that the Northern European, Southeastern European countries (including Malta) and Portugal consider animal welfare of high importance. However, the Northern European countries have more influence in the European Union compared to Northeastern Mediterranean countries, which is based on the principle degressive proportionality (see Chapter 2: sub-subparagraph 2.2.1.2, "Influence of individual European member states"). Furthermore, Eastern European countries neither considers animal welfare as important, nor do they have much influence in the European Union (except from Poland). Finally, Spain, Italy and France do not attach much importance to animal welfare, but have (especially France) much influence in the European Union due to its large population (Philips et al., 2012; European Commission 2007; Ghione et al., 2013).

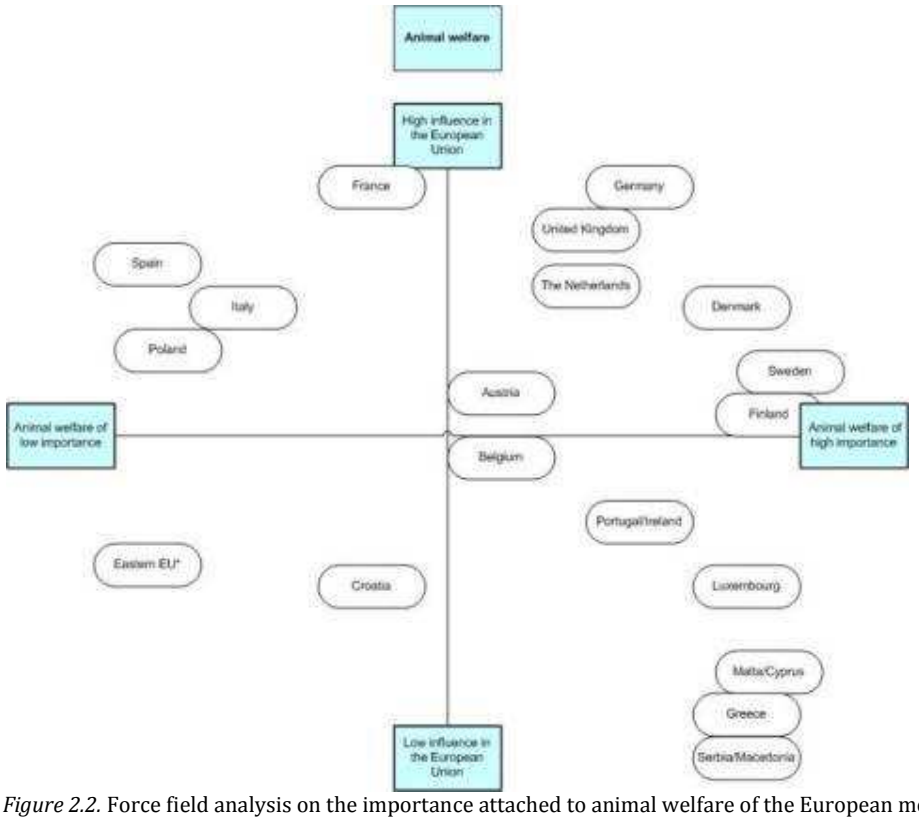


Figure 2.2. Force field analysis on the importance attached to animal welfare of the European member states. It is solely based upon the research of Philips et al. (2012), European Commission (2007) and Ghione et al. (2013). *Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia and Romania.

2.3.2 Framework of factors that influence the importance attached to animal welfare

European member states differ in the extent of importance attached to animal welfare (European Commission 2007; Kjærnes et al., 2007; Philips et al., 2012; Ghione et al., 2013; Kallas et al., 2013). Figure 2.3 provides an overview of several factors that influence the importance given to animal welfare and could be possible explanations for the differences in animal welfare between the European member states.

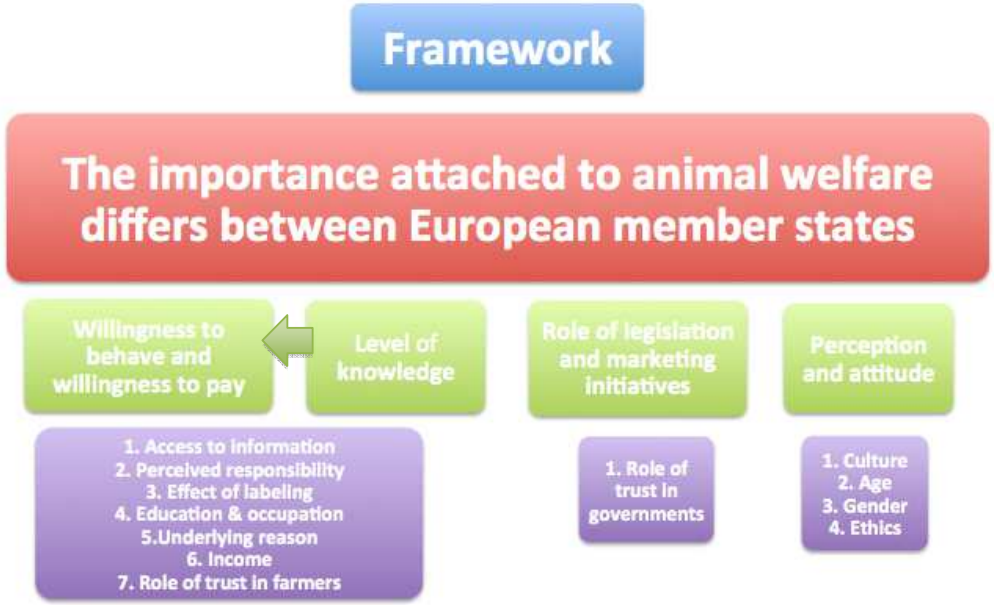


Figure 2.3. Framework of factors that influence the importance attached to animal welfare.

First of all, the behavioral willingness of consumers towards animal welfare produced food products is an important aspect that explains the differences between European member states (Toma et al., 2012). Toma et al. (2012) have concluded that access to information, perceived responsibility, the effect of labeling and education and occupation are factors that have a significant influence on the willingness to behave in a more animal friendly way (Toma et al., 2012). A more detailed overview of these factors can be found in Appendix A. Another factor that possibly influences the behavioral willingness of consumers is the underlying reason of why a citizen buys an animal friendly food product (e.g. food quality or food origin). This has shown to highly differ between countries (Roex & Miele, 2005; European Commission, 2007; Kjærnes et al., 2007). Moreover, the willingness to pay does also indicate the willingness to behave in an animal friendly way and consequently in the importance attached to animal welfare (Lagerkvist & Hess, 2011; Ghione et al., 2013). Lagerkvist & Hess (2011) have found a positive relationship with income and the willingness to pay for farm animal welfare, while a negative relationship was found with age. However, no substantial differences were found in the willingness to pay between countries (Lagerkvist & Hess, 2011).

Not only are the willingness to behave and pay of consumer's important aspects that explains the differences between European member states on animal welfare, but also the level of knowledge (Figure 2.3). It is expected that an increased level of knowledge on animal welfare will enhance the importance attached to it (European Commission, 2007; Toma et al., 2012). Furthermore, the more information is provided, the higher the level of knowledge is and this will in turn influence also the willingness to behave animal friendly (Napolitano et al., 2010; Toma et al., 2012). Access to information, the level of education and living in rural areas are factors that highly influence the level of knowledge of an individual (European Commission, 2007; Toma et al., 2012).

Moverover, the role of trust in farmers and national government are important to consider when it comes to differences between countries. The trust in farmers is important to consider for the benefit of animal welfare, since they are the first in the food production chain and spend much of their time with the animals (Nocelle et al., 2010). Nocelle et al. (2010) has demonstrated that trusting farmers for producing animal friendly products positively influences the willingness to pay for these products. The willingness to pay has already shown to be of influence when it comes to the importance given to animal welfare (Ghione et al., 2013; Lagerkvist & Hess, 2011). The second type of trust, trust in the national government, is important to consider, because it is related to the perceived responsibility for behaving in an animal friendly way. A clear example is Sweden that highly trusts the national government for taking care of legislation concerning animal welfare (Roex & Miele, 2005; European Commission, 2007; Philips et al., 2012). This is understandable, since the national government of Sweden has more stringent legislation introduced for animal welfare on top of the legislation set by the European Union (Mul et al., 2010; D'eath et al., 2014). This shows that animal welfare actions are primarily set by legal regulation and not by means of non-legislative initiatives. As a consequence, the government is hold responsible for taking care of the welfare of animals (Roex & Miele, 2005). Non-legislative initiatives is an other method to enhance the welfare standards in a country, which are frequently used by the Netherlands and Germany. In contrast to Sweden, Italy has a very low trust in the government (Roex & Miele, 2005; Kjærnes et al., 2007; Ghione et al., 2013). Their national government does not set more strict legislation concerning animal welfare on top of the EU-legislation, as is done in Sweden (Fiks-van Niekerk & De Jong, 2007). As a

consequence, this raises the importance that individuals act in animal friendly way, which requires an effort (Roex & Miele, 2005; Kjærnes et al., 2007; Ghione et al., 2013).

Finally, the perception that animals have the ability to feel and to perceive things (animal sentience) and the attitude towards animals do also influence the interest in animals (Figure 2.3). It appears that culture and sometimes gender have an effect on these factors (Philips & McCulloch, 2005). In terms of culture, it appears that importance towards animals differs between animal categories and uses of animals. Moreover, it is possible that females more often attribute sentience to animals compared to male, since they often think of animal welfare as more important than males (European Commission 2007; Vanhonacker et al., 2009; Toma et al., 2012). Similar to females, younger people and households without children often consider animal welfare as more important (European Commission 2007; Vanhonacker et al., 2009; Kehlbacher et al., 2012; Toma et al., 2012). Finally, people that indicate ethical issues as important tend to choice animal friendly products sooner than people who do not consider ethical issues as important (Vanhonacker & Verbeke, 2009).

3. Material and methods

3.1 Desk research

This study has performed two types of research, namely qualitative and quantitative research, in order to find out which European member states have the potential to become a coalition partner of the Netherlands, Germany, Sweden and Denmark to reduce the number of mutilations on animals. It started with a qualitative research, which was performed by means of a desk research. The desk research has focused on retrieving in-depth information, by using existing literature, on getting to know underlying reasons and motivations of certain matters (Verschuren & Doorewaard, 2007). It has tried to gather information by means of a literature study on the following aspects:

1. Animal welfare effects and economic impact of the three mutilations:
    i. Surgical castration of male pigs
    ii. Tail docking of pigs
    iii. Beak trimming of laying hens
2. The current situation of the three mutilations across the European Union

The information was found by means of scientific papers on Wageningen UR Library and PubMed. The desk research has contributed to the answer on the research question, because, it has sketched the animal welfare effects and economic impact of the three mutilations and the current situation of the member states regarding the mutilations. Consequently, it was used as the starting point of this study.

3.2 Questionnaire

3.2.1. Design of the questionnaire

The second type of research that has been performed is a quantitative research. This type of research enables to give information on opinions and attitudes of respondents expressed in terms of a quantity. A questionnaire is a way to perform a quantitative research and was used in this study (Verschuren & Doorewaard, 2007). The questionnaire was set up to obtain data on which actions have the greatest chance of success and which reasons form the biggest obstacles in reducing the number of mutilations in animals. The questions that were asked in the questionnaire can be found in Appendix B. The results, retrieved from the questionnaire, are used to answer the sub-questions (2-7) of this study.

For practical purposes one questionnaire was send out, which consisted of four set of questions: one for each of the three mutilations and demographic variables. The questions of the parts of the mutilations (surgical castration of male pigs, tail docking of pigs and beak trimming of layinghens) were designed in a similar way. These three parts were asked in a randomized order and based on the level of (sufficient) knowledge it was possible to answer a set of questions relating to one of the thee mutilations. First of all, a list of ten actions was shown to the respondent and it was asked if he/she could rank it (1 being the most successful and 10 being the least successful). These actions, like: legislation by the national government or non-legislative initiatives from the sector, were formulated to find out which of them has the greatest change of success in reducing the mutilation in their country. Furthermore, two questions followed to find out what the biggest obstacles are in order to reduce the number of the mutilation in animals. The first question was about several country characteristics, like climate and cultural aspects. The second question was about animal production related aspects, as

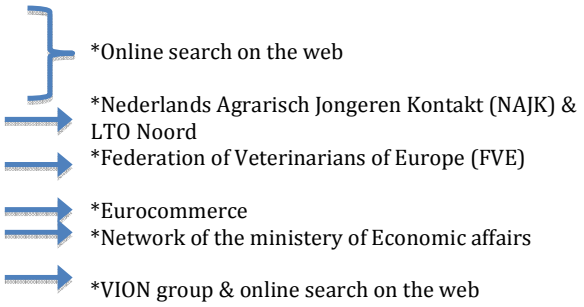
housing system and breeding type of animal used. These questions were assessed by means of a Likert-scale (one to five). The respondent was requested to give a score (very unlikely to very likely) on how they perceive the aspects related to country and animal production in terms of being an obstacle for reducing the practice of the mutilation. Finally, two (tail docking and beak trimming) or three (surgical castration) questions were asked that specifically focused on the husbandry conditions of that particular animal in the country of the respondent. The type of breed of laying hens and pigs, the housing system used for laying hens and the type of flooring of the housing of pigs are some examples of these specialized questions. Finally, the demographic variables (gender, country of residence and profession) were asked to obtain more knowledge about the background of the participant. As a consequence, the demographic part of the questionnaire has made it possible to use the response of the first three parts for the appropriate member state.

Not only consisted the questionnare of closed questions, but also several open questions regarding the opinion of the respondent was asked for. First of all, the respondent was provided a question concerning why or why not he/she thinks it is possible to significantly reduce the mutilation (depending on the part of questions: either surgical castration of male pigs, tail docking of pigs and beak trimming of layinghens) in their country within 3-5 years. Finally, the respondent was asked for what reason he/she ranked or scored the greatest success factor and the biggest obstacle in reducing the mutilation in their country. This final set of questions was used to find the underlying thought of why a respondent filled out the questionnaire in the way he/she did.

3.2.2. Questionnaire sampling

Qualtrics software was used to develop and design this questionnaire. It was spread by means of an introducing email across the European Union. The email was signed by the coordinator of Animal Supply Chains and Animal Welfare, Janny Gooijer, of the Ministry of Economic Affairs and the reseacher of this study Sanne van Zanen. Two reminders were send after the first email. The introducing email can be found in Appendix C. The questionnaire was distributed to the following target groups all over the European Union and different methods were used to find contact details about them:

- Scientific researchers
- Student associations
- Non-governmental organizations
- Farmers
- Veterinarians
- Retailers
- Policy officers and advisors
- Slaughterhouse owners



Twelve European member states did not fill out the questionnaire. Consequently, these countries have not taken part in this study, which are: Cyprus, Bulgaria, Greece, Luxembourg, Latvia, Czech Republic, Hungary, Estonia, Lithuania, Malta, Romania and Slovenia. The remaining 16 European member states have contributed to this study by means of filling out the questionnaire. However, not all of the 16 countries answered the questions regarding each mutilation due to insufficient knowledge. Ireland did only fill out tail docking. Croatia and Poland did fill out the questions regarding tail docking and surgical castration of male pigs, but not the questions regarding beak trimming. Furthermore, several countries have already forbidden the procedure by means of

national legislation or by means of a voluntary ban. Consequently, these countries have only given answer to the questions which succes factor has the greatest chance of reducing the number of the mutilation, to find out how that country was able to stop the practice of the mutilation, and to several questions regarding the housing management and breed used, to know their current husbandry conditions.

Table 3.1 shows that in total 262 respondents started the questionnaire. Nonetheless, 130 of the 262 (49,6%) respondents completely filled out at least one part (surgical castration and or tail docking and or beak trimming) of the questionnaire and could be used for this study. Furthermore, the majority (58,5%) of the respondents are female. Moreover, over half of the respondents (53,1%) are a scientific research, while barely any are employed in a slaughterhouse (1,5%). The questionnaire was not filled out by the retail sector. Figure 3.1 illustrates the total number of respondents and its gender per European member state that have taken part in this study. Most of the respondents are of Dutch (31) of British (29) origin and only one Irish and one Polish respondent have filled out the questionnaire.

In Appendix D an overview of the total number and type (gender, profession and country of residence) of the respondents per mutilation is provided.

Table 3.1. Total number and type of respondents.

Respondents	Total number	Percentage (%)
Questionnaire started	262	
Questionnaire completed	130	49,6
Surgical castration[1]	84	64,6
Tail docking[1]	87	66,9
Beak trimming[1]	73	56,2
Gender[1]		
Male	54	42,5
Female	76	58,5
Profession[1]		
Scientific researcher	69	53,1
Policy officer/advisor	13	10,0
Veterinarian/Veterinary medicine	17	13,1
Student	9	6,9
NGO	8	6,2
Farmer	5	3,8
Employed in a slaughterhouse	2	1,5
Other[2]	7	5,4

[1]Number or percentage of the respondents that completed the questionnaire
[2]Others are: Animal management (University of Applied Science, VHL), Animal welfare advisor, Chemistry, Interest in farming, Independent Consultant on farm animal welfare (with a scientific background), Lecturer and Poultry consultant with significant welfare experience.

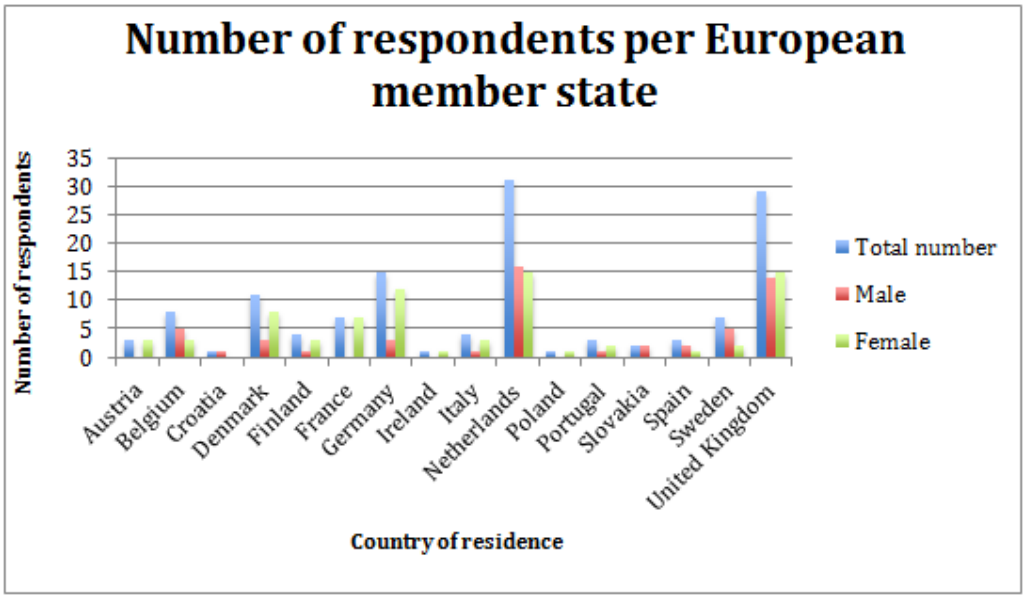


Figure 3.1. Total number of respondents and its gender per European member state.

Figure 3.2 shows the professions of the respondents that filled out the questionnaire per European member state. The French respondents are all scientific researcher, while the respondents of Denmark, Germany, Portugal, Netherlands, Sweden and United Kingdom are highly divers.

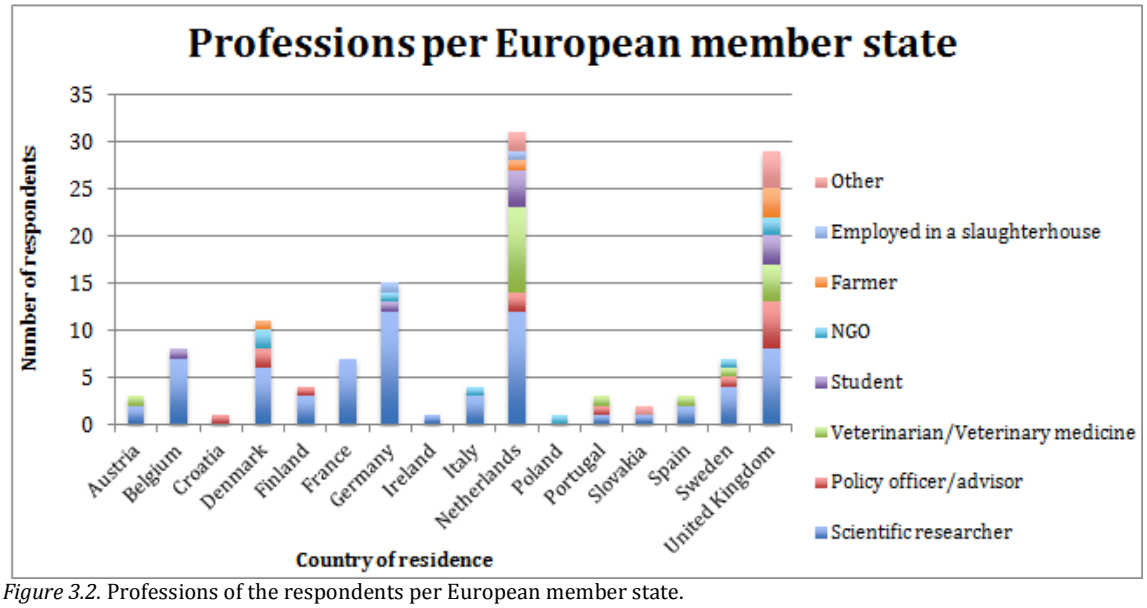


Figure 3.2. Professions of the respondents per European member state.

3.3 Analysis

3.3.1. Descriptive analysis

A descriptive analysis was performed of the results retrieved from the questionnaire. The analysis was performed three times, each time a different filter was used:

1. Country
2. Profesion
3. Gender

The first (country) analysis has focused on the differences between the European Member states, which is important in order to answer the research question of this study. The member states were clustered based on the answers they provided and the demographic region they are in. Figure 3.3 provides an overview of how the European member states, which have taken part in this study by filling out the questionnaire, are clustered in a geographic region. However, the clusters slighlty change between the mutilations (e.g. Denmark belongs to the Northern Scandinavian countries when it comes to surgical castration of pigs and beak trimming of laying hens, but to Northern European countries in tail docking of pigs). The clustering was done to increase the sample size and to make the analysis more clearly. The second and third type of analysis has focused on the results regarding the different professions and genders of the respondents. Research of Toma et al. (2012) has showed that a profession, which is used as an indicator for income, and level of education is of significant influence on the willingness to behave in an animal friendly way. The respondents belong all to one of the seven different types of professions (Table 3.1). A final eight category, named as "others", includes the remaining type of professions (mainly related to a consultant or a lecturer). The differences between the genders is also looked at, since Vanhonacker et al. (2009) has showed that a difference exists between males and females when it comes to the level of concern on animal welfare related issues. Consequently, it is relevant to look at these two demographic variables and will be used for explaining the differences found in the country analysis in the discussion-section.

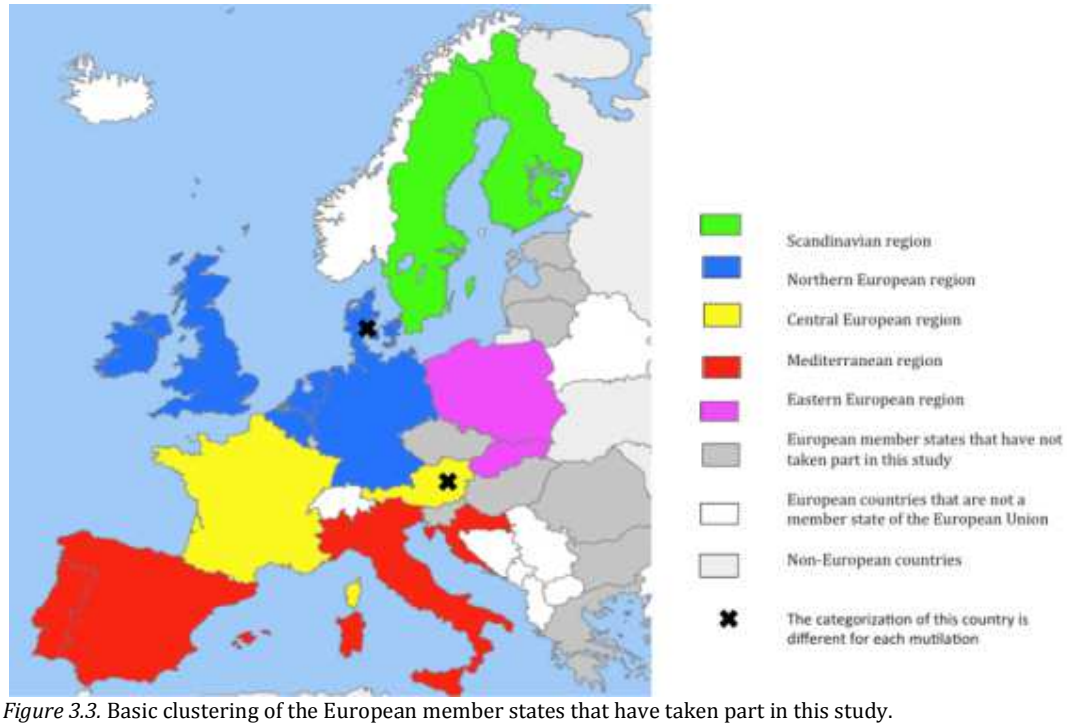


Figure 3.3. Basic clustering of the European member states that have taken part in this study.

Several open questions regarding the opinion of the respondent was asked for and will also be used to declare the results of the country-analysis in the discussion-section.

Each type of analysis has included several steps. First of al, their has been looked at the question if a significant reduction is possible within 3 to 5 years within the country. Since it was a yes/no question and only two option were available, percentages were used to find out if a significant reduction is possible and according to what part of the respondents. This question will be used for explaining the differences found in the country analysis in the discussion-section. Secondly, the success factor with the lowest mean value (a ranking of one to ten, one being the most succesful) is considered as the factor with the greatest chance of success in reducing the number of the procedure. However, it has occurred that more than one success factor is considered, in case when factors had a similar mean value. A ranking scale is quantitative data, but due to the low sample size and variable number of respondents (from 21 respondents in the Netherlands, to 1 in Poland) it is decided to perform a descriptive analysis. Consequently, the mean values of a score of 1,2 or 3 are used for the analysis of the results and are considered as possible succesfactors. The values higher than three are not thought of as factors that succesfully lead to a reduction and will for this reason not be used in this study. Thirdly, a five-point Likert scale (1, very unlikely to 5, very likely) was used to measure the likeliness of a particilar factor, either country-based or animal-production based, for being a obstacle in realizing a reduction of one of the mutilations. A score of three meant: undediced. Thus, a high score showed that the respondent considered that particular factor as likely being an obstacle for reducing the number of that particular mutilation. This study assumes that the physiological distances between the five point-scale is equal (Perloff, 2010). For the analysis of the results retrieved from the Likert Scale, mean values were used (Philips & McCulloch, 2005; Boone, H.N., Boone, D.A, 2012). It is argued that mean values and non-parametric tests are not allowed to be used for nominale data, like: a Likert Scale and ranking scale (Jamieson, 2004). However, Norman (2010) has concluded that parametric tests (e.g. mean values) can be used for Likert Scale data and low sample size data without being afraid of jumping to wrong conclusions. Additionally, Likert Scale data is more and more considered as interval values, which allow the use of mean values (Jamieson, 2004). Since Likert Data is quantitative data, a statistical analysis is normally used (Jamieson, 2004). For this study, the sample sizes are small and variable between member states. Consequently, it is decided to perform a descriptive analysis instead of a statistical analysis A score of 4 and higher is considered as an obstacle in realizing a succesful reduction, because a score of 1 and 2 are unlikely to be an obstacle and a score of 3 meant undecided.

As is mentioned before, the sample size of this study is very low. Consequently, countries are clustered in order to increase the sample size to at least 3 and in turn the external validity of the results. Norman (2010) has argued that the problem of generalization of the results to other situations with small sample sizes (like 2 or 3) is not a matter of statistics, but a matter of judgement. Although, sample sizes are generally low, like Eastern European region, the professions and gender differ between the respondents, which will increase the credibility of the results. It is decided to not discuss the individual countries of the Eastern European region (includes a maximum of three respondents) and countries with only one or two respondents, but considered as a whole (as part of a region, unless remarkable results are found).

Finally, several remaining questions regarding the housing management and the breed of pigs or laying hens used was analyzed by means of percentages. The answer with the

highest percentage was considered as the type of housing system or breed that is most frequently used. However, when the percentages are equal, both are considered as possible. Some respondents have filled out a question (*the most suitable alternative(s) for surgical pig castration and the most frequently used housing system of laying hens*) more than once, since it is possible that more than one housing system and a combination of alternatives for surgical castration are used in a country. Furthermore, similar questions were asked for regarding housing management and breed used in the part of tail docking and surgical castration, consequently the results have been combined. However, it is possible that information is retrieved regarding the questions of tail docking but not to surgical castration, simply because the respondent have filled out only one of the two parts. Moreover, it was chosen for the question that asked for which alternative for surgical castration is most suitable, to only mention one alternative when it had a percentages of at least 30%, if not a combination of several strategies are considered as the most suitable alternatives for surgical castration.

3.3.2. Force field analysis

The information found by means of the literature review together with the analyzed data retrieved from the questionnaire were used for three force field analyses (one for each mutilation). This insightful and decision-making tool is designed by Kurt Lewin in 1951 (Toolkits, 2009). A force field anaylsis visualizes which countries have the highest chance of success in becoming a coalition partner of The Netherlands, Denmark, Germany and Sweden in order to achieve a reduction in the number of that particular mutilation in animals and which countries are not. It shows on the x-as the degree of being pro or against a reduction of the mutilation and on the y-as the influence of a country in the European Union (Toolkits, 2009).

4. Results

The results that are retrieved from the literature study on the three mutilations (surgical castration of male pigs, tail docking of pigs and beak trimming of laying hens) and of the questionnaire will be shown in the following two paragraphs.

4.1 Introduction on the results retrieved from a literature study on the mutilations

In livestock farming many types of mutilations are carried out across the European Union. Mutilations are physical modifications, often carried out by means of surgery. Body parts of animals are cut off or measures are taken to prevent it from growing, like tail docking of pigs (EFSA, 2007a; RDA, 2013). Recently, the European Commission has decided to aim for a ban of surgical castration of pigs in the European Union by 2018 (European Commission, 2015). However, many other mutilations (like beak trimming of laying hens and tail docking of pigs) are still allowed. Mutilations often prevent inappropriate behavior from happening (e.g. sexual behavior of entire boars), while the actual causes of undesired and or abnormal behaviors remain unsolved (e.g. low amount of enrichment material) (RDA, 2013).

The process of prohibiting a mutilation is difficult, because many stakeholders are involved. This leads to intensive debates between proponents and opponents. For example, in livestock farming some mutilations are an integrated part of a farming system. As a consequence, a change in a farming system needs to be made when a mutilation becomes prohibited. This requires some efforts of farmers, which is frequently the reason why farmers are opposed a prohibition (RDA, 2013). Furthermore, it is difficult to determine what is allowed and what is not in terms of modifications to an animal. In 2013, the RDA developed an assessment tool that clearly shows, by means of four logical steps, which mutilations are allowed and which ones should not. The first three steps are based on factual decisions, while the fourth step ethical values are of importance (RDA, 2013).

As is mentioned in the general introduction the focus of mutilations of this study will be on:

1. Surgical castration of male pigs
2. Tail docking of pigs
3. Beak trimming of laying hens

In the following subpragraphs a brief overview of each of the three mutilations will be given. These overviews are based upon an extensive literature research carried out on these mutilations, which can be found in the Appendices E-G.

4.1.1 Surgical castration of male pigs

Surgical castration of male pigs is commonly (about 70-80%) performed in the European Union (EFSA, 2004; FCEC, 2015). This procedure is done to eliminate boar taint (> 99% of the cases) in male pigs. Boar taint has a negative influence on the quality of meat of male pigs due to its odor and taste. However, the performance of surgical castration has implications for the welfare of male pigs (Fredriksen et al., 2009; Vanhonacker & Verbeke, 2011; FCEC, 2015). Tabel 4.1 illustrates the welfare effects of surgical castration with anesthesia and or analgesia and its alternatives on male pigs under the current husbandry conditions. The welfare effects mentioned in the Table 4.1

(Colom two) are all relative to surgical castration without administering any pharmaceuticals.

Table 4.1. The welfare effects of surgical castration with anesthesia and or analgesia and its alternatives on male pigs under the current husbandry conditions.

Male pigs	***Surgical castration***	**Castration with anesthetics**	**Castration with analgesics**	**Castration with analgesics and anesthetics**	**Immuno-castration**	**Entire boar**
		Animal welfare effects				
Positive	*-Low sexual and aggressive behavior* [1,2]*	-Local anesthesia lower stress level[a,6]	-No significant beneficial changes[6,7]	-Analgesia and local anesthesia lower stress level[a,6]	-No surgery -Able to perform natural behaviors (until the 2nd injection)[3,4]	-No surgery[2] -Able to perform natural behaviors[4,5] -Integrity is intact[4,5]
Negative	*-Acute and long-term pain[6,7]* *-Stress[6]* *-Prone to infections[8]* *-Impaired integrity[8]* *-Can not perform some of their natural behaviors[8]*	-Local anesthesia local pain reaction[b,6] -General anesthesia no significant beneficial changes[6,7]	-No significant beneficial changes[6,7]	-Extra-handling[6,7] -Analgesia and general anesthesia no significant beneficial changes[9]	-Sexual and aggressive behavior (until the second injection)[3,4]	-Sexual and aggressive behavior** [b,1]
		Boar taint risk				
Risk (%)	*0%[3]*	0%[3]	0%[3]	0%[3]	1%[3,4]	3.31%***[10] 18-66%***[11]

* Low performance of aggressive and sexual behavior is beneficial for pen mates, not specifically for the individual that the behavior performs. Number of behaviors is lower in surgical castrated pigs compared to entire boars, but not significant (Fàbrega et al., 2010)
** Entire boars significantly higher aggressive and sexual behaviors compared to female pigs and immunocastrated pigs (Fàbrega et al., 2010)
*** 3.31% in conventional production and 18-66% in organic production (respectively skatole and androstenone levels)
[a](P<0.001); [b](P<0.05)
[1]Fàbrega et al. (2010); [2]Zamaratskaia (2014); [3]Vanhonacker & Verbeke (2007); [4]Jensen et al. (2014); [5]Valeeva et al. (2009); [6]Kluivers-Poodt et al. (2007); [7]Borell et al. (2009); [8]Kruijf & Welling, (1988), EFSA, (2004); [9]Schmidt et al. (2012); [10]ten Have-Mellema et al. (2011); [11]Maribo (2012).

Surgical castration lowers the risk of aggressive and sexual behaviors in male pigs, which is beneficial for the welfare of pen mates and related to the prevention of tainted meat (Fàbrega et al., 2010; Vanhonacker & Verbeke, 2011; Zamaratskia, 2014). However, the procedure itself does have serious implications for the welfare of the individual pig. It leads to pain, stress and an increased risk of infections (Kruijf and Welling, 1988; EFSA, 2004; Kluivers-Poodt et al., 2007; Moya et al., 2008; Borell et al., 2009). The use of local anesthesia with or without analgesia is able to significantly reduce the pain and stress levels of castrated pigs (Table 4.1, Colom 3&5) (Kluivers-Poodt et al., 2007). However, the use of general anesthesia with or without analgesia and solely analgesia is expected to be limited in terms of reducing the perceived pain and stress levels in pigs during surgical castration (Table 4.1, Colom 4&5). These results need to be interpreted with caution, because it highly depends on the type of pharmaceuticals used, the method of restraining and the timing of injecting (Zöls & Ritzmann 2006; Kluivers-Poodt et al., 2007). Taylor et al. (2001) have concluded that the age of pigs does not influence the perceived level of pain. Furthermore, the integrity of pigs is impaired and they are no longer able to perform natural behaviors, like sexual behaviors (EFSA, 2004).

An alternative for surgical castration is immunocastration of pigs (Table 4.1, Colom 6). These pigs do not have to suffer from the castration procedure (Vanhonacker & Verbeke, 2007). Additionally, pigs are able to perform natural behaviors for a longer period of time compared to surgical castrated pigs, because the injections are administered in a

later stage (couple of weeks old) (EFSA, 2004; Vanhonacker & Verbeke, 2007; Jensen et al., 2014). Furthermore, administering of the injections does not impair the welfare of the animal in terms of an extra pain and or stress response (Dunshea et al., 2000; Vanhonacker & Verbeke, 2007; Pauly et al., 2009; EMA, 2014). However, the time between the injections leads to an increase of sexual and aggressive behaviors and skin injuries compared to surgical castrated animals. As a consequence, the levels of stress and injuries of pen mates increases and the risk of boar taint. The risk of boar taint is expected to be 1%, a slight increase compared to surgical castration (0%) (Vanhonacker & Verbeke, 2007; Jensen et al., 2014). A second alternative for surgical castration is raising entire boars (Table 4.1, colom 7), which is even more beneficial for the welfare compared to immunocastrated pigs, because they are able to live an entirely natural life (Kruijf and Welling, 1988; Jensen et al., 2014; Zamaratskaia, 2014). Although, the number of aggressive and sexual behaviors is significantly increased compared to immunocastrated pigs. As a consequence, these behaviors become a serious safety and welfare issue for pen mates and the risk of boar taint is increased (Fàbrega et al., 2010). The risk is increased to 3.31% in entire boars raised in conventional systems (ten Have-Mellema et al., 2011). Several management and feeding strategies are able to lower the risk of boar taint and unwanted behaviors in male pigs (Peet-Schwering et al., 2013; Wagenberg et al., 2013). Other techniques like: selective breeding and slaughtering of pigs at a younger age or weight, have also proven to successfully reduce the level of boar taint in entire males (Gregerson et al., 2012; Zamaratskaia, 2014). Finally, on-line detection on the slaughter line, sexen of semen and processed meat products are also able to lower the risk that boar taint is detected in the meat, but these techniques do require further research (Backus et al., 2008; Valeeva et al., 2009; Jensen et al., 2014). Not only are the animal welfare effects of surgical castration and its alternatives important to discuss, but also the economic impact of it. Research of FCEC (2015) has showed that raising entire boars is economically the best alternative for surgical castration. However, the pigs need to have a weight of at least 90 kg and boar taint need to be accepted. Raising entire pigs is the least feasible option when the pigs have a lower weight than 90kg and tainted meat is not accepted and in turn detected (Baltussen et al., 2008; Roest et al., 2009; Jensen et al., 2014; FCEC, 2015).

Currently, not one alternative strategy for surgical castration of pigs is able to entirely eliminate boar taint. For this reason, it is suggested that the entire pig production chain should be involved in order to prevent tainted meat from happening (Valeeva et al., 2009). Key stakeholders in this chain are the pig industry and the retailers. First of all, pig farmers often think that the market is not ready yet to accept alternatives for surgical castration, and in turn they stick to the produce of surgical castration (EFSA, 2004; de Roest et al., 2009; Valeeva et al., 2009). In contrast to pig farmers, retailers have made an increased number of steps towards alternatives of surgical castration, which suggests that they are more and more accepting and trusting the alternatives (Jensen et al., 2014). Furthermore, consumers are also important to take into account, because this group is crucial for the market acceptance and economic feasibility of alternative strategies for surgical castration of male pigs (Beakert et al., 2011; Jensen et al., 2014). Sensitivity to boar taint, knowledge about surgical castration and its alternatives and cooking habits of pork meat are factors that determine and influence the attitude of consumers towards the alternatives (Font i Furnols et al., 2003; Beakert et al., 2011; Vanhonacker & Verbeke, 2011).

The status of surgical castration of male pigs in the European Union is also looked at. The European Commission regarding this mutilation states (Directive 2008/120/EC):

> "Castration of males without anesthesia is allowed within 7th day of life by other means then tearing of tissue." (European Commission, 2008a, p.10)

About 71% of pigs raised for production were surgically castrated in the European Union in 2012 (FCEC, 2015). Additionally, recent numbers have showed that the number of pigs slaughtered without anesthetics is decreasing, while the number of entire boars raised is increasing in the European Union (FCEC, 2015). However, large differences in the way pigs (for production) are castrated and slaughtered remain visible between the member states (Fredriksen et al., 2009; Backus et al., 2014). Table 4.2 provides an overview of surgical castration and its alternatives of male pigs in several European Member states, which is relative to the legislation set by the European Commission. Countries that are not mentioned in the Table 4.2, mainly (South)Eastern European, have not forbidden surgical castration within their national legislation, nor do they have not implemented legislation that is more strict than European Union (EFSA, 2004; FCEC, 2015). The final two columns of Table 4.2 show more strict national legislation on top of the legislation set by the Commission and the active non-legislative initiatives of a member state that aims for a ban or has already forbidden surgical castration of pigs. It includes the initiatives found by means of a web search, it is expected that more initiatives do exist. Additionally, it is decided to leave the initiatives of the retail out (e.g. the Dutch supermarkets do no longer sell fresh pork meat of pigs that are surgically castrated (Backus, 2013)). Each member states allow the procedure of surgical castration within their national legislation. However, the United Kingdom, Ireland, Spain and Portugal nearly raise all their pigs as entire boars, while Austria and Italy surgical castrate almost all their male pigs (EFSA, 2004; Fredriksen et al., 2009; FCEC, 2015). Moreover, Belgium frequently castrated their pigs by means of immunocastration (FCEC, 2015). Furthermore, non-legislative initiatives, often initiated by the market, show that countries, like: the Netherlands and Germany, make efforts by means of non-legislative initiatives to reduce surgical castration (Valeeva et al., 2009; "Pork processors," 2012; ten Have-Mellema et al., 2013; Backus et al., 2014). Nonetheless, mostly Italy and third countries do not accept meat of entire boars due to the risk of boar taint. Consequently, it is difficult for major exporting countries like Germany, Denmark, the Netherlands and Belgium to sell their pig and porkmeat to these importing countries, which makes it more risky for them to reduce the number of surgical castration of pigs (Valeeva et al., 2009; Backus et al., 2014; Eurostat, 2014; Jensen et al., 2014). Finally, France, Germany, Spain and Poland are the biggest pig producing countries and Denmark, Germany, Spain and the Netherlands are the greatest exporting countries of porkmeat (Eurostat, 2014).

Table 4.2. Overview of surgical castration and its alternatives of male pigs in several European Member states.

Male pigs	Percentage of surgical castrated pigs without pharmaceuticals	Percentage of castrated pigs with anesthetics	Percentage of castrated pigs with analgesics	Percentage of castrated pigs with analgesics and anesthetics	Percentage of immuno-castrated pigs	Percentage of entire boars	More strict national legislation on top of EU*	Non-legislative initiatives*
European Commission	Castration of males without anesthesia is allowed within 7th day of life by other means then tearing of tissue[1]							
Austria	±5%[2]	0%[2]	± 95%[2]	0%[2]	0%[2]	0%[2]	Extra regulations regarding enrichment materials[3]	
Belgium	0%[2]	0%[2]	62-90%**[2]	0%[2]	8-10%[2]	1-2%[2]		
Denmark	0%[2]	0%[2]	90-95%[2,4] Use of analgesia is compulsory by law	0%[2]	0%[2]	1-5%[2,4]	Extra regulations regarding enrichment materials & fully slatted floors forbidden[3]	-Velfaerdsdeli-katesser[5]
Finland	5%[2,4]	0%[2]	90%[2,4]	0%[2]	0%[2]	5%[2,4]	Permanent access to enrichment materials & increased space allowance[3,6]	-Atria Finland[7]
France	5%[2,4]	0%[2]	90%[2,4]	0%[2]	0%[2]	1-7%[2,4]		-Cooperl Arc Atlantique[4]
Germany	2%[2]	0%[2]	± 90%[2]	0.5%[2]	0%[2]	2-8%[2,4]	Extra regulations regarding enrichment materials[3]	-Vion, Westfleisch and Tönnies[8] -Declaretion of Dusseldorf [9]
Ireland	0%[2]	0%[2]	0%[2]	0%[2]	0%[2]	±100%***[4,10]		
Italy	80%[2]	0%[2]	20%[2]	0%[2]	0%[2]	0%[2]		
Spain & Portugal	14-16%[2]	2%[2]	0%[2]	0%[2]	0%[2]	80%***[2,4]		
Sweden	±3%[2]	0%[2]	85-95%[2,4] Use of analgesia is compulsory by law	5-8%[2]	<5%[4]	1-2%[4]	Permanent access to straw and increased space allowance[3]	

Netherlands	±0%[2]	35-50%[2,4]	0%[2]	0%[2]	0%[2]	50-65%[2,4]	Use of straw is compulsory in organic production[6]	-Declaretion of Noordwijk****[11] -Beter-Leven[12] -Keten Duurzame Varkensvlees[13] -Good Farming Star Animal Health Management scheme[14]
United Kingdom	<0.75%[2]	0%[2]	<0.25%[2]	0%[2]	0%[2]	±100%***[3,10]	Extra regulations regarding enrichment materials (Freedom food scheme and organic production)[6]	-Red tractor Assured Food Standards[15] -RSPCA assured[15] -Soil association[15]

* This Colom only includes the national initiatives that have already forbidden or aim for a stop of surgical castration.
** According to Redactie (2014) the percentage of surgical castrated pigs in Belgium is 62% and the remaining part is held intact (either immunocastrated or raised as entire boar), while FCEC (2015) estimated a percentage of 85-90% of surgical castrated pigs.
*** These pigs are raised as entire boars but are slaughtered at a lower age and weight (<90kg) (Fredriksen et al., 2009)
**** The declaration of Noordwijk is supported by the Dutch ministry of Economic Affairs (former ministry of Agriculture, nature and food quality)
[1]European Commission (2008); [2]FCEC (2015); [3]Mul et al. (2010); [4]Backus et al. (2014); [5]"Sortbroget landracegris," (n.d.); [6]D'eath et al. (2014); [7]Pihlajavitta & Juva (2014); [8]"Pork processors" (2012); [9]"Tönnies, Vion und Westfleisch" (2012); [10]Fredriksen et al. (2009); [11]Valeeva et al. (2009); [12]De Dierenbescherming (n.d.); [13]"Moeder en big," (n.d.); [14]"Agriculture," (n.d.); [15]CIWF (n.d.-a).

Summarizing, the procedure of surgical castration of male pigs with or without analgesia and or anesthesia impairs the welfare of pigs (Zamaratskia, 2014). Immunocastration of pigs and raising entire boars have proven to be successful alternatives for surgical castration, because these pigs do not have to suffer from the castration procedure and can perform (at least for a longer period of time) natural behaviors. Additionally, several management and feeding strategies are able to lower the risk of boar taint and unwanted behaviors of entire boars (Peet-Schwering et al., 2013; Wagenberg et al., 2013 Vanhonacker & Verbeke, 2011; Jensen et al., 2014). Furthermore, research of FCEC (2015) has showed that raising entire boars is economically the best alternative for surgical castration. The pigs need to have a weight of at least 90 kg and boar taint need to be accepted. However, meat of immunocastrated pigs and or of entire boars is currently not accepted within the society, because of the risk of boar taint (Valeeva et al., 2009).

Furthermore, The United Kingdom, Ireland, The Netherlands, Spain, Portugal, Belgium and Germany are expected to be in favor of a reduction and or a ban of surgical castration of male pigs (Backus et al., 2014). In Appendix E an extensive literature research can be found regarding surgical castration of pigs.

4.1.2 Intact vs. Docked tails of pigs

Tail-biting behavior of pigs is one of the most frequently seen animal welfare problems in the pig industry (Sonoda et al., 2013; Valros and Heinonen, 2015). The underlying cause of this behavior is related to the inability of pigs to meets its behavioral needs (Studynitz et al., 2007; EFSA, 2014; Ursinus, 2014). Several factors are related to this inability of meeting behavioral needs and in turn the performance natural behaviors, like exploring and foraging (Taylor et al., 2010; Ursinus, 2014). The most important factors are: enrichment materials, stocking densities, feeding and management measures, housing systems, health status, genetics, climate and environmental stressors. As a consequence, tail-biting behavior is a multifactorial problem. For this reason, multiple factors need to be taken into account in order to prevent this behavior from happening. However, these factors are not always sufficiently taken care of, but tails are frequently docked in order to prevent tail-biting behaviors from occurring (Smulders et al., 2008; Taylor et al., 2010; Zonderland, 2010; Ursinus, 2014). The procedure of tail docking does impair the welfare of pigs. An outline is shown of the welfare effects on pigs with intact tails and pig with docked tails under the current husbandry conditions in Table 4.3.

Table 4.3. The welfare effects on pigs (with intact tails vs. docked tails) under the current husbandry conditions.

Pigs	**Animal welfare effects**		
	Positive	**Negative**	***Welfare effect depends on:***
Intact tails	-Able to perform natural behavior with their tail[1] -Animal integrity is intact[2]	*Risk of tail-biting behaviors (2-12%)[3]:* *1. Short term** Acute pain[4] Primary (bacterial) infections[5] *2. Long term** Secondary (respiratory) infections[5] Chronic stress[6] Reduced weight and growth[7] Extreme blood losses and trauma > Death[8]	-Severity of the lesions[9]
Docked tails	-Reduced prevalence of tail-biting behaviors (1-3%)[10]	*Tail docking procedure:* *1. Short term* Acute pain and stress[11] Growth impairments[9,11] *2. Long term* Chronic pain and stress[9,12,13] Integrity is compromised[14] No longer able to perform natural behaviors with their tail[12] Tail-biting behaviors are not entirely eliminated (1-3%)[10] Infection risk due to open wound[12]	-Effectiveness of reducing the prevalence of tail-biting -Length that is docked -Method of tail docking used -Extent to which pain is perceived[11,12,15]

* In case a tail-biting outbreak occurs

[1]Werkgroep Krulstaart (2013), Nannoni et al., (2014); [2] Sutherland and Tucker (2011); [3]Valros & Heinonen (2015); [4]Statham et al. (2008); [5]Heinonen et al. (2010); Kritas & Morrison (2007); [6]Munsterhjelm et al. (2013); [7]Nieme (2010); [8]van Putten (1969), Bracke et al. (2013); [9]Sutherland et al. (2009); [10]Scollo (2013); [11]Marchant-Ford et al. (2009), Torrey et al. (2009); [12]Nannoni et al. (2014); [13]Taylor et al. (2010); [14]Sutherland & Tucker, (2011); [15]Sutherland et al. (2008).

Pigs with an intact tail are able to communicate about their emotional state to pen mates and are able to cover their anus or vagina by means of its tail (Werkgroep Krulstaart, 2013; Nannoni et al., 2014). As a result, they are able to perform these natural behaviors and their integrity is remained (Sutherland and Tucker, 2011). However, pigs that have a tail will have a significantly higher risk (2-12%) of tail biting behaviors compared to pigs that have a docked tail (1-3%). This effect is only significant when more than 75% of the tail is docked (Thodberg et al., 2010, Scollo, 2013). Tail biting behaviors strongly impair the welfare of pigs (Heinonen et al., 2010; Scollo, 2013). They suffer from pain, (chronic) stress and an impaired health status and growth rate. Finally, tail-biting behaviors could lead to extreme blood loss and trauma, which ultimately leads to death (van Putten, 1969; Nieme, 2010; Zonderland et al., 2011; Munsterhjelm et al., 2013). It is important to keep in mind that the impact on the welfare depends on the severity of the tail lesions (Sutherland et al., 2009). In contrast to pigs with intact tails, pigs with docked tails have a lower risk of tail biting behaviors, but it does not entirely eliminate it (Scollo, 2013). Furthermore, it is until now unclear how tail-biting behaviors can completely be prevented. For these reasons, tails are commonly docked (Taylor et al., 2010; Sutherland and Tucker, 2011). The lower risk of a tail-biting outbreak is beneficial for the welfare of pigs (Sutherland et al., 2009; Heinonen et al., 2010). However, the procedure itself causes short- and long-term pain and stress in pigs and a short term growth impairment. Additionally, the integrity of the animal is compromised, pigs can not perform natural behaviors with their tail and the risk of tail-biting behaviors does still exists. Finally, the procedure impairs the tissue around the tail, which increases the risk of infections (Sutherland et al., 2008; Sutherland et al., 2009; Torrey et al., 2009;

Nannoni et al., 2014). Under current husbandry conditions it is suggested that the short-term pain and stress response in tail-docked pigs outweigh the long-term negative effects of tail-biting behaviors in pigs with intact tails, if no proper measures are taken (Sutherland et al., 2009). However, this highly depends on the effectiveness of reducing tail-biting behaviors when an animal is tail-docked, the length that is docked, the method used for the procedure and on the extent of acute and chronic pain that is perceived due to the procedure of tail-docking (Sutherland et al., 2008; Nannoni et al., 2014). Regardless of the animal welfare effects, tail-biting behaviors have enormous economic consequences for the pig farmer due to higher production costs and lower market values (Zonderland et al., 2011).

As a consequence, an acute stop of tail docking leads to a decrease in animal welfare and high economical losses due to an increase in tail-biting behaviors in pig with intact tails (Werkgroep Krulstaart, 2013). However, it is suggested that proper management (e.g. feeding measures and enrichment materials) is able to significantly reducing tail-biting behaviors. In turn, it is assumed that under the current husbandry conditions it is not possible to ban tail docking, but when changes are made it is expected to be possible in the long-term (Werkgroep Krulstaart, 2013). Nonetheless, the changes need to be accepted before they can be successfully implemented in order to reduce and or ban the procedure of tail docking of pigs. Important stakeholders like: pig producers, consumers and retailers, are such groups that need to be willing to accept pigs with intact tails and can make a difference when it comes to a reduction of tail docking of pigs (Paul et al., 2007; Boogaard et al., 2011; Werkgroup Krulstaart, 2013). Generally, farmers consider tail docking of pigs the most effective measure in reducing tail-biting behaviors (Paul et al., 2007; de Lauwere et al., 2009). Furthermore, research about the attitude of consumers towards the procedure of tail docking could not be found. The third important stakeholder group, retailers, has shown to take more and more actions to lower the number of tail docking procedures on pigs (e.g. Marks & Spencer and Waitrose (CIWF, n.d.-a).

Finally, the status of the tail docking procedure in the European Union will be shown. In Table 4.4 illustrates the current status of the procedure of tail docking in several European Member states, relative to the legislation set by the European Commission. Due to insufficient information, not all the 28 member states are shown. However, it is expected that tail docking of pigs is allowed in the countries that are left out of the table (EFSA, 2007a; Wageningen UR Livestock research, 2010). The European Commission regarding tail docking states:

> "Neither tail-docking nor reduction of corner teeth must be carried out routinely but only where there is evidence that injuries to sows' teats or to other pigs' ears or tails have occurred. Before carrying out these procedures, other measures shall be taken to prevent tail-biting and other vices, taking into account environment and stocking densities. For this reason inadequate environmental conditions or management systems must be changed." (European Commission, 2008a, p.10).

However, this procedure is about 75-100% of the cases carried out in Europe (Nannoni et al., 2014). Exceptions are seen in Finland, Lithuania and Sweden, these countries have completely forbidden tail docking in their national legislation (Table 4.4, colom 2) (EFSA, 2014; Valros and Heinonen, 2015). Additionally, some member states have more strict regulations regarding enrichment materials and space allowance of pigs compared to the regulations set by the European Commission (Table 4.4, colom 2) (Mul et al.,

2010; D'eath et al., 2014). As is mentioned before, these aspects are related to the onset of tail biting behaviors (Taylor et al., 2010). Denmark is such a country that has made it compulsory to use enrichment materials that consists of natural products across the entire pig industry. It also need to be provided on the floor and used for rooting behaviors. The regulations of the United Kingdom states that pigs must have permanent access to and sufficient amounts of enrichment materials in the Freedom food scheme and the organic production (D'eath et al., 2014). Furthermore, Table 4.4 (colom 3) shows a number of active national non-legislative initatives (or a combiation of non-legislative and legislative) of several member states that could be found by means of a web search, like: Beter Leven in the Netherlands and Bioland in Germany ("Bioland richtlinien," 2015; "Factsheet varkens," 2015). However, it is expected that more initiatives do exists, especially related to the retail sector.

All in all, the procedure of tail docking of pigs impairs to welfare of pigs. However, under the current husbandry conditions an acute stop of tail docking leads to a worse animal welfare state in terms of short-and longterm pain and stress of pigs with intact tails compared to docked tails and high economical losses, due to an increase in tail-biting behaviors (Werkgroep krulstaart). However, it is suggested that proper management (e.g. feeding measures and enrichment materials) is able to significantly reducing tail-biting behaviors. Consequently, changes in the current husbandry systems will make a complete stop of this mutilation possible in the long term (Werkgroep krulstaart).

The Netherlands, Germany, Denmark and the United Kingdom clearly show movements towards a ban of tail docking in the long-term (Bioland richtlinien," 2015; "Factsheet varkens," 2015; CIWF,n.d.-a). Sweden, Finland and Lithuania have already forbidden tail docking of pigs in their national legislation (D'eath et al., 2014)

In Appendix F an extensive literature research can be found regarding tail docking of pigs.

Table 4.4. Overview of tail docking in several European member states.

Pigs	More strict national legislation on top of EU*	Non-legislative initiatives and or mixed legislative initiatives*	Percentage of tail docking in pigs for production
European Commission	Neither tail-docking nor reduction of corner teeth must be carried out routinely but only where there is evidence that injuries to sows' teats or to other pigs' ears or tails have occurred. Before carrying out these procedures, other measures shall be taken to prevent tail-biting and other vices, taking into account environment and stocking densities. For this reason inadequate environmental conditions or management systems must be changed[1]		
Austria	-Extra regulations regarding enrichment materials and space allowance[2]	-Freiland Standard[3]	± 100%[4,5]
Belgium			± 100%[4]
Denmark	-Not more than 50% of the tail is allowed to be docked in conventional production[6,7] -Tail docking is forbidden in organic production[6,7] -Extra regulations regarding enrichment materials and space allowance[2,7] -Fully slatted floors are forbidden[2,7]	-Petition of the Danish Animal Welfare Society[8] -Action plan for better pig welfare of the Danish pig industry[8] -Velfaerdsdelikatesser[9]	± 100%[4,5]
Finland	-Tail docking not allowed (in conventional and organic production) -Permanent access to enrichment materials -Extra regulations regarding space allowance and solid floor area[2,6,10]		0% (Law) (in practice 5%)[10]
France		-Nature Progres[11]	± 100%***[4]
Germany	-Extra regulations regarding enrichment materials, space allowance and solid floor area[2]	-Joint declaration in North-Rhine Westphalie[12] -Ringelschwanzprämie[13] -"Für mehr Tierschutz" Tierschutzlabel[14] -Bioland[15]	100-79%[4,15]
Ireland			± 100%[16]
Italy			99%[17]
Lithuania	-Tail docking not allowed (in conventional and organic production)[4]		0%[4]
Spain & Portugal			90-95%***[4]
Sweden	-Tail docking not allowed (in conventional and organic production)[7] -Extra regulations regarding enrichment materials, space allowance, solid floor area and air quality[2,7]	-Svenskt Sigill[20] -KRAV[19]	0%[10]
Netherlands	-Tail docking is not allowed and the use of straw is compulsory in organic production[7] -Extra regulations regarding space allowance and solid floor area[2,7]	-Werkgroep Krulstaart[20] -Beter Leven[21]	± 100%[4,5]
United Kingdom	-Tail docking is not allowed in organic production[7] -Extra regulations regarding enrichment materials (Freedom food scheme & organic production)[7]	-Soil Association[22] -RSPCA assured[22]	54-88%[4,23,24]

* This Colom includes the national initiatives that have already forbidden tail docking of pigs. **No information could be found in the cells that are empty. *** Research of EFSA (2014) has showed that about 60% of the French farms and 75% of the Spanish farms dock tails, the remaining (40% and 25%) is unknown.

[1]European Commission (2009); [2]Mul et al., (2010); [3]"Freiland Tierhaltungsstandards," (2007); [4]EFSA (2007a); [5]Wageningen UR Livestock Research (2010); [6]Spoolder et al. (2011); [7]D'eath et al. (2014); [8]Ministry of food, agricultural and fisheries of Denmark (2015); [9]"Sortbroget landracegris," (n.d.); [10]EFSA (2014); [11]Nature & Progress (2002); [12]PROVIEH (2014); [13]ter Beek (2015); [14]Für mehr Tierschutz", (2013); [15]"Bioland richtlinien," (2015); [16]Boyle et al. (2012); [17]Scollo (2013); [18]Svenskt Sigill (n.d.); [19]"Krav Standards," (2016); [20]Werkgroep Krulstaart (2013); [21]"Factsheet varkens," (2015); [22]CIWF (n.d.-a); [23]CIWF(n.d.-c); [24]Hickman (2011).

4.1.3 Intact vs. Trimmed beaks of laying hens

Severe feather pecking is the most observed behavioral problem in laying hens, which leads to serious welfare issues (Gilani et al., 2013; Rodenburg et al., 2013; de Haas et al., 2014). The underlying cause of this behavior is similar to tail-biting behaviors in pigs. Feather pecking behavior relates to a mismatch of the natural and husbandry conditions. Currently, the husbandry conditions in which laying hens are raised, unable them to meet there behavioral needs. Consequently, their motivation to perform natural behaviors in an attempt to meet their needs is increased. This leads to stress and in turn it results in the expression of undesired harmful behaviors like feather pecking (Pickett, 2008; de Haas et al., 2014; Rodenburg, 2014). Several factors have a significant influence in the onset of this undesired behavior, like breed, available litter, housing system, feeding and management measures and health status (Rodenburg et al., 2004; Newberry et al., 2007; Pickett, 2008; Rodenburg et al., 2013). In order to reduce the levels of feather pecking behaviors these factors need to be taken into account. As a consequence, there is not one measure that can guarantee that feather pecking does not occur, which makes it a multifactorial approach (Pickett, 2008; Rodenburg et al., 2013). Beak trimming of laying hens is a commonly used method to lower the risk of the onset of severe feather pecking behaviors, but the procedure itself impairs the welfare of the hens. Table 4.5 provides a general overview of the welfare effects on laying hens with intact beaks and hens with trimmed beaks under the current husbandry conditions.

Beak trimming of laying hens is a routine practice in the European Union, because it is considered as a preventive measure for severe feather pecking behavior. As a consequence, low numbers of laying hens are raised with intact beaks across the European Union (de Haas et al., 2014). However, laying hens with intact beak are able to perform natural behaviors like exploring and foraging behaviors with their beak. Furthermore, the integrity of these animals is intact (FAWC, 2007; Kuenzel, 2007; Pickett, 2008; FeatherWel, 2013). The drawback of raising hens with intact beaks is the significant increase in the performance of severe feather pecking behaviors compared to beak-trimmed hens, which shows that these animals suffer from the mismatch between natural and the current husbandry conditions (Staack et al., 2007; Lambton et al., 2010). Severe feather pecking behaviors are shown to be painful for the victim (short-term effect) and leads to thermoregulatory issues (Tauson et al., 2004; Rodenburg et al., 2013). Additionally, severe feather pecking can lead to cannibalistic behaviors (e.g. tissue and vent pecking), which increases the risk of infections and as a consequence to extensive blood loss (Rodenburg et al., 2004; Rodenburg et al., 2013). Ultimately, vent and tissue pecking lead to a significant increase in mortality of the hens (up to 20% in non-cage systems). The type of housing system, group size and the breed of laying hens used highly influence the mortality rate (Tauson et al., 2004; Sandilands and Hocking, 2012). Furthermore, it is concluded that laying hens with intact beaks have significantly higher levels of chronic stress compared to hens with trimmed beaks, due to a higher number of feather pecking behaviors (Struwe et al., 1992). High levels of stress could lead to an impaired health status and in turn in a disease outbreak (Green et al., 2000; FeatherWel, 2013). In contrast to hens with intact beaks, hens with trimmed beaks do have significantly lower number of severe feather pecking behaviors, but it is not completely eliminated. This shows that the underlying behavioral problem, which causes this behavior, of laying hens with trimmed beaks is not solved. (Hadorn et al., 2000; Tauson et al., 2004; Sandilans and Hocking, 2012).

Table 4.5. The welfare effects on laying hens (with intact beaks vs. trimmed beaks) under the current husbandry conditions.

Laying hens	**Animal welfare effects**		
	Positive	**Negative**	**Depending factors:**
Intact beak	-Able to perform natural behaviors[1] -Integrity is intact[2] -Significant reduced level of gentle feather pecking behaviors*[3]	*Severe feather pecking behaviors***[3] 1. Short term Pain[4,5] 2. Long term Thermoregulation issues[4,5] Cannibalism > tissue and vent pecking Infections[5,6] and Mortality risk[4,7] (chronic) Stress[8]	-Mortality rate:[4,7] type housing system group size laying breed used
Trimmed beak	-Significant reduced level of severe feather pecking behaviors**[3]	*Severe feather pecking behaviors are not entirely eliminated*[3,7] *Gentle feather pecking behavior**[3,5] -Indicates a behavioral problem *Beak trimming procedure* 1. Short-term Pain[2,9] Reduced body weight[10] 2. Long-term Chronic pain:[2,10] Neuroma formation and/or regrowth No natural behaviors: [2,10,11] (chronic) Stress and discomfort Integrity is compromised[2,10] Infection risk[9,12]	-Perceived level of pain: age of the hen[2,13] length of the beak that is removed[2,13] method used[9,10]

* The risk of gentle feather pecking behaviors in hens with trimmed beaks is significantly (P <0.001) higher compared to hens with intact beaks during the rearing phase (Lambton et al., 2010) ** The risk of severe feather pecking behaviors in hens with intact beaks is significantly (P=0.028) higher compared to hens with trimmed beaks during the laying phase (Lambton et al., 2010)
[1]Pickett (2008), FeatherWel (2013); [2]Kuenzel (2007); [3]Lambton et al. (2010); [4]Tauson et al. (2004); [5]Rodenburg et al. (2013); [6]Rodenburg et al. (2004); [7]Sandilands & Hocking (2012); [8]Struwe et al. (1992); [9]Dennis & Cheng (2012); [10]Fiks- van Niekerk & de Jong (2007); [11]FAWC (2007); [12]Cheng (2006); [13]Freire et al. (2007).

Furthermore, hens with trimmed beaks perform significantly more gentle feather pecking behaviors (Lambton et al., 2010). This type of behavior does not cause much damage in the victim, but it does also reveal a behavioral problem, like severe feather pecking (Lambton et al., 2010; Rodenburg 2013). Moreover, the procedure of beak trimming has negative welfare effects of its own as well. Research has indicated that beak trimmed hens suffer from acute and short-term pain and a reduced weight gain. However, age of the hens and the method used for the procedure are determining factors in the perceived level of pain (Hester and Shea-Moore, 2003; Kuenzel, 2007; Dennis and Cheng, 2012). Moreover, the existence of long-term pain in hens highly depends on the length that is trimmed. Neuromas form when more than 50% of the beak is trimmed, which leads to chronic pain (Kuenzel, 2007; Jongman et al., 2008). Removing less than 50% of the beak increases the risk of regrowth, which possibly leads to irregularities in the beak and cannibalistic behaviors and in turn to long-term pain (Cheng, 2006; Kuenzel, 2007; Gentle and McKeegan, 2007). Additionally, beak trimmed hens can not perform natural behaviors with their beaks, which results in (chronic) stress, discomfort an a short term reduction in body weight (FAWC, 2007; Fiks- van Niekerk & de Jong, 2007). Furthermore, their integrity is compromised (Hester and Shea-Moore, 2003). Finally, it is suggested that the procedure causes an open wound,

which will lead to bleedings and in turn will increase the risk of infections (Cheng, 2006).
As a result of, the increased level of feather pecking behaviour in laying hens with intact beak compared to trimmed beaks (Tabel 4.5), it is expected that the economic consequences of laying hens with intact beaks are of a greater extent compared to hens with trimmed beaks. However, it highly depends on an outbreak of feather pecking behavior and the severity of it (Tauson et al., 2004; FAWC, 2007; Nicol et al., 2013). A relevant study that expresses the economic impact of hens with intact beaks or trimmed beaks in euros could not be found.

It has been shown that raising hens with intact beaks increases the risk of severe feather pecking behaviours, but factors, like breeding, proper feeding and management measures, are able to lower the risk of the undesired behaviours. For this reason, these husbandry factors need to be taken into account in order to successfully reduce the number of beak trimming procedures in laying hens (Pickett, 2008; Rodenburg et al., 2013). Nonetheless, it is not only important to know that it is possible to reduce the number of beak trimming procedures in laying hens, but it also need to be accepted by stakeholders, like poultry producers, consumers and retailers. They are of crucial importance for this success. However, the number of researches done on the attitude of these stakeholders is limited (Sandilands and Hocking, 2012).

Finally, the status of beak trimming procedure in the European Union will shortly be explained. Table 4.6 gives an overview is given of the current status of the procedure of beak trimming in several European Member states, relative to the legislation set by the European Commission. There could not be found sufficient information on all the 28 member states, resulting in an overview of 13 countries. It is expected that beak trimming of laying hens is allowed in the countries that are not shown in Table 4.6 (Fiks-van Niekerk & de Jong, 2007). Additionately, Table 4.6 shows several national legislative and or non-legislative initiatives that are found by means of an online web search. It is expected that more initiatives do exist especially related to the retail sector. The European Commission regarding beak trimming states:

> "In order to prevent feather pecking and cannibalism, however, the Member States may authorise beak trimming provided it is carried out by qualified staff on chickens that are less than 10 days old and intended for laying." (European Commission, 1999, p.57)

Visible differences exist between the European member states regarding this mutilation, which is similar to surgical castration of male pigs and tail docking of pigs (Fiks- van Niekerk & de Jong, 2007). First of al, Sweden and Finland have forbidden this mutilation by national law (Table 4.6, colom 2) (Fiks-van Niekerk & De Jong, 2007). Furthermore, Austria and Denmark have also nearly stopped the performance of this procedure, not by means of national law but by national assurance schemes (Watson, 2011; Larsen, 2014; "Managing untrimmed flocks," 2014). Thirdly, The Netherlands, Germany and the United Kingdom make numerous efforts (legislative and non-legislative acts) to completely stop this mutilation from happening in the near future (Table 4.6, colom 3) (Department for Environment, Food & Rural Affair, 2010; Watson, 2011; World Poultry, 2013; de Haas et al., 2014; Burkin, 2015; Clarke, 2015). The Southern European countries nearly trim all the beaks of laying hens and no active initiatives that aim for a reduction of this mutilation could be found. Spain, France, Germany, Italy, the United

Kingdom, the Netherlands and Poland are the biggest egg producing countries of the European Union (CIWF, 2013).

Table 4.6. Overview of beak trimming in several European member states.

Laying hens	More strict national legislation on top of European Union*	Non-legislative initiatives or a combination of legislative and non-legislative*	Laying hens with trimmed beaks (%)*	Additional characteristics of the poultry sector*
European Commission	In order to prevent feather pecking and cannibalism, however, the Member States may authorize beak trimming provided it is carried out by qualified staff on chickens that are less than 10 days old and intended for laying[1]			
Austria		-Austrian KAN certification scheme[2,3] -Toni's Freilandeie[4]	±1-5%[5]	-Small exporting country[6] -Management guidelines provided to the producers and monitoring[2]
Belgium			±100%**[5]	
Denmark		-Voluntary stop of beak trimming by the producers[6]	±0%**[6]	-Frequently use of enriched cages[6] -Selective breeding against aggression, perches and litter materials[6]
Finland	-Forbidden by national law[5]		±0%[5]	-Low use of brown strains[7]
France		-Nature&Progres[8] -Label Rouge[9]	±100%**[5]	
Germany		-KAT label[10] -Bioland[11] -Neuland[12] -"Was steht auf dem ei"[13] -Voluntary agreement to ban beak trimming in 2016 (1. Pilot in Lower Saxony region[14] 2. Poultry industry[15])	±100%***[5]	
Italy & Spain			±100%**[5]	-Frequently use of cage systems****[16]
Portugal			±100%**[5]	
Sweden	-Forbidden by national law[5]	-Krav[17] -Svenskt Kott[18]	±0%[5]	-Low use of brown strains[8] -Use of barn systems is common[16,19]
Netherlands	-Procedure is allowed by means of Infrared treatment[20]	-Aim for a ban by 2018[20] -Rondeel[21] -Beter Leven[22]	±90%**[5,22]	-Use of barn systems is common[16,19]
United Kingdom	-Procedure is allowed by means of Infrared treatment and trained personnel[23] -Only 1/3 is allowed to be trimmed[23]	-Aim for a ban in the near future (government)[24] -RSPCA assured[25] -Soil Association[26]		-Use of free range areas common[16,19]

* Cells are empty when more strict national regulation or information could not be found for a country. Only includes initiatives that forbid or

aim for a stop of beak trimming. Only the ones found by a simply web search (retailers are left out) ** Is a suggestion, no hard proof could be found. *** Is expected to be lower due to the upcoming ban on beak trimming. **** These systems are forbidden since 2012 (Rodenburg et al., 2008)

[1]European Commission (1999); [2]"Managing untrimmed flocks" (2014); [3]Fromwald (2010); [4]"Toni's Freilandeier," (2015); [5]Fiks- van Niekerk & De Jong (2007); [6]Larsen (2014); [7]Sandilands & Hocking (2012); [8]Nature&Progres (2002);[9]"Label Rouge," (2011); [10]KAT (n.d); [11]"Bioland richtlinien," (2015); [12]"Neuland," (2015); [13]"KAT Guide for Laying Farms", (2013); [14]Burkin (2015); [15]Linden (2015); [16]Horne & Achterbosch (2008); [17]KRAV (2015); [18]Svenskt Sigill (n.d.); [19]Wageningen UR Livestock Research (2010); [20]Dierenwelzijnsweb, (2013); World Poultry (2013); [21]Rondeel (n.d.); [22]"Factsheet leghennen," (2015); [23]EFSA (2005), FAWC (2007); [24]Department for Environment, Food & Rural Affair (2010), Watson (2011); [25]Soil Association (2009); [26]RSPCA (n.d.-a), RSPCA (n.d.-b).

Summarizing, beak trimming of laying hens is a commonly used method to lower the risk of the onset of severe feather pecking behaviors, but the procedure itself strongly impairs the welfare of the hens (de Haas et al., 2014). Factors, like breeding, proper feeding and management measures, are able to lower the risk of feather pecking behaviors behaviours and in turn the economic consequences of this behavior. For this reason, these husbandry factors need to be taken into account in order to successfully reduce the number of beak trimming procedures in laying hens (Pickett, 2008; Rodenburg et al., 2013).

It is suggested that Sweden, Finland, Austria, Denmark, Germany, The Netherlands, Germany and the United Kingdom favor a ban on beak trimming of laying hens (Department for Environment, Food & Rural Affair, 2010; Watson, 2011; World Poultry, 2013; de Haas et al., 2014; Burkin, 2015; Clarke, 2015).

In Appendix G an extensive literature research can be found regarding beak trimming of laying hens.

4.2 Introduction on the results retrieved from the questionnaire

The results that are retrieved from the questionnaire are shown in this paragraph. The results are split up in three subparagraphs (surgical castration, tail docking and beak trimming). Each subparagraph consists of the results of the geographic regions ('clustering countries'), professions and gender. The three types of filtering of the results (geographic regions, professions and gender) are divided into some specific parts:

- Possibility of a significant reduction of the particular mutilation within 3 to 5 years
- Factor that has the greatest chance of success in reducing the mutilation
- Factors that are the biggest obstacles (both country and animal production related) in reducing the mutilation
- Housing management and type of breed used

4.2.1 Surgical castration of male pigs

4.2.1.1 Clustering countries

In Appendix H (Table H-1 till H-5) a complete overview of the results per geographic region and of each country separately can be found. This result-section will focus on the results of the different geographic regions (clusters), which are shown in Figure 4.1.

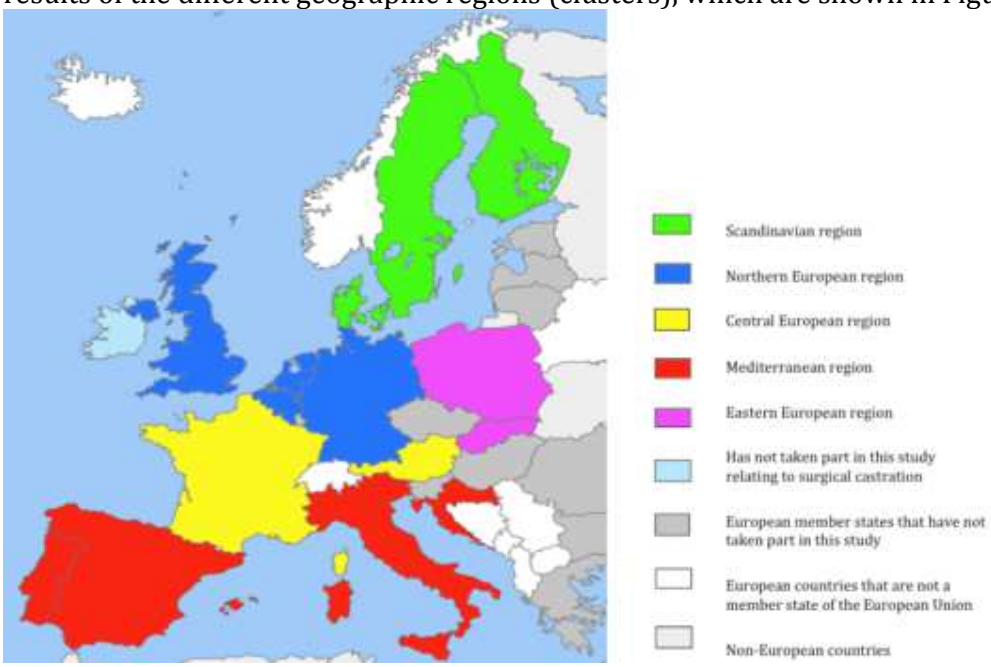


Figure 4.1. Overview of the geographic regions used for surgical castration of pigs.

4.2.1.1.1 Possible significant reduction

Table 4.7 illustrates if a significant reduction of surgical castration of male pigs is achievable within 3 to 5 years of each geographic region. The majority of the Central,- Northern European and Mediterranean respondents consider a significant reduction of surgical castration of male pigs possible. In contrast to these three regions, respondents

of the Scandinavian,- and Eastern European countries do not consider a reduction achievable in their country.

Table 4.7. Total number of respondents and the possibility of a significant reduction of surgical castration of male pigs within 3 to 5 years of each geographic region.

Geographic location		Central Europe[1]	Northern Europe[2]	Mediterranean[3]	Scandinavia[4]	Eastern Europe[5]
Total number		7	48	9	17	3
Significant reduction possible within 3-5 yrs (%)	Yes	66,65	61,63	75	48,6	0
	No	33,35	38,38	25	51,4	100

[1]Austria and France [2]Belgium, Germany, Netherlands and United Kingdom [3]Croatia, Italy, Portugal and Spain [4]Denmark, Finland and Sweden [5]Slovakia and Poland

4.2.1.1.2 Success factors

Figure 4.2 illustrates the factors that have the greatest chance of success in reducing surgical castration for each geographic region. The majority of the geographic regions consider *a legislative approach by the national government* as the factor with the greatest chance of success. However, the Central European region thought differently, they rank a *wholesale price increase by retailers* as the most successful factor for reducing the number of practices of this procedure.

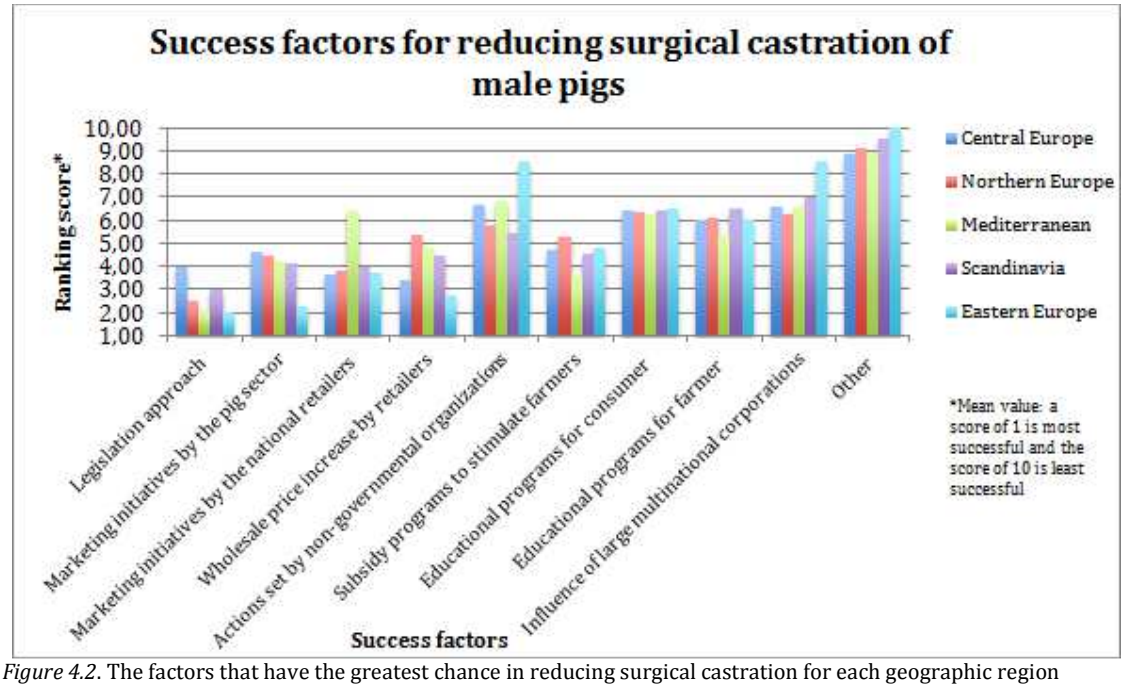


Figure 4.2. The factors that have the greatest chance in reducing surgical castration for each geographic region

4.2.1.1.3 Obstacles

Figure 4.3 shows the country-based obstacles for reducing surgical castration of male pigs of each geographic region. The Mediterranean and Eastern European countries consider the *restrictions imposed by specialty or regional products* as likely to be a problem. Furthermore, Central- and Eastern European think of *a lack of market acceptance in importing countries, cooking habits and being highly sensitive and low appreciation* for boar taint as three handicaps for a reduction. Eastern European countries do also mark a *lack of acceptance in importing countries* and say that:

"lower price for intact boars sold as fatteners to slaughterhouses" and *"the use of immuno castration"* form additional problems for a successful reduction.

Figure 4.4 consists of the animal production based factors that likely form an hinder for reducing surgical castration of male pigs. *Mixing of litters and insufficient or unavailable detection methods* are considered as the most likely animal-production based factors that form a problem in reducing surgical castration in Eastern European countries.

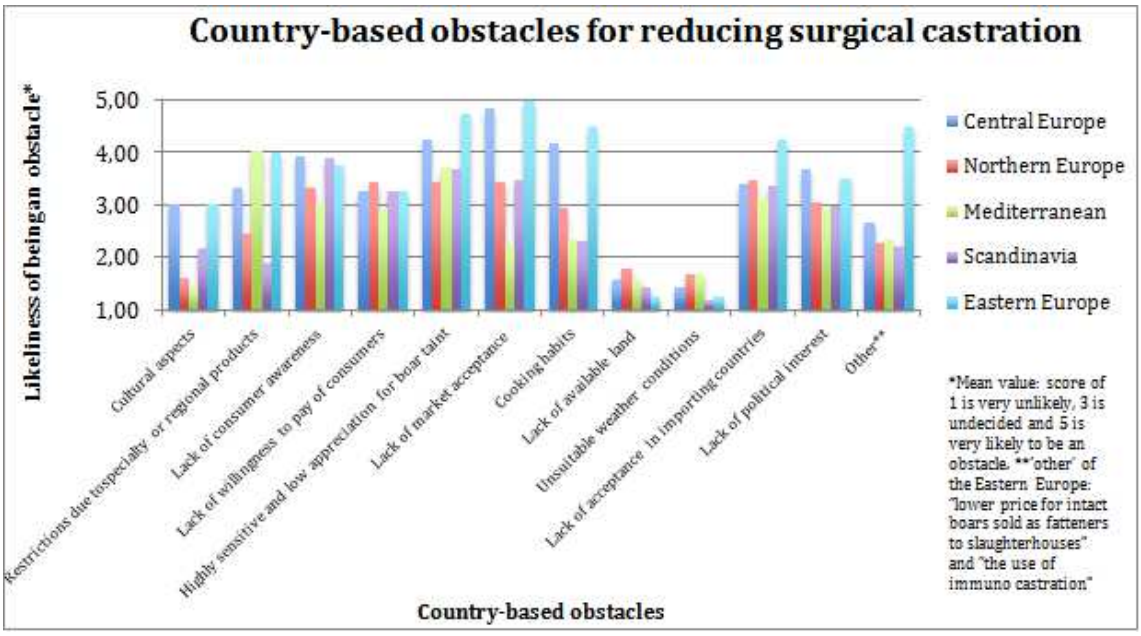


Figure 4.3. Country-based obstacles for reducing surgical castration of male pigs of each geographic region

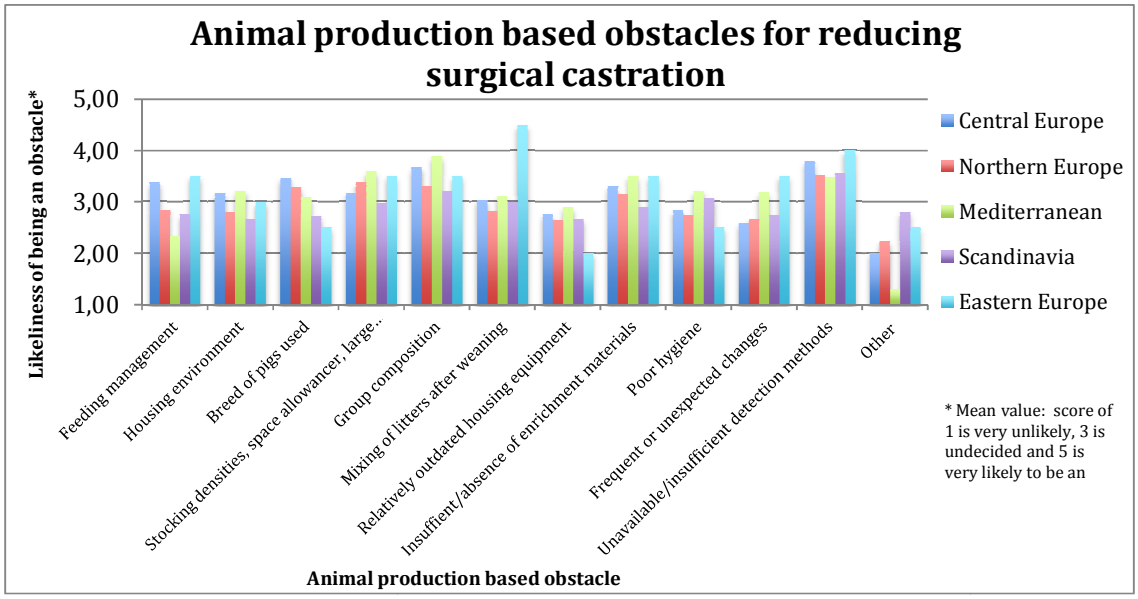


Figure 4.4. Animal production based obstacles for reducing surgical castration of male pigs of each geographic region.

4.2.1.1.4. Housing management and breed

Figure 4.5 demonstrates that Northern European and Central European countries most frequently use fully slatted floors, while Mediterranean,- Scandinavia and Eastern European countries use more commonly partly slatted floors.

Figure 4.6 shows that each geographic region most commonly use mixed-sex housing of pigs.

Figure 4.7 illustrate the most suitable alternative(s) for surgical castration. Generally, no clear differences could be seen between the geographic regions, except from the Scandinavian countries. This region thinks of immunocastration as the most appropriate alternative of surgical castration.

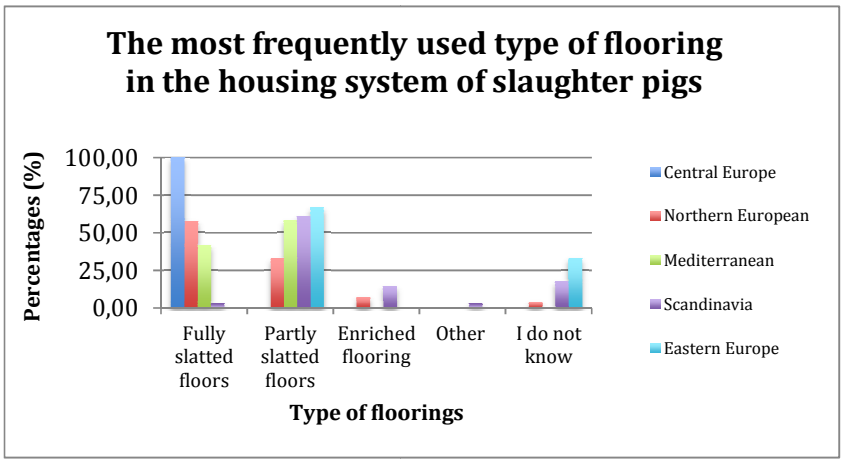


Figure 4.5. The most frequently used type of flooring in the housing system of slaughter pigs

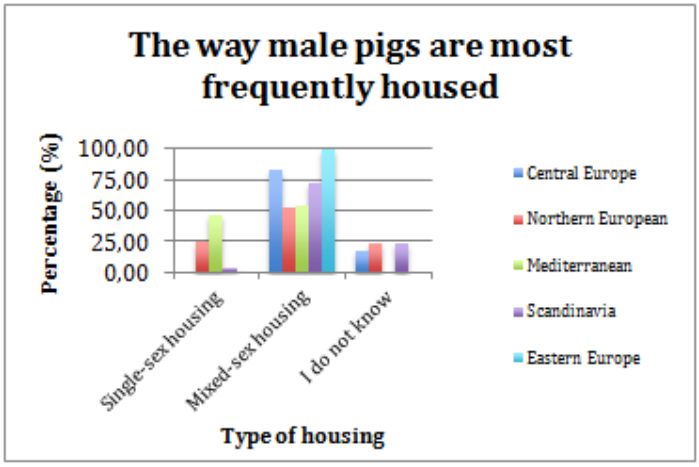


Figure 4.6. The way male pigs are most frequently housed

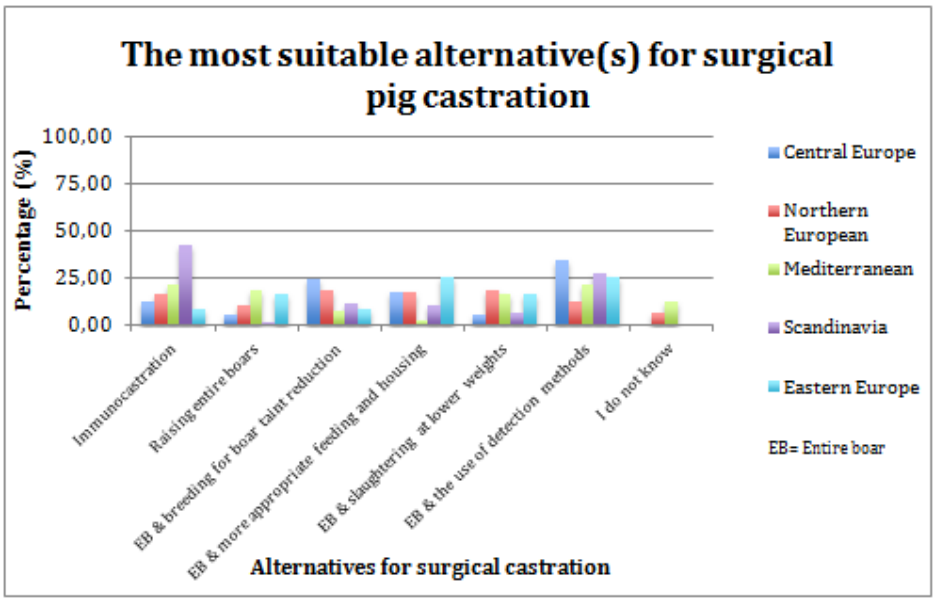


Figure 4.7. The most suitable alternative(s) for surgical pig castration

4.2.1.2 Surgical castration and the different professions

Appendix H (Table H-6) includes the mean values of each profession. The majority of the groups (type of professions) consider a significant reduction of surgical castration within 3 to 5 years in their country possible, except from the respondents that are a veterinarian, part of a non-governmental organization or belong to the group 'other'.

According to the respondents that are a scientific researcher, veterinarian, students or belong to the group 'other', *a legislative approach by the national government* would lead to the greatest success for reducing the number of surgical castration practices. Furthermore, policy advisors and officers and the respondents that are part of a non-governmental organization or employed in a slaughterhouse thought of either *marketing initiatives of retailers or of the sector* as most likely to succeed in a decrease. Finally, according to the one farmer respondent, *educational programs for consumers* is seen as the factor that has the greatest potential for a reduction of this procedure.

Several different country-based factors (*Lack of consumer awareness- and or willingness to pay of consumers, highly sensitive and low appreciation for boar taint and or lack of market acceptance*) are mentioned as, across the different groups, an obstacle for realizing a reduction of surgical castration of male pigs. However, the employee in a slaughterhouse, farmer and part of a non-governmental organization did also mention a *lack of acceptance in importing countries* and *or lack of political interest* as being likely factors for being a hinder for realizing a reduction.

4.2.1.3 Surgical castration and the different genders

Appendix H (Table H-7) provides an overview of the results (mean values) of the gender. About 60% of the male respondents considered a significant reduction of surgical castration possible within 3 to 5 years, which is slightly higher compared to the female respondents (53%). Furthermore, *a legislative approach by the national government* is considered as most successful for a reduction (respectively: a score of 2.6 by the males and 3.0 by the females). Finally, *highly sensitive and low appreciation for boar taint, high stocking densities, low space allowance and or large group sizes* and *group composition* are the most likely factors that that are an hinder in terms of realizing a reduction of surgical castration for both genders.

4.2.2 Tail docking of pigs

4.2.2.1 Country clustering

In Appendix I (Table I-1 till I-4) a complete overview of the results per geographic region and of each country separately can be found. This result-section will focus on the results regarding tail docking of pigs of the different geographic regions (clusters), which are shown in Figure 4.8.

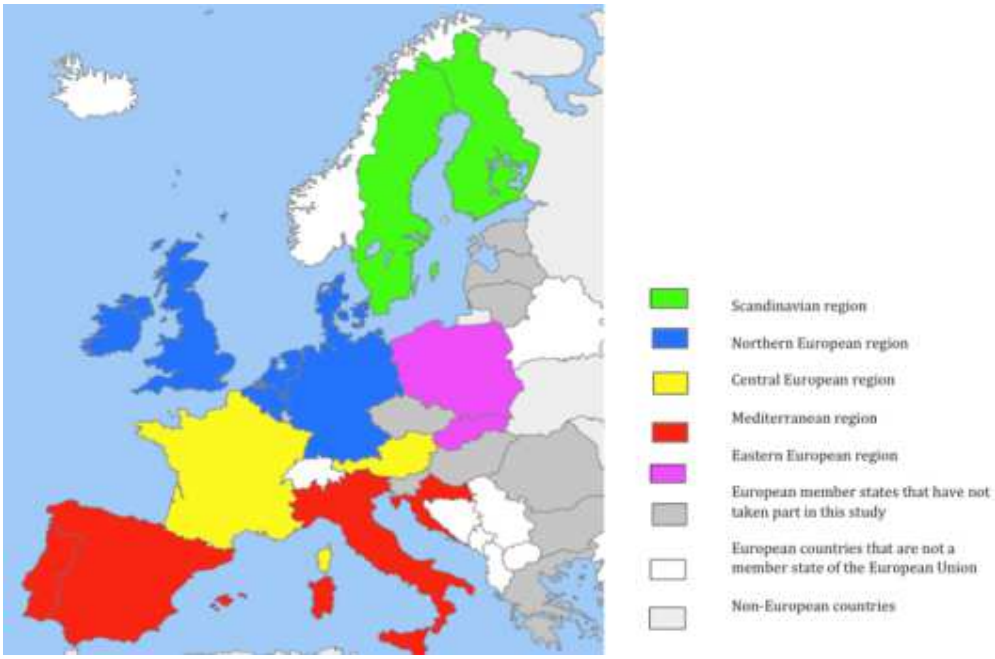


Figure 4.8. Overview of the geographic regions used for tail docking of pigs.

4.2.2.1.1 Possibility of a significant reduction of tail docking

Table 4.8 shows the large differences between geographic regions regarding the possibility of a significant reduction of tail docking of pigs within 3 to 5 years. A small majority (52,5%) of the respondents from Northern European countries and 75% of the Eastern European respondents think that a significant reduction of tail docking is impossible in their country. In contrast to these two regions, the Mediterranean (65,50%) respondents do consider a significant reduction possible. Finally, it can not be said if a significant reduction is thought of as possible in the Central European countries, because the results show a similar value (both 50%).

Table 4.8. Total number of respondents and the possibility of a significant reduction of tail docking of pigs within 3 to 5 years of each geographic region.

Geographic location		**Northern Europe[1]**	**Eastern Europe[2]**	**Mediterranean[3]**	**Central Europe[4]**
Total number		60	3	10	6
Significant reduction possible within 3-5 yrs (%)	Yes	47,50	25,00	64,50	50,00
	No	52,50	75,00	35,50	50,00

[1]Belgium, Denmark, Germany, Ireland, Netherlands and United Kingdom [2]Poland and Slovakia [3]Croatia, Italy, Portugal and Spain [4]Austria and France

4.2.2.1.2 Success factors

Figure 4.9 illustrates the factors that have the greatest chance in reducing tail docking of each geographic region. The Northern Scandinavian countries, which have already forbidden the mutilation by national law, indicated that *a legislative approach by the national government* is the factor that has the greatest chance of success in reducing the procedure of tail docking. In line with the Northern Scandinavian countries, *a legislative approach by the national government* is also seen as most successful for the Northern European, Mediterranean and Eastern European countries. A *wholesale price increase by retailers* is considered most successful for the central European countries.

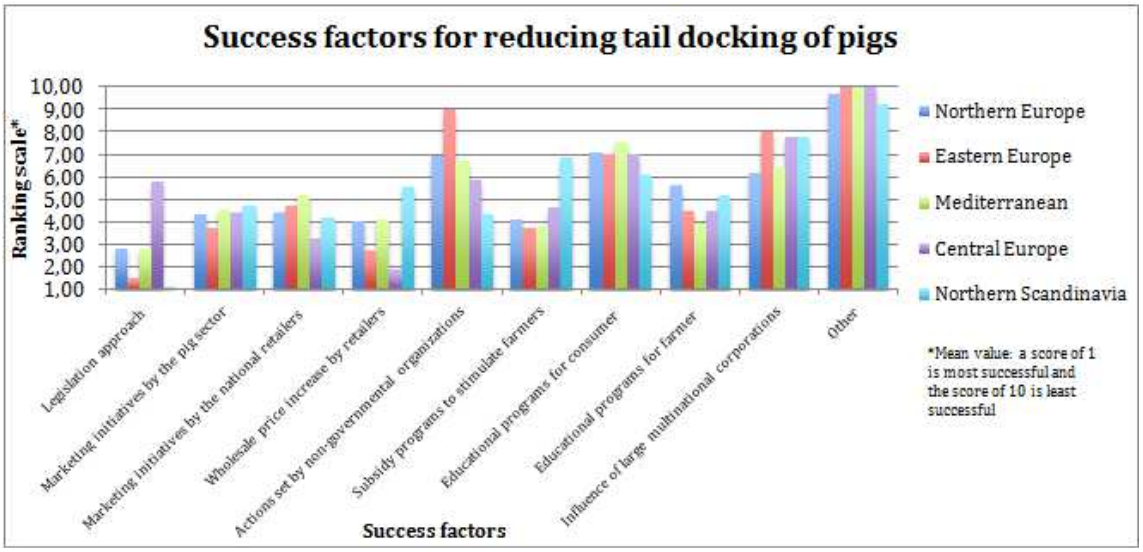


Figure 4.9. The factors that have the greatest chance in reducing tail docking for each geographic region

4.2.2.1.3 Obstacles

Figure 4.10 shows the country-based obstacles for reducing tail docking of pigs of each geographic region. The results indicate that Central,- and Eastern European countries consider *a lack of willingness to pay by consumers* as a country-based hinder for realizing a reduction of tail docking. Furthermore, *a lack of political interest* and "*economical aspects*" are thought of obstacles for the Eastern European countries.

Figure 4.11 illustrates the animal production based factors that likely form an obstacle for reducing tail docking of pigs. Each region mention that *high stocking densities, low space allowance and or large group sizes* and *insufficient or absence of enrichment materials* are problematic factors in realizing a reduction of tail docking for each geographic region. Furthermore, *floor type of housing system* is also considered as an obstacle by each region, except from the Mediterranean countries. Finally, the Eastern European country do also think that *housing environment, mixing of litters after weaning* and *frequent or unexpected changes* are obstacles for realizing a reduction of tail docking.

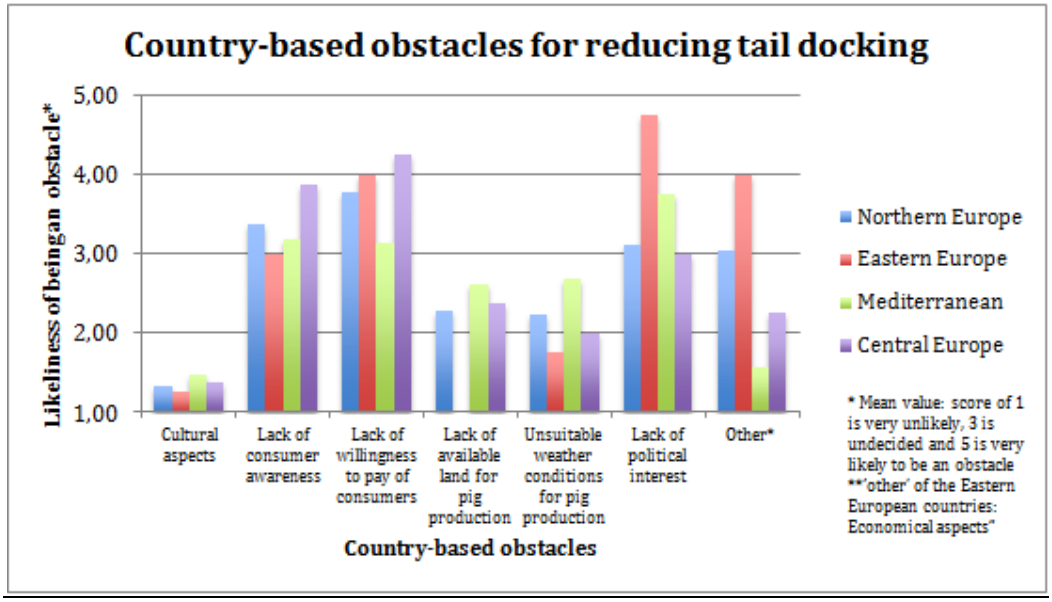


Figure 4.10. Country-based obstacles for reducing tail docking of pigs of each geographic region

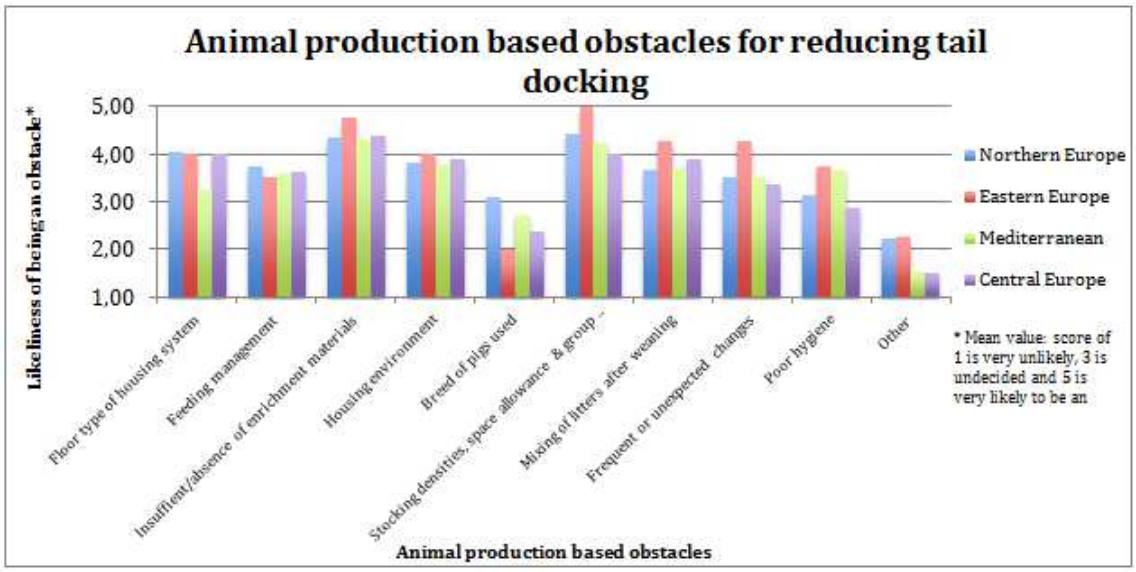


Figure 4.11. Animal production based obstacles for reducing tail docking of pigs.

4.2.2.2 Tail docking and the different professions

Appendix I (Table I-5) includes the results (mean values) regarding tail docking of each profession. According to the result, the majority of the different groups (type of professions) consider a significant reduction of tail docking within 3 to 5 years within their country possible. However, the policy officers and advisors and non-governmental organization thought of it being as impossible (respectively 57,1% and 62,5%). The respondents that are a scientific researcher, veterinarian, farmer, student or a member of a non-governmental organization thought of *a legislative approach by the national government* as the most successful in reducing tail docking. The remaining groups, policy advisors or officers, employed in a slaughterhouse or 'other' considered either *actions initiated from the pig sector* or *a wholesale price increase of retailers* as most likely to succeed in a reduction of the procedure of tail docking.

Furthermore, the results showed that the biggest country-based obstacles are, across each group, for realizing a reduction of tail docking: *a lack of awareness and or willingness to pay of consumers* and *or a lack of political interest*.

Finally, the most frequently mentioned animal-production based factors that form an handicap for a reduction, across each group, are: *high stocking densities, low space allowance and or large group sizes, insufficient or absence of enrichment materials* and *housing environment*.

4.2.2.3 Tail docking and the different genders

In Appendix I (Table I-6) an overview of the results (mean values) regarding tail docking of the genders can be found. A slightly higher part of the females (59.6%) consider a significant reduction of tail docking possible compared to the males (51%). Furthermore, *a legislative approach by the national government* is considered by both genders as the most successful factor in realizing a reduction of tail docking (3.09 by the males vs. 3.35 of the females).

Finally, *a lack of willingness to pay, insufficient or absence of enrichment materials* and *high stocking densities* are considered as the biggest obstacles for realizing a reduction of tail docking of pigs.

4.2.3 Beak trimming of laying hens

4.2.3.1 Country clustering

In Appendix J (Table J-1 till J-5) a complete overview of the results per geographic region and of each country separately can be found. This result-section will focus on the results regarding beak trimming of laying hens of the different geographic regions (clusters), which are shown in Figure 4.12.

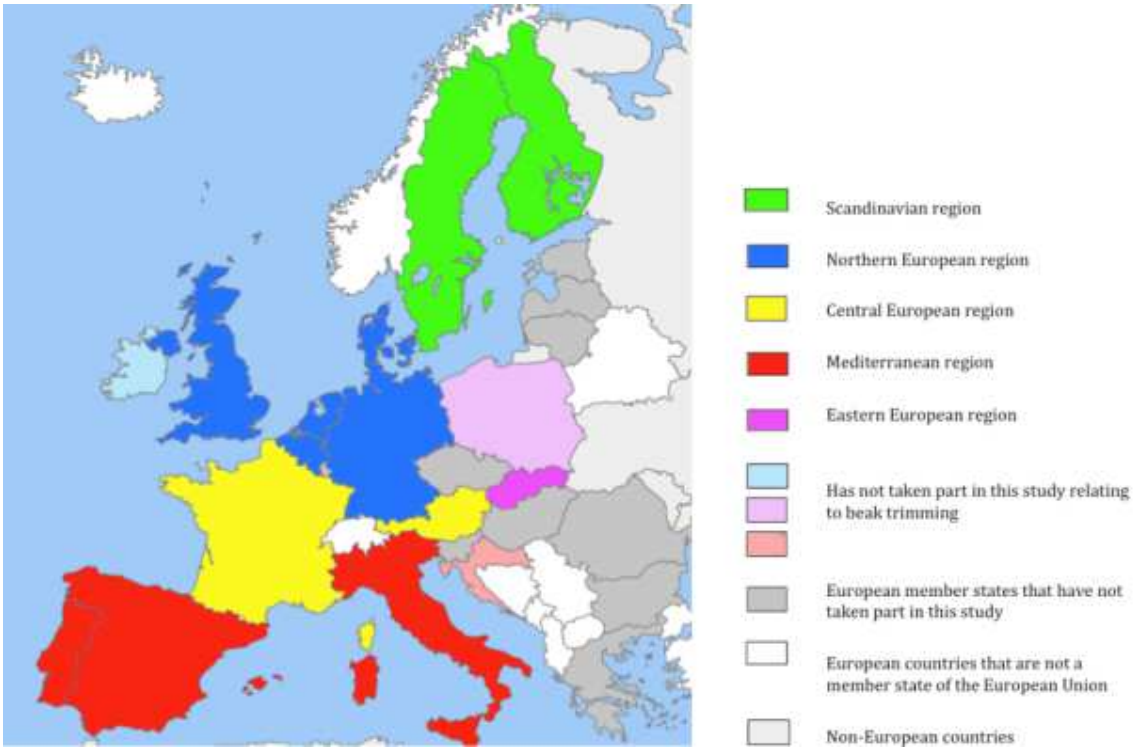


Figure 4.12. Overview of the geographic regions used for beak trimming of laying hens.

4.2.3.1.1 Possibility of a significant reduction

According to the majority (68,93%) of the respondents of Northern European countries a significant reduction of beak trimming of layinghens is achievable within 3 to 5 years (Tabel 4.9). However, the other three geographic regions (Mediterranean, Central European and Eastern European countries) do not consider a significant decrease of beak trimming possible (respectively 66,67%, 100% and 100%).

Tabel 4.9. Total number of respondents and the possibility of a significant reduction of surgical castration of male pigs within 3 to 5 years of each geographic region.

Geographic cluster		**Northern Europe[1]**	**Mediterranean[2]**	**Central Europe[3]**	**Eastern Europe[4]**
Total number		50	4	3	1
Significant reduction possible within 3-5 yrs (%)	Yes	68,93	33,33	0,00	0,00
	No	31,08	66,67	100,00	100,00

[1]Belgium, Germany, Netherlands and United Kingdom [2]France [3]Italy, Portugal and Spain [4]Slovakia

4.2.3.1.2 Success factors

Figure 4.13 illustrates the factors that have the greatest chance in reducing beak trimming of Austria, Denmark, Finland and Sweden. These four countries have already forbidden beak trimming of laying hens. A *legislative approach by the national government* is mentioned as the most successful factor for the Northern Scandinavian countries in reducing the number of procedures of this mutilation, while *initiatives of the poultry sector* are seen as most important for Austria and Denmark.

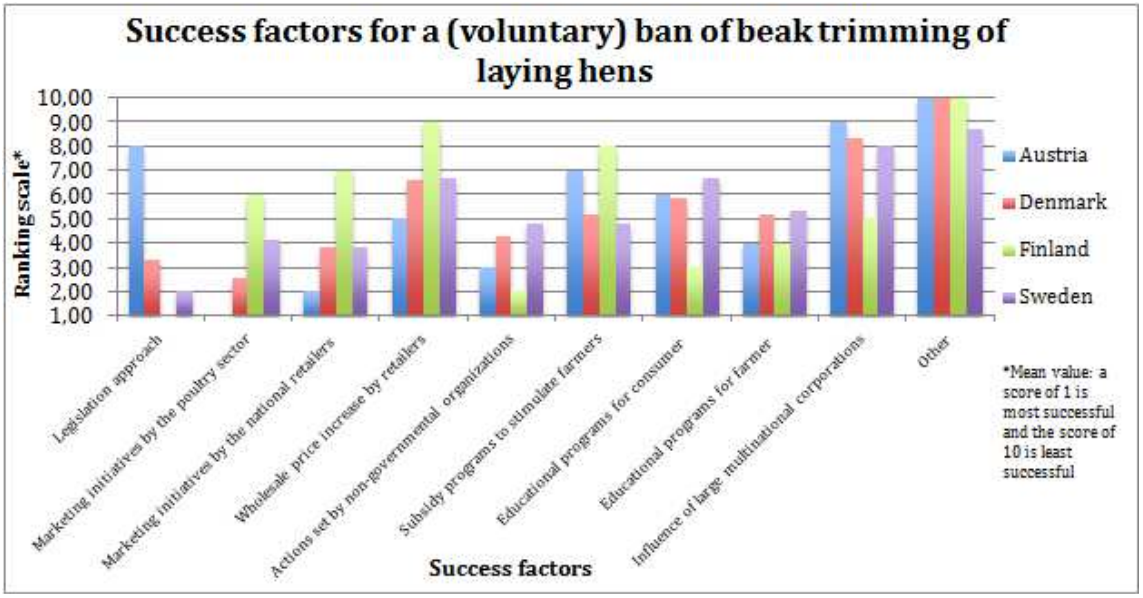


Figure 4.13. The factors that have the greatest chance in reducing beak trimming of laying hens of four countries

Figure 4.14 shows of each of the four regions the factor that has the greatest chance in reducing beak trimming of laying hens. Each region considers *a legislative approach by the national government* as the most successful factor in reducing beak trimming.

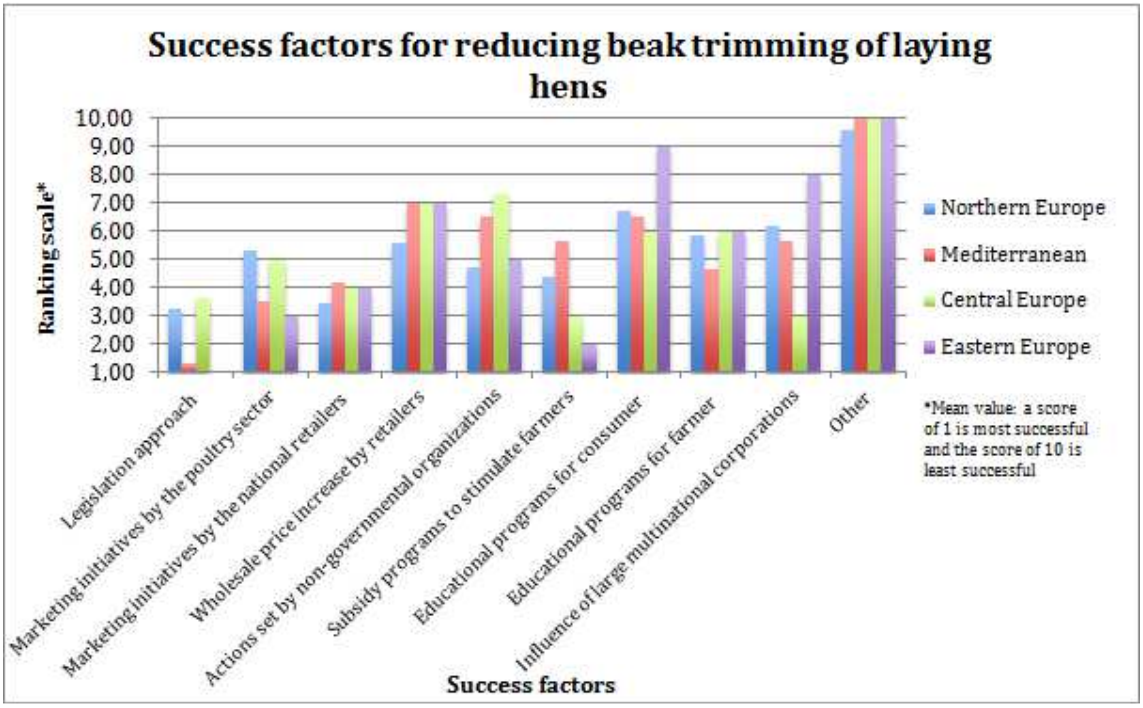


Figure 4.14. The factors that have the greatest chance in reducing beak trimming of laying hens for each geographic region

4.2.3.1.3. Obstacles

Figure 4.15 illustrates the mean scores of the country-based obstacles of each geographic region. *A lack of willingness to pay by consumers* is seen as likely an obstacle for reducing beak trimming of each geographic region, except from the Northern European countries. Furthermore, the Mediterranean and Eastern European countries consider also *a lack of political interest* as factor that is an hinder for a reduction. Moreover, the "*economy"* of the Eastern European countries is also considered as likely being an obstacle for a reduction. Additional hinders (*a lack of consumer awareness*, *lack of farmer awareness about the other possibilities without beak trimming* and *lack of scientific data showing that it is possible to do without any damaging consequences for birds and farmers*) are for the Central European country also seen as a problem.

Figure 4.16 shows that the animal production based obstacles highly differ between the geographic regions. *High stocking densities and large group sizes* and *Insufficient or absence of litter materials* are the factors that are most frequently seen as obstacles for reducing beak trimming of laying hens for each region except from the Northern European countries. Moreover, *breed of laying hens used, housing environment* and *frequent or unexpected changes* are also factors that are according to Eastern and Central European countries need to be taken care of since they likely form an obstacle for a reduction. The *housing systems used* in the Mediterranean and Central European countries is seen as an additional problem, while the *hygiene status* and *"lightening, mineral feed"* are factors that the Eastern European countries struggle with.

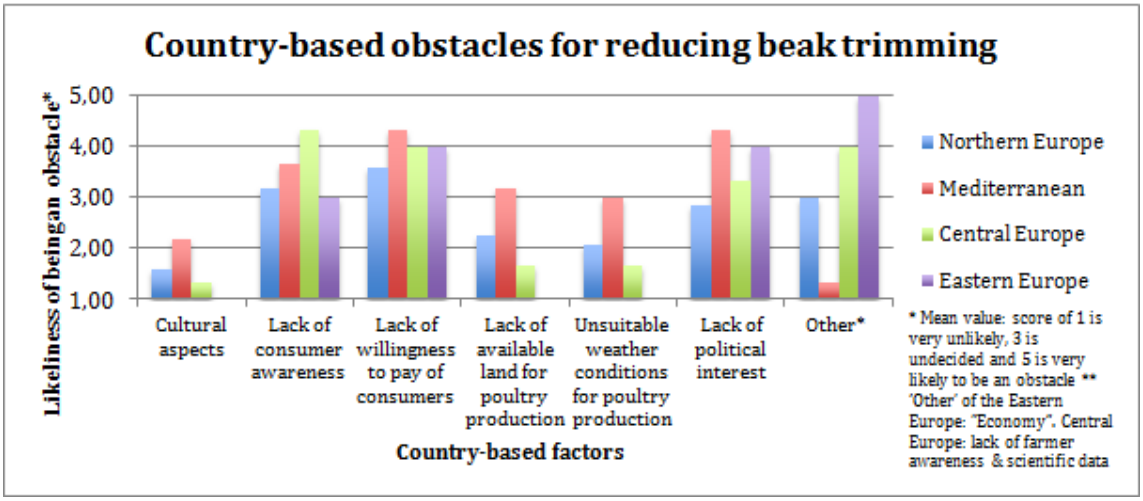


Figure 4.15. Country-based obstacles for reducing beak trimming of laying hens

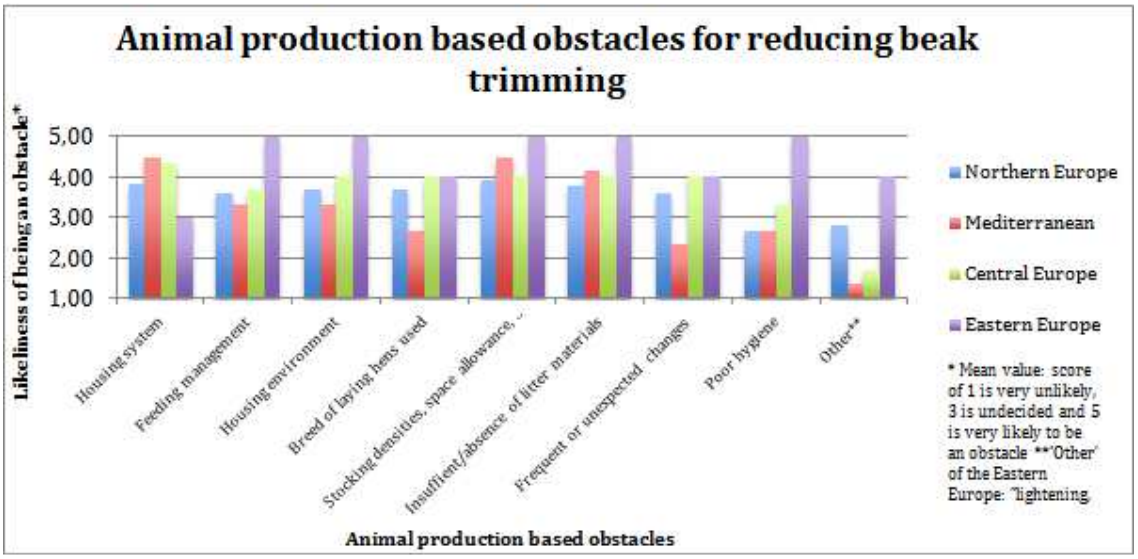


Figure 4.16. Animal production-based obstacles for reducing beak trimming of laying hens

4.2.3.1.4 Housing management & breed

Figure 4.17 shows that furnished cages are the most frequently used housing systems of laying hens in Mediterranean,- Central-, Eastern European,- and Northern Scandinavian countries. Northern European countries mainly use aviary systems.

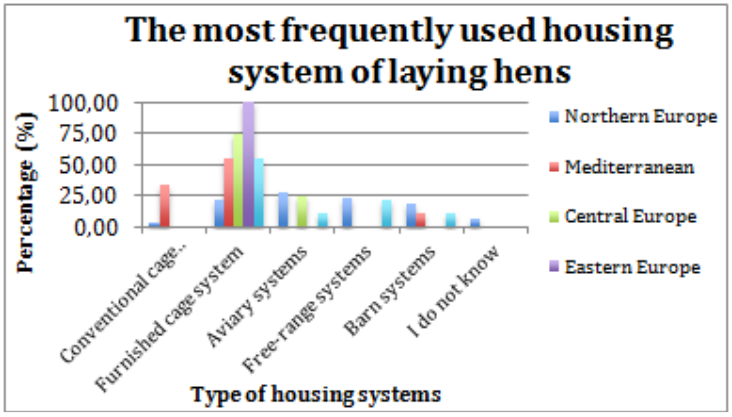


Figure 4.17. The most frequently used housing system of laying hens

Figure 4.18 illustrates that brown breeds of laying hens are most commonly used across the regions, except from the Northern Scandinavian countries. This Northern region most commonly uses white laying breeds.

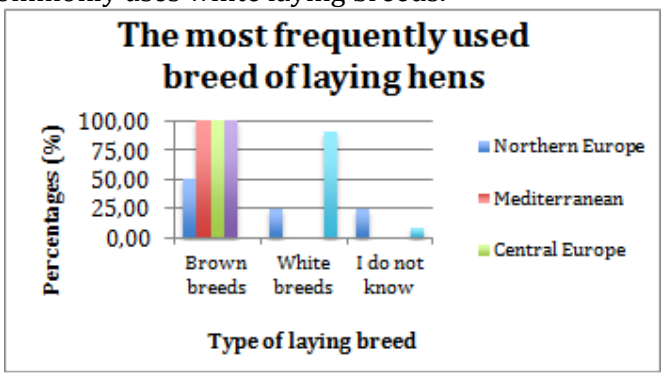


Figure 4.18. The most frequently used breed of laying hens

Table J-5 in Appendix J includes a total overview of the results regarding the questions about housing management and breed of hens used.

4.2.3.2 Beak trimming and the different professions

Table J-6 in Appendix J includes a total overview of the results regarding the different professions. Each group (type of profession) considers a significant reduction of beak trimming possible within 3 to 5 year in their country, except from the group farmers (80% of the farmers indicated that it is impossible). Additionally, the results indicated that scientific researchers, employed in a slaughterhouse and the veterinarians consider *a legislation approach by the national government* as most successful in terms of reducing the number of procedures of beak trimming. Furthermore, the policy advisors or policy officers consider *educational programs for farmers* as most appropriate for a reduction. In contrast to the policy advisors or officers, the farmers and non-governmental organization mentioned that *initiatives from the sector* is most successful for the reduction. The final two groups, students and 'others', marked *a subsidy program for farmers* as most successful.

Moreover, the results showed that the biggest obstacles are, across each group, for realizing a reduction of beak trimming is a *lack of awareness* and or *willingness to pay of consumers.* Finally, the numbers of animal-based factors mark as potential handicaps for a reduction differ between the groups. Scientific researchers, veterinarians and policy advisers and officers marked not any factors as a problem, while the other groups marked several ones (*e.g. housing system, litter material and frequent or unexpected changes*).

4.2.3.3 Beak trimming and the different genders

Table J-7 in Appendix J includes a total overview of the results regarding the different genders. A clear difference between the responses given by male or by females could be found regarding the statement if a significant reduction is achievable in their country within 3-5 years, which is answered by the majority (75.6%) of the females. In contrast to the females, only half of the males (50%) consider a significant reduction possible. Moreover, both genders consider *a legislation approach by the national government* as most successful in reducing beak trimming. However, females (2.93) consider this factor as slightly more successful in reducing beak trimming compared to males (3.34). Finally, none of the sexes indicated any factor for being likely an obstacle in realizing a reduction of beak trimming.

5. Discussion

5.1 Introduction

The results of the literature study on the current status of the three mutilations (surgical castration of male pigs, tail docking of pigs and beak trimming of laying hens) across the European Union and the results of the questionnaire will be discussed in this section. The section consists of three sub-paragraphs, one for each mutilation (sub-paragraphs 5.2-5.4). Essential elements of the framework of factors that influence the importance attached to animal welfare (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*") will be used to explain the results of the literature study and questionnaire of the three mutilations in the broad context of animal welfare accross the European Union.

The sub-paragraphs will discuss the above-mentioned results by referring to the sub questions of this study, namely: the influence of the individual member states in the European Union and the key success factors and the biggest obstacles in realizing a reduction of each of the three mutilations within the geographic regions. It is expected that the sub questions of this study contribute to answer the research question: *which European member states have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce the following three mutilations*:

1. Surgical castration procedures in male pigs?
2. Tail docking procedures in pigs?
3. Beak trimming procedures in laying hens?

It is important to mention some drawbacks of this study. First of all, the Eastern European countries consist of only one to three respondents, which could be related to a language barrier. According to the one Polish respondent, the English language is not well understood by his/her colleagues. Consequently, it explains why the number of respondents of Eastern European countries is low. Secondly, a lack of awareness of consumers and or willingness to pay for more animal friendly products is mentioned as one of the key problems for reducing a mutilation. However, the questionnaire is not filled out by a general category of 'consumers', but focused on specific professions, like: scientific researcher or veterinarian. Consequently, more research is needed to confirm the lack of consumer awareness and willingness to pay. Thirdly, the number of policy officers/advisors is low, because the network of the Ministery could not be used. This network was used for a related study during the same period of time.

Furthermore, the questionnaire has not taken into account that Sweden and Finland have already forbidden tail docking of pigs and beak trimming of laying hens. Consequently, these respondents were not able to fill out the questionnaire in a proper way.

Moreover, a Likert scale was used to measure the likeliness (score 4 and 5) of several factors that possibly form an obstacle for a reduction of a mutilation and a Ranking scale was used for measuring which factor has the greatest change of success (score 1 to 3) in reducing one of the mutilations. However, the relatively small sample size and the different professions cause a high risk of outliers. Consequently, this could lead to misinterpretations of the results. Additionally, no significant differences could be found in this study. However, it does give insights into which European member states have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce the number of mutilations across the European Union.

5.2 Surgical castration of male pigs

This sub-paragraph of the discussion will not use the questionnaire results of Croatia, because only one respondent has filled out the questions regarding surgical castration of male pigs. As a consequence, the results are highly inconclusive and need further research.

The *influence of the individual member states within the European Union* is the first sub question of this study. According to the literature study, France, Germany, Spain and Poland are the biggest pig producing countries and Denmark, Germany, Spain and the Netherlands are the greatest exporting countries of porkmeat (Eurostat, 2014). These results show the high number of livestock animals (pigs) within these countries and in turn the high level of influence within the European Union related to pigs. This is in line with the high number of seats in the European Parliament of Germany and France. Furthermore, the United Kingdom and Italy are also influential states due to the large population of these countries (Florek, 2012; European Parliament, n.d.-b).

The second sub question of this study relates to the *key success factors for reducing the procedures of surgical castration with or without the use of analgesia and or anesthesia in male pigs in each geographic region.* A legislative approach by the national government is seen as the most successful factor for reducing the number of surgical castrated pigs in nearly each region[1]. The level of trust in the national governments of the Northern European countries plays a role in this (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*"). These countries held the government (partly) responsible for taking care of animal welfare (Roex and Miele, 2005; Kjærnes et al., 2007; Vanhonacker et al., 2010). They have a reason to do so, since more strict legislation concerning animal welfare is set on top of the European regulation within these countries (Vanhonacker et al., 2010; Mul et al., 2010; D'eath et al., 2014). In contrast to the Northern European countries, citizens within the Meditereanean and Eastern European regions do generally not highly care and their level of knowledge is low of animal welfare. Consequently, it is assumed that citizens will not take action to reduce the number of mutilations. Legislation is a way to force citizens to behave more animal welfare friendly and farmers to produce more animal friendly (European Commission; Ghione et al., 2013). Additionally, according to Meyer (2015) Southern and Eastern Europe tend to be more hierarchical compared to Northern European countries, which indicates that the influence of legislation implemented by high status people will be heard. The greatest succesfactor of the Central European countries remains to be discussed, because the mean values do not have a score that indicates 'success' (<3). This is possibly related to the low number of responses and the differenent profession that speeds up the risk of outliers (Ott & Longnecker, 2006). Similar to the Central European countries, the Netherlands and Germany do also not have a value of a succes factor beyond 3. However, it is expected that a successful reduction of this mutilation can not be achieved by one factor, but more than are needed. The Netherlands do not only belief in the role of the government, but also in the influence of the market to realize an higher standard of animal welfare (Kjærnes et al., 2007). Additionally, several non-legislative and legislative initiatives are active to reduce the number of surgical castration in Germany. Consequently, it shows

[1] German: "*It reaches the highest percentage of farmers and has the most widespread influence and is not voluntarily"* & Swedish: "*Most Swedes tend to adhere to animal welfare legislation"* & Spanish: *"...real changes come more from market requirements or legislation"*

that cooperation is thought of between the German pig sector and the national government (Pork processors, 2012; Schmidt, C, 2015).

The third sub question of this study that relates to surgical castration of pigs is: *Which of the two factors form the biggest obstacles in realizing a reduction of the procedures of surgical castration with or without the use of analgesia and or anesthesia in male pigs in each geographic region?.* First of all, the country-based obstacles will be discussed. The Meditereanean region considers the restrictions imposed by specialty or regional products and or being highly sensitive and or low appreciation for boar taint as likely being obstacles for reducing surgical castration. The literature study shows that the Italian pig meat is mainly produced for the Parma ham industry[2], which is a protected designation of origin. The regulations say that pigs need to be slaughtered around 9 months of age (160kg), which increases the risk of boar taint (Zamaratskaia, 2004; "Prosciutto di parma," n.d.). Additionally, it explains why about all of the pigs are surgically castrated in Italy. It is important to mention that about 20% of the Portuguese and Spanish pigs are also surgically castrated for the production of the Parma Ham industry (Backus et al., 2014).

A lack of market acceptance and being highly sensitive to boar taint are seen as problems for realizing a reduction in Finland, Germany, Central European and Eastern European regions. Generally, being highly sensitive to boar taint is often not accepted by the market, because of the unpleasant smell[3] (Valeeva et al., 2009). Consequently, it is suggested that these two factors are related. No research could be found that indicate significant differences of sensitivity for boar taint between the regions. A lack of acceptance in importing countries of non-castrated pigs is considered as an obstacle by the Netherlands and Denmark. These countries are, together with Germany, the biggest exporting countries of pigs and porkmeat in Europe (Klompenhouwer, 2014; Simoes, n.d.-b,-d). Consequently, they highly depend on the acceptance of non-castrated pigs in importing countries. It is expected that importing countries, mainly Italy and third countries, do not accept non-castrated pork meat[4] (Valeeva et al., 2009; Backus et al., 2014; Redactie, 2014). It is noteworthy to mention that Belgium and Germany do not consider this factor as an obstacle. Since Germany is the biggest exporting country of pork meat in Europe and about 62% of the total number of Belgian produced pig meat was exported in 2012 (Redactie, 2014; Simoes, n.d.-c). However, it could be that a 'lack of acceptance in importing countries of non-castrated pigs' is interpreted by the Germans as a 'lack of market acceptance', which explain the confusion in the results.

Furthermore, it is interesting to zoom in on the Eastern European region. This region considers restrictions imposed by specialty or regional products, a lack of market acceptance and lack of acceptance in importing countries and being highly sensitive to boar taint as problems for a reduction of this mutilation. This can be explained by the fact that Poland exports mainly (±75%) porkmeat to Eastern European countries, Asia or Italy (Simoes, n.d.-i). These countries do not have a sense of urgency to stop castration, but stick to their current practices (Valeeva et al., 2009; Backus et al., 2014)[5].

[2]Italian: "The farmers are not interested to raise castrated male pigs for management or economic reasons, they are forced in practicing castration to guarantee a specific quality of products"
[3]German: "*At the moment, there is almost no market acceptance of entire males & Boar taint sensitive consumers are a huge risk for pork market"*
[4]Danish: *"Countries exporting very much pig-meat to the rest of the world will also have to explain the change in the procedure of castration to their customers outside of the EU; luckily countries like China are making huge developments of alternative markets at the moment - but still; it can become an obstacle if this risk is not managed carefully"*
[5]Polish: "Reaction of markets importing European pork is difficult to be predicted or the meat might not be accepted by demanding markets like Japanese one" & "There is no method of detecting boar taint on slaughter line which makes it difficult to divide the carcasses for different products (fresh meat, processed products) or to select proper carcasses for export to demanding markets"

Furthermore, the Eastern European region surgically castrates about all its pigs and considers animal welfare of low importance (Ghione et al., 2013; Backus et al., 2014). As the society does not see it as much of a problem, there will be a low market acceptance of non-castrated boars. As a consequence, the industry and or government do not have much reason to make an effort to forbid pig castration (Ghione et al., 2013; Backus et al., 2014; FCEC, 2015).

Moreover, a lack of consumer awareness and or willingness to pay for animal friendly products are expected to be additional obstacles for each of the regions[6]. Especially within the Meditereanean regions, research of Ghione et al. (2013) has showed that the level of knowledge and interest is especially low in Southern parts (e.g. Spain and Italy) of Europe. Furthermore, Vanhonacker & Verbeke (2011) have looked into the attitude of Belgian consumers towards alternatives for castration, as an indication of a Northern European country. They have also confirmed the low level of awareness about the current situation of surgical castration and its alternatives (44,5% have never heard of physical castration, 85,3% have never heard of the vaccine method and 58,2% never heard of boar taint, $P < 0.001$).

The final country-based obstacle that will be discussed relates to the cooking habits of the Eastern- and Central European regions that are used to prepare pork meat. It is known that the use of herbs, type of meat and the way it is prepared highly influence the smell of boar taint (Valeeva et al., 2009; Beakert et al., 2011; Kristensen et al., 2012). However, no explanation could be found in literature about the specific cooking habits of these regions.

The second type of obstacles, related to the animal-production, will be discussed next. It is expected that unavailable and or insufficient detection methods are considered a problem for exporting countries, like: the Northern European region, and countries that have problems with accepting the risk of boar taint of non-castrated pork meat within their country, like: the Eastern European region. These systems could be a useful tool to create acceptance of non-castrated pigs within (importing) countries. However, it is remarkable that the biggest exporting countries as the Netherlands and Denmark do not think of this factor as an obstacle. The different types of professions and genders that have taken part in this study possibly plays a role in this, because they have a different attitude towards animal welfare issues (Appendix H, Table H-6&H-7). Research of Toma et al. (2012) has showed that a profession (used as an indicator for income) and level of education is of significant influence on the willingness to behave in an animal friendly way. Research of Vanhonacker et al. (2009) has showed that a difference exists between males and females when it comes to the level of concern on animal welfare related issues (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*").

Furthermore, the questionnaire shows that most of the countries hold their pigs in mixed–sex groups, which increase the risk of aggressive and sexual behavior (Zamaratskaia, 2014). Consequently, the factor 'group composition' is also seen as a hinder for reducing surgical castration (e.g. in Poland and Austria). However, not each region that raise pigs in mixed-sex groups indicates 'group composition' as likely being a problem, nor are other factors, like: feeding management, stocking densities and housing environment, indicated as problem when raising entire boars (Van der Peet-Schwering et al., 2013; Wagenberg et al., 2013). It is assumed that these countries have

[6]Danish: *"In Europe in general, consumer awareness about problems in pig industry is very low, also in case of the not-state-of-the art castration in piglets, which will make changes in this sector difficult to understand for consumers"*

taken other measures in order to prevent unwanted behaviors to occur in castrated pigs, like: the use of enrichment[7] (Van der Peet-Schwering et al., 2013).

A final remarkable result of the questionnaire that needs to be mentioned in this discussion section relates the the Scandinavian region. The majority of this regions does not consider a significant reduction of castration possible, which relates to the high importance given to animal welfare of Finland and Sweden (Ghione et al., 2013). Moreover, raising entire boars is not considered as an option, due to animal welfare related aspects, but prefer a change of castration method, like immunocastration. However, the biggest problem is that this method is currently not accepted by the society[8] (Valeeva et al., 2009).

All in all, it is suggested that the United Kingdom has the highest potential to be a coalition partner of Germany, Denmark, Netherlands and Sweden in order to successfully reduce the number of surgical castrated pigs within the European Union. The United Kingdom considers animal welfare of high importance, raise about all their pigs as entire boar and it is a highly influential state within the European Union (European Commission, 2007; Ghione et al., 2013; Backus et al., 2014; European Parliament, n.d.-b). However, the British questionnaire results indicate that a significance reduction of castration is not possible. A remarkable response, since the British have not been castrating their pigs (±100%) and slaughter them at a lower weight for over 30 years (Backus et al., 2014; FCEC, 2015). It is expected that the question was interpreted differently, like: 'a significant reduction is not possible, because we do not castrate'.

5.3. Tail docking of pigs

Sweden and Finland have already forbidden the procedure by national legislation[9] (EFSA, 2014). The high importance of animals welfare and more specifically the level of trust in the national governments to take care of animal welfare of the Scandinavian countries explain why a legislative ban is implemented (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*"). The results of Ireland and Croatia will not be used in this discussion section, because only one respondent of each country have taken part in this study. This makes their results highly inconclusive and need further research. Furthermore, the discussed results of the Eastern European region do not apply to Lithuania, since this country has already forbidden the procedure by national law (Valros & Heinonen, 2015).

The first sub question of this study that relates tail docking of pigs concerns the *influence of the individual member states within the European Union*. Similar to the previous sub-paragraph (5.2) of surgical castration of male pigs, Germany, France, Italy and the United Kingdom are the most influential member states within the European Union (Florek, 2012; European Parliament, n.d.-b). Additionally, Spain, Poland, Denmark and the

[7]British: *You don't need to castrate if you provide pigs with adequate space, enrichment and manage groups to reduce hassling behavior"*
[8]Finnish: *"Introduction of immune castration, at the moment slaughterhouses are not willing to accept immunologically castrated pigs because they are afraid of consumer reactions" & Swedish: "Sweden does not want a reduction of castration of male pigs, but a change of castration method. Intact male pigs cause much animal suffering at the end of the fattening period and is not an animal welfare friendly option"*
[9]Swedish: *"Legislative approach because Swedes tend to adhere to legislation and especially when it comes to animal welfare, it is not socially acceptable to carry on procedures that is not in compliance with the legislation"*

Netherlands are also influential states due to being either on of the biggest pig producing countries or one of the greatest exporting countries of porkmeat (Eurostat, 2014).

Secondly, the study looked into *the key success factor for reducing tail docking procedures of pigs in each geographic region*. A legislative approach is considered as the most successful factor for a decrease in the number of tail docking procedures within almost each region[10]. A legislative approach will force citizens and farmers to act more animal friendly in especially the Meditereanean and Eastern European regions, since the influence of hierarchy is high and the absence of citizen interest in animal welfare is low (European Commission 2007; Meyer, 2015). The Italian results stand out from the other Mediterranean countries, because they consider educational programs for farmers as the most successful factor[11], which is in line with the low level of knowledge on animal welfare related aspects (European Commission, 2007). Furthermore, only two Portuguese respondents filled out the questionnaire, but the results are interesting to look at. The mean values indicate the importance of marketing initiatives[12], but a legislative approach is considered as most important by one respondents, while it is thought of as least important by the other respondent. Consequently, the most successful factor for a reduction of tail docking in Portugal remains to be discussed.

In contrast to the Meditereanean and Eastern European regions, the high level of trust in the national governments to take care of animal welfare of the Northern European countries explain why a legislative approach is seen as most succesful to reduce tail docking within this region (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*"). However, most of the Northern European countries do not have a clear value that shows 'success' (<3). The different professions and gender of the respondents explain the inconsistencies within the results (Appendix I, Table I-5&I-6) (Vanhonacker et al., 2009; Toma et al., 2012). Consequently, more studies are needed to prove which factor has the greatest chance of a successful reduction of tail docking within the individuel Northern European countries.

A wholesale price increase of national retailers is the factor with the greatest chance of reducing tail docking of pigs within the Central European region. It is expected that this factor relate to providing a financial benefit for the farmer, which gives them the feeling that it is possible to raise pigs with intact tails[13].

The third and final sub question is about *the two factors that form the biggest obstacles in realizing a reduction of tail docking procedures in pigs in each geographic region*. First of all, the country-based obstacles will be discussed. A lack of political interest is likely being a obstacle for realizing a reduction of tail docking within the Meditereanean- and Eastern regions[14]. This study could not found any legislative initiatives (nor any non-legislative initiatives) that aim for a ban or a reduction of tail docking of pigs within Meditereanean and Eastern regions, which explains the lack of political interest. In

[10]Dutch: *"Legislation needs to be put in place that makes it less attractive for consumers to buy cheap, animal-unfriendly meat"* & Spanish: *"Legislation (and price) are the main factors leading to changes in management"*
[11]Italian: *"Knowledge issue of farmers on how to raise pigs with intact tails"*
[12]Portuguese: *"because people are always very influenced by marketing campaigns"*
[13]French: *"The major difficulty with implementing change in the practice of tail docking is to make the farmer confident and to feel economically "safe". Takes time and is costly"* & Austrian: *"Farmers need to be convinced that intact tails raising is possible"*
[14]Portuguese: *"Although, willingness to pay for welfare friendly products is increasing in my country, it is still not strong"* & *"its a topic that many people, not even farmers, dont know anything about"* & Polish: *"There isn't any political interest in changing the law in this matter. In my opinion authorities would prefer the branch initiative"* & *"A lack of willingness to pay more for products from pigs kept in welfare, the market is mainly price driven"*

contrast to Meditereanean- and Eastern regions, several legislative and non-legislative initiatives could be found within the Northern European region that aim for a reduction (especially in the United Kingdom, Germany and the Netherands)[15] (Werkgroep Krulstaart, 2013; "Für mehr Tierschutz", 2013; PROVIEH, 2014; "Factsheet varkens," 2015; Ter Beek, 2015; CIWF, n.d.-c). A second obstacle within the Meditereanean, Central- and Eastern regions is a lack of consumer willingness to pay for animal friendly products. A lack of willingness to pay indicates that the willingness to behave in an animal friendly way is also absent (Lagerkvist & Hess, 2011; Ghione et al., 2013). According to the Framework of factors that influence the importance attached to animal welfare (Chapter 2, sub-subparagraph 2.3.2) consider these regions animal welfare not of high importance. One of the factors that influence the willingness to behave animal friendly behavior is the role of perceived responsibility (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*"). Sweden is an example of where citizens (74%) belief in this way (being personal responsible for animal welfare) of influencing animal welfare (European Commission, 2007). Ghione et al. (2013) has showed related results of Northern European countries: Germany (78%), Austria and Ireland (both 76%) think about livestock conditions of animals while going shopping. This may suggest that they feel personal responsible for the welfare of animals (Ghione et al., 2013). In contrast to these countries, only 39% of Italian respondents consider the conditions of animals, indicating that Italians do not feel personally responsible for the welfare of animals (Ghione et al., 2013). It should be noted that not considering animal welfare when doing shopping, could also be declared from the fact that Italians have low levels of knowledge about this topic and consider food quality of high importance (European Commission, 2007; Ghione et al., 2013). It is important to mention that the results of the literature study show that the political and consumer interest in animal welfare is low within the Meditereanean region (*Framework of factors that influence the importance attached to animal welfare*, Chapter 2, sub-subparagraph 2.3.2). However, the results of the questionnaire do not confirm this. It is expected that the low sample size and highly diverse types of respondents that have taken part in this study play a role in this (Vanhonacker et al., 2009; Norman, 2010; Toma et al., 2012).

Moreover, the unawareness of consumers is seen as the biggest country-related obstacle for a decrease of tail docking of several Northern European countries[16]. However, it is unknown if this is really the case for these countries, since no up to date research could be found about the willingness to pay of consumers. It is known that the willingness to pay is generally increasing and higher in Northern European countries compared to Southern European, but it has possibly not reached the level as is wished for (Ghione et al., 2013; Ingenbleek et al., 2013).

The second type of obstacles related to animal production and will be discussed next. The most frequently mentioned animal production based obstacles are high stocking densities and insufficient or absence of enrichment materials. These factors cause troubles for realizing a reduction tail docking due to tail biting behaviors. Zonderland et al. (2008) have found that providing straw is able to reduce the prevalence of tail-biting behaviors up to 50%. Furthermore, Goossens et al. (2008) have found that the

[15]German: *"Taken and planed actions of government and retail industry to improve animal welfare"* & *"Demand for animal friendly products by consumers"* & Netherlands: *"Animal welfare is more and more important in NL"* & British: *"Consumer demand for higher welfare products, due to it being an emotive subject for consumers"*

[16]Dutch: *"Consumer plays a big role, of course they need to be aware of the problem first. The farmer is mainly driven by economic reasons and if the consumer is willing to pay more so the farmer's paycheck does not decrease when he/she decides to pay more attention to the wellbeing of the animals"* & British: *"The general problem with high welfare products is that they are pricey. People are not going to buy them unless they are made aware of the problems in animal husbandry"*

prevalence of tail lesions was increased with a stock density of less than 0.31m^2 per pig (growing pigs) (P<0.01). It is remarkable that these factors are mentioned as obstacles within the Northern European region, since more strict regulation, compared to the European Union, is set regarding these to factors (Mul et al., 2010; D'eath et al., 2014). For example, pigs must have permanent access and sufficient amounts of enrichment materials in the Freedom food scheme in United Kingdom and the entire pig industry in Denmark (D'eath et al., 2014). Consequently, it is suggested that the national legislation is not complied to and it is not strongly enforced by inspection bodies to prevent tail biting from happening[17].

Furthermore, fully slatted flooring is most commonly used within each European region and must been seen as an obstacle. Smulders et al. (2008) have shown that the type of flooring is of significant influence on the onset of tail biting behaviors (P<0.001), which relate to the high concentration of unpleasant gases like ammonia that causes irritation in pigs. It is also frequently assumed that the use of fully slatted floorings causes problems for the use of enrichment materials, because it blocks the system (Zonderland et al., 2008; Ursinus et al., 2014).

Finally, literature has shown additional risk factors, which relate to feeding management and frequent or unexpected changes, of tail biting behaviors. Consequently, it explains why the tails are most commonly docked (Smulders et al., 2008; Taylor et al., 2010). However, no up to date information regarding the housing conditions of pigs within each country could be found, which would have given explanations for the differences found in the results between the regions and countries.

Summarizing, it is expected that Finland needs to be seen as the member state with the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce the number of tail docking procedures within the European Union. The fact that this procedure is already forbidden by the Finish national law shows the high importance attached to animal welfare, which makes it a coalition partner with great potential (Ghione et al., 2013; EFSA, 2014).

5.4. Beak trimming of laying hens

Austria, Denmark, Finland and Sweden have already forbidden beak trimming by means of a (voluntary) ban that is initiated by the poultry sector or national legislation (Fiks-van Niekerk & De Jong, 2007; Fromwald, 2010; Larsen, 2014). The high interest in and importance of animal welfare plays an essential role in the ban of beak trimming (Ghione et al., 2013). Furthermore, the Eastern European region includes only one respondent of Slovakia, which makes the credibility of these results highly questionable and will not be used in this study (Norman, 2010). It could be that the English language is considered as difficult within this region, as is mentioned by a Polish respondent. Literature has shown that this region frequently performs beak trimming of laying hens and the general lack of interest in animal welfare imply that this region has no sense or urgency to reduce the number of beak trimming procedures (Fiks- van Niekerk & De Jong, 2007; Ghione et al., 2013)

The influence of the individual member states within the European Union was the first sub question of this study. Germany, France, Italy and the United Kingdom are the most influential member states within the European Union due to the large population within

[17]British: *Many farms in the UK (approx30-40%) do not provide suitable material, relying more on 'toys'"*

these countries (Florek, 2012; European Parliament, n.d.-b). Furthermore, these countries, together with the Netherlands, Spain and Poland were the biggest egg producing countries in 2011 (CIWF, 2013).

Secondly, *the key success factor for reducing beak trimming procedures of laying hens in each geographic region* will be discussed. A legislative approach is the most successful factor for reducing the number of beak trimming procedures within the Meditereanean region[18], which is possibly related to the influence of hierachy and the absense of citizens involvement (European Commission 2007; Meyer, 2015). Subsidy programs for farmers and the influence of large multinationals are the two factors that have the greatest chance of success in realizing a reduction in France[19]. The role of multinationals can be explained by the fact that this is the only factor that requires international efforts, instead of national efforts. Since national efforts are currently absent, the (market) power of multinationals can have a huge impact on governmental policies (Irogbe, 2013). The most successful factor for reducing the number of beak trimming procedures is highly diverse between the Northern European countries. A legislative approach and initiatives of the market (especially retail initiatives) are considered as most successful for a reduction in the Netherlands and Germany[20]. In the near future this mutilation will be banned by implementation of national law within these countries (Kjærnes et al., 2007; World Poultry, 2013; Burkin, 2015). Furthermore, several non-legislative initiaties work on a reduction of this mutilation and the retail has proven to be influential when it comes to enhancing animal welfare in Germany (e.g. a ban of battery eggs)[21] (KAT, n.d.; Rondeel, n.d.). Furthermore, the results of Belgium and the United Kingdom do not show a factor of 'success' (<3), which indicates that more research is needed to find a success factor for these two countries. It is assumed that the different genders in the data, leads to different opinions when it comes to animal welfare (Vanhonacker et al., 2009). It is expected that more than one factor are of importance for a reduction (legislation and marketing initiatives of retailers)[22].

Furthermore, the study looked into the sub question: *which of the two factors form the biggest obstacles in realizing a reduction of beak trimming procedures in laying hens in each geographic region?* First of all, the country-based obstacles will be discussed. The Central-and Meditereanean regions consider a lack of political interest and a lack of consumer awareness and or willingness to pay as obstacles for a successful reduction of beak trimming[23]. These obstacles imply that animal welfare is not considered of high importance (European Commission, 2007). This can be explained by the fact that the underlying reason why people behave animal welfare friendly differs between countries (*Framework of factors that influence the importance attached to animal welfare*, Chapter 2, sub-subparagraph 2.3.2). While Sweden and the Netherlands care about the wellbeing of the animal and in turn consider animal welfare of high importance, Italy and France

[18]Portuguese: "Legislation is important to put boundaries in the poultry sector"
[19]French: *"Multinational are very powerful. They decide which type of production they want to market. National government have not enough money compared to multinational"* & *"Poultry farmers are not paid a lot"* & *"If producers loose or don't earn money with the action, they won't do it"*
[20]Dutch: *"There are two main incentives to change behaviour: (1) legislation and (2) market driven changes"*
[21]German: *"Strong power of retailers"* & *"It has happened with battery produced eggs: they were excluded from the assortment and never appeared again > same could happen with eggs from hen without beaks"*
[22]Beglian: *"Legislation and pressure by NGO or retailers: because breeders do not like or do not wish that beak trimming is not more allowed"* & British: *"Supermarkets have the potential to be the biggest drivers of change, to stop beak trimming without high levels of feather pecking requires investment by the farmers, this would encourage it. Finally, farmers will respond to legislation (which is why this has to be carefully applied)"*
[23] French: *"Consumers don't know that hens are beak trimmed; so they cannot put pressure on producers. Furthermore, most of consumers do not want to pay more for welfare. As no pressure is put by consumers, political interest for this problem is low"*

think about a better food quality when buying products of animal origin (Roex and Miele, 2005; European Commission, 2007; Kjærnes et al., 2007). This difference can be explained by a culture difference, the quality of food is more important than the welfare of animals in Southern-Europe (Ghione et al., 2013). An example is foie gras that is very popular in France (88% of the respondents indicate that they have consumed it at least once). This indicates that despite the negative aspects for the welfare of goose, the tradition of consuming still exists (Ghione et al., 2013). Furthermore, a lack of consumer awareness could be explained by the lack of access to information about animal welfare related issues within the Central-and Meditereanean regions (European Commission, 2007; Toma et al., 2012) (*Framework of factors that influence the importance attached to animal welfare*, Chapter 2, sub-subparagraph 2.3.2).
Secondly, the animal production based factors will be discussed. Absence and or insufficient availability of litter materials and large stocking densities are the most frequently mentioned factors that are likely being obstacles for realizing a reduction of beak trimming across the countries and or regions. These factors are also mentioned in literature as being high risk factor of feather pecking behaviors (Lambton et al., 2010; Haas et al., 2014).

Furthermore, it is expected that the type of breed does also form an obstacle across several regions and or countries, because brown breeds is the most frequently used breed across the regions. Literature has shown this type of breed performs higher levels of serious feather pecking compared to white breeds (De Haas et al., 2014; De Haas et al., 2013).

Moreover, according to literature and to the results of this study, (furnished) cage-systems are most frequently used within Central-, and Meditereanean region (Horne & Achterbosch 2008). Currently, in each type of housing system feather-pecking behaviors occurs. It is argued that it is lower in cage systems, because the animals are more individually housed (Pickett, 2008; Nicol et al., 2013). However, the welfare of hens is strongly impaired in these systems, like the inability of performing natural behaviors in cages. Consequently, these systems are banned within the European Union. Additionally, the Mediterranean countries and France have to change to an other system (Rodenburg et al., 2013). For this reason, it is expected that 'housing system of laying hens' is considered as an obstacle. Additionally, the Mediterranean climate is generally more tropical compared to the Northern European countries, which makes raising hens outdoors not a suitable alternative due to heat stress (Wageningen UR, 2015). Lambton et al. (2010) has showed that increasing temperatures in laying houses significantly increase feather pecking behaviors (P=0.001). Consequently, it was also expected that the Mediterranean climate would be considered as an obstacles for realizing a reduction of beak trimming within the Mediterranean region.

The Northern European region has not given any factor as likely being an obstacle. However, literature has shown that several animal-production related factors (e.g. feeding management and housing environment) are potential risks for feather pecking behavior and in turn are the reason why beaks are trimmed (Lambton et al., 2010; Haas et al., 2014). It is assumed that a different level of expertise, due to the presences of different professions in the data, leads to different opinions when it comes to animal production related obstacles (Appendix J, Table I-6& I-7) (Toma et al., 2012).

Finally, it is interesting to zoom in on the Meditereanean and Eastern European regions. The majority of these regions do not consider a reduction of beak trimming of laying hens possible, which is in contrast to the major part of the Northern European region.

The findings that a significant reduction of beak trimming is not possible within the majority of the Meditereanean and Eastern European regions possibly relate to the level of importance attachted to animal welfare. One of the factors that determine the importance of animal welfare is the use of animals. The use of animals differ between countries, due to the influence of religion (Chapter 2, sub-subparagraph 2.3.2 "*Framework of factors that influence the importance attached to animal welfare*"). The percentage of agnosticism (17.1-20.9%) is greater in the Northern and Western European countries compared to the Southern and Eastern European countries (respectively: 8.54-8.01%), which indicates that these Southeastern European countries are more religious and belief in a god (The Association of religion data archives, n.d.- a,-b,-c,-d). Consequently, animals play a different role (e.g. Muslims will not keep a dog at home). Additionally, culture is another aspect that influences the differences, like: dogs are man's best friend in the Netherlands and United Kingdom, while bullfights are common practice in Spain (Maclachlan, 2010; Szücs et al., 2012; "Cultural attitudes," n.d.). This difference is also visible in the number of stray animals, which is frequently seen in countries, like: Spain, Italy and Poland. Stray animals are not seen in Northern European countries, because they take care of these animals ("Stray dogs in Europe," n.d.).

The Portuguese response is worth noticing, because it does consider a significant reduction possible, because they have invented a new type of colony system that gives the hen more space allowance[24]. Although, it is an interesting finding, only one Portuguese respondent have filled out the questionnaire. Consequently, more research is needed to enhance the credibility of this result. Furthermore, the Britsh questionnaire results are also interesting to look at, because a slight majority of the British respondents have indicated that a significant reduction is impossible. This mainly relates to the thought that welfare of laying hens with intact beaks is more impaired compared to trimmed beaks especially in free range systems[25], which is in line with literature found that relate to the importance of poultry welfare in the United Kingdom (Ghione et al., 2013; Nicol et al., 2013). Additionally, a study conducted in Nottinghamshire concerning chicken welfare, revealed that 69,6% of British consumers say that they buy 'always or often' free-range eggs (Clonan et al., 2010).

All in all, Austria and Finland are suggested to have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden to reduce the number of beak trimming procedures within the European Union. The legislative or voluntary ban and the general interest in animal welfare make these countries successful coalition partners (Fiks- van Niekerk & De Jong, 2007; Fromwald, 2010; Ghione et al., 2013; Larsen, 2014).

[24] Portuguese: "*New colony system allows more space per hen > hens have more the opportunity to run from aggression of other hens"*
[25] British: "*Free range systems are growing in UK and these have a higher incidence of feather-pecking than other systems. Additionally, consumer preference for brown eggs from free range"* & *"It is more important for animal welfare to reduce the incidence of injurious pecking BEFORE consideration of the need to trim or not to trim (welfare is paramount!)"* & *"Introduction of Infra-red beak treatment is a major step forward in protecting bird welfare > research have indicated that this treatment does not result in chronic adverse consequences for nerve function, nor does it demonstrate evidence of chronic pain" & "After receiving advice from the GB Farm Animal Welfare Council in 2007, the Government considered a total ban on beak trimming not to be in the interest of laying hen welfare"*

6. Conclusion

In order to get animal welfare higher on the European agenda The Netherlands, Germany and Denmark reached an agreement on several animal welfare related mutilations in 2014. Sweden joined the trilateral agreement in 2015. It is expected that by means of a joint European approach the biggest win for improving animal welfare can be reached, and as a result the ultimate goal of improving animal welfare in the European context. Consequently, this study focused on the following research question: *which European member states have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden in order to reduce surgical castration procedures in male pigs, tail docking procedures in pigs and beak trimming procedures in laying hens?*. Furthermore, the influence of the individual member states in the European Union and the key success factors and the biggest obstacles in realizing a reduction of each of the three mutilations within several geographic region is looked at.

This study has not found significant differences between regions, mainly due to the low number of respondents. Consequently, more research is needed to confirm the results of this study. However, it gives insights into which European member states have the highest potential to become a coalition partner of the Netherlands, Germany, Denmark and Sweden in order to reduce the number of mutilations across the European Union.

Germany, France, Italy and the United Kingdom are the most influential member states within the European Union. Furthermore, these member states, together with the Netherlands, Spain and Poland are the biggest egg and pig producing states and or the greatest exporting countries of porkmeat.

A legislative approach by the national government is of each geography region seen as the most successful factor for reducing the number of surgical castrated pigs, except central European region (remains unknown). The majority of the pigs raised in the United Kingdom, Ireland, Spain and Portugal are entire boars. In contrast to these member states, the restrictions imposed by the Parma ham industry force the Italian pig market (and small parts of the Spanish and Portuguese pig production) to slaughter their pigs at heavy weights, which makes surgical castration the most desired option. Consequently, the restrictions imposed by the Parma Industry and the sensitivity for boar taint are the biggest obstacles for reducing surgical castration for the Mediterranean region. Similar to Italy, the Eastern European and Central European region do also nearly all surgical castrate their pigs and consider the restrictions imposed by the Parma Industry and or boar taint sensitivity as an obstacle(s). The Northern European and Scandinavian regions, like: the Netherlands and Germany, have already made some efforts on reducing the number of surgical castration procedures by means of non-legislative initiatives. However, the biggest obstacle for realizing a complete stop or a reduction of surgical castration of these high exporting regions, and an additional problem of the Central and Eastern European regions, relates to the absence of (international and or national) market acceptance of non-castrated pigs or immunocastrated pigs. This increases the importance of on-line detection methods on the slaughter line. Figure 6.1 illustrates a force field analysis of surgical castration of male pigs. The anaylsis visualizes that the United Kingdom has the highest potential to become coalition partner of The Netherlands, Denmark, Germany and Sweden in order to achieve a reduction of surgical castrated in male pigs within the European Union.

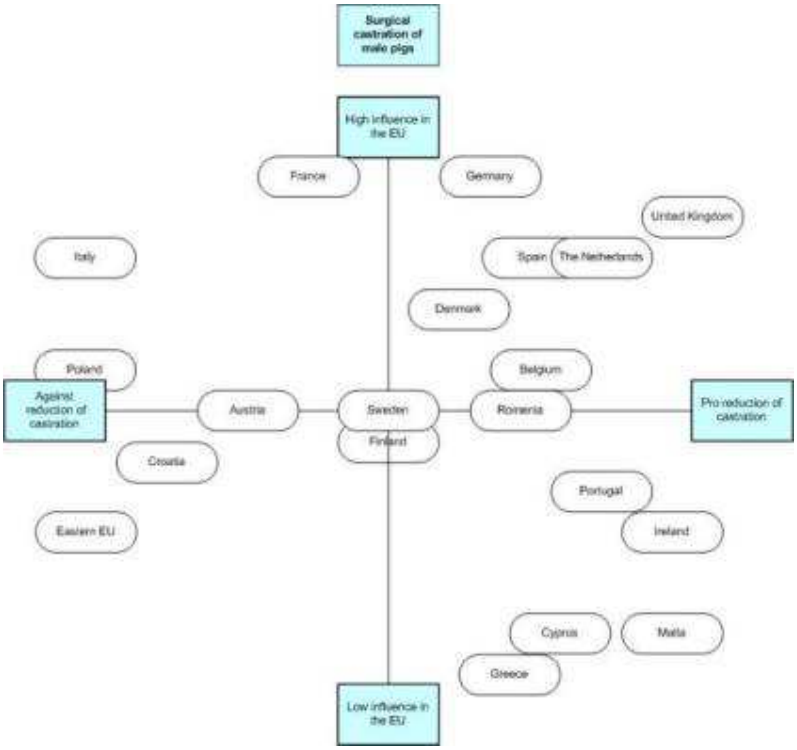


Figure 6.1. Force field analysis of surgical castration of male pigs. Based on the results found by means of the literature study on the current status of surgical castration within the European Union and the questionnaire

The majority of the geographic regions consider a legislation approach by the national government as the most successful factor for a reduction of tail docking of pigs. The Central European region is an exception, because they consider a wholesale price increase by retailers as most important. Tail docking of pigs is forbidden by the national law of Sweden, Finland and Lithuania. The Northern European countries do carry out this procedure on pigs, but an increasing number of legislative and non-legislative initiatives of the United Kingdom, Germany and the Netherlands show the urgency of phasing out this mutilation. The other European regions raise also pigs with docked tails, but no active initiatives could be found that aim for a reduction of this procedure. This is in line with a lack of political interest and or consumer willingness to pay of more animal friendly products of the Eastern-, and Central European regions and several Mediterranean countries. Large stocking densities of groups of pigs, floor type of housing system used and absence and or insufficient enrichment are the biggest obstacles for realizing a reduction of tail docking of all the regions. Figure 6.2 illustrates a force field analysis of tail docking of pigs. The anaylsis visualizes that FInland has the highest potential to become a coalition partner of The Netherlands, Denmark, Germany and Sweden in order to achieve a reduction of tail docking in pigs within the European Union.

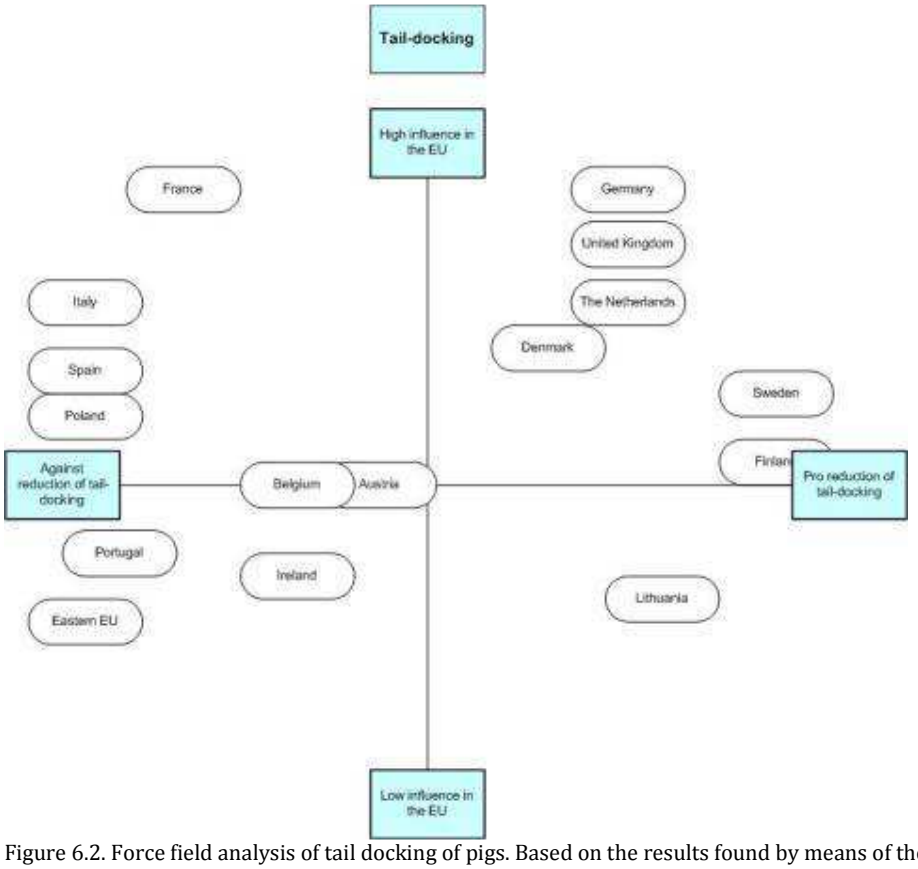


Figure 6.2. Force field analysis of tail docking of pigs. Based on the results found by means of the literature study on the current status of tail docking within the European Union and the questionnaire

The Mediterranean region considers a legislative approach by the national government as the factor with the greatest chance of success in realizing a reduction of beak trimming procedures. The central European region considers the influence of large multinationals as most successful, while the Northern European region is highly diverse. Consequently, no clear success factor of this region could be found. Furthermore, the questionnaire results of the Eastern European region could not be used, it is expected that this region is not ready (yet) to reduce the number of beak trimming procedures. Beak trimming of laying hens, is already forbidding in Sweden, Finland, Austria and Denmark either by means of national legislation or a voluntary ban by the poultry sector. Legislative and non-legislative initiatives aim for a stop or a reduction of beak trimming within the Northern European region in the near future. The other regions do not show a sense of urgency of reducing beak trimming of laying hens. A lack of willingness to pay of consumers and political interest are seen as country-based obstacles for reducing beak trimming within the Mediterranean and Central European regions. Furthermore, large stocking densities, breed and the housing system used are seen as the most frequent animal-production obstacles of each of the regions. Figure 6.3 illustrates a force field analysis of beak trimming of laying hens. The anaylsis visualizes that Austria and Finland are the countries with the highest potential to become coalition partner of The Netherlands, Denmark, Germany and Sweden in order to realize a reduction of beak trimming of laying hens within the European Union.

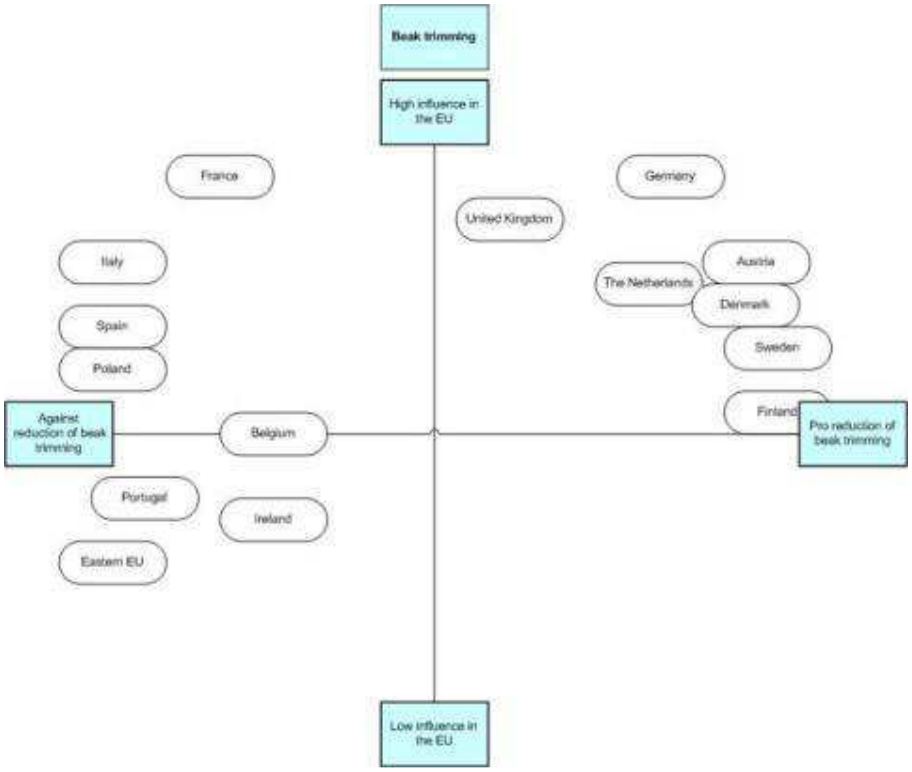


Figure 6.3. Force field analysis of beak trimming of laying hens. Based on the results found by means of the literature study on the current status of beak trimming within the European Union and the questionnaire

References

Agriculture. (n.d.). Retrieved, 7 November, 2015 from: http://www.vionfoodgroup.com/en/csr/key-themes-and-commitments/agriculture/

Backus, G.B.C. (2013). *Welkom.* Retrieved, 3 November, 2015 from: http://boars2018.com/2013/02/boar-meat-does-not-affect-consumption/

Backus, G.B.C. (2015). *CAMPIG: consumer acceptance in the EU and in 3rd countries of pig meat obtained from male pigs not surgically castrated* [Powerpoint slides]. Retrieved from: http://ec.europa.eu/dgs/health_food-safety/information_sources/docs/ahw/20150226_ahw_pig-castration_pres_5_en.pdf

Backus, G.B.C., Baltussen, W.H.M., Hennen, W.H.G.J., van de Wiel, D.F.M., Spoolder, H.A.M., Margry, R., Dahlmans, H., & Vaessen, J. (2008). Removing the taint: Bottlenecks and possible directions for a solution in the marketing of the meat of non-castrated male pigs. LEI Wageningen UR, Lelystad, report 27, 22pp.

Backus, G.B.C., Støier, S., Courat, M., Bonneau, M., & Higuera, M. (2014). First progress report from the European declaration on alternatives to surgical castration of pigs (16/12/2010). *Report from the Expert Group on ending the surgical castration of pigs (2012 – 2014).* Retrieved from: http://ec.europa.eu/dgs/health_food-safety/information_sources/docs/ahw/20150226_ahw_pig-castration_pres_9_en.pdf

Balancing Pig Welfare, Castration and Boar Taint. (2009). Retrieved, 3 November, 2015 from: http://www.thepigsite.com/articles/2553/balancing-pig-welfare-castration-and-boar-taint/

Baltussen, W.H.M., Backus, G.B.C., & Hennen, W.H.G.J. (2008). Economische effecten van het per direct stoppen met castratie van beerbiggen in Nederland. LEI, The Hague, Report 5-08-02, 23p.

Beekman, J. (2010). *Berenvlees, kwestie van smaak.* Retrieved, 2 Februari, 2016 from: http://www.pigbusiness.nl/nieuws/276/berenvlees-kwestie-van-smaak

Bekaert, K.M., Tuyttens, F.A.M., Duchateau, L., De Brabander, H.F., Aluwé, M., Millet, S., Vandendriessche, F., & Vanhaecke, L. (2011). The sensitivity of Flemish citizens to androstenone: Influence of gender, age, location and smoking habits. *Meat Science*, 88, 548-552.

Best, D. (2015). Rewe makes move on animal welfare. Retrieved, 6 November, 2015 from: http://www.just-food.com/news/rewe-makes-move-on-animal-welfare_id130817.aspx

Bestman, M.W.P., Koene, P., & Wagenaar, J.P. (2009). Influence of farm factors on the occurrence of feather pecking in organic reared hens and their predictability for feather pecking in the laying period. *Applied Animal Behaviour Science,* 121, 120-125.

Bestman, M.W.P., & Wagenaar, J.P. (2003). Farm level factors associated with feather pecking in organic laying hens. *Livestock production Science,* 80, 133-140.

Bhikhie, A. (2014, October 26). Europa staat dierenwelzijn in de weg. *NU.* Retrieved, 15 July, 2015 from: http://www.nu.nl/politiek/3911822/europa-staat-dierenwelzijn-in-weg.html

Bilcík, B., & Keeling, L.J. 1999. Changes in feather condition in realtion to feather pecking and aggressive behavior in laying hens. *Britisch Poultry Sciences,* 40(4), 444-451.

Bioland richtilinien [PDF Document]. (2015). Retrieved from: http://www.bioland.de/fileadmin/dateien/HP_Dokumente/Richtlinien/Bioland-Richtlinien_16_Nov_2015.pdf

Blanch, M., Panella-Riera, N., Chevillon, P., Font i Furnols, M., Gil, M., Gil, J.M., Kallas, Z., & Oliver, M.A. (2012). Impact of consumer's sensitivity to androstenone on acceptability of meat from entire male pigs in three European countries: France, Spain and United Kingdom. *Meat Science*, 90, 572-578.

Blokhuis, H.J., Keeling, L.J., Gavinelli, A., & Serratosa, J. (2008). Animal welfare's impact on the food chain. *Trends in Food Science Technology,* 19, 79-87.

Boogaard, B.K., Boekhorst, L.J.S., Oosting, S.J., & Sørensen, J.T. (2011). Socio-cultural sustainability of pig production: Citizen perceptions in the Netherlands and Denmark. *Livestock Science*, 140, 189-200.

Boone, H.N., Boone, D.A. (2012). Analyzing Likert Data. *Journal of Extension,* 50(2), 1-5.

Boyle, L., Harley, S., O'Connell, N., Moore, S., O'Hanlon, A., & Teixeira, D. (2012, October). *Improving pig welfare reduces carcass and financial loss*. Paper presented at the Pig Farmers' Conference, Ireland.

Bracke, M.B.M., De Lauwere, C.C., Wind, S.M.M., & Zonderland, J.J. (2013). Attitudes of Dutch Pig Farmers Towards Tail Biting and Tail Docking. *Journal of Agricultural and Environmental Ethics*, 26(4), 847-868.

Brambell Committee. (1965, December). *Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems.* Presented to Parliament by the Secretary of State for Scotland and the Minister o f Agriculture, Fisheries and Food by Command of Her Majesty, London, United Kingdom.

Brandes, E. (2011, September 13). Belgische Lidl stopt met castratie varkens*. Levensmiddelen krant*. Retrieved from: http://www.levensmiddelenkrant.nl/nieuws/buitenland/belgische-lidl-stopt-met-castratie-varkens

Breuer, K., Sutcliffe, M.E.M., Mercer, J.T., Rance, K.A., Beattie, V.E., Sneddon, I.A., & Edwards, S.A. (2003). The effect of breed on the development of adverse social behaviours in pigs. *Applied Animal Behaviour Science,* 84, 59–74.

Broom, D.M., & Fraser, A.F. (2007). *Domestic animal behaviour and welfare* (4th ed.). Wallingford, United Kingdom: CAB International.

Burkin, R. (2015). *German poultry industry agrees to beak trimming ban*. Retrieved, 11 November, 2015 from: http://www.worldpoultry.net/Broilers/Health/2015/7/German-poultry-industry-agrees-to-beak-trimming-ban-2658040W/

Carroll, J.A., Berg, E.L Strauch, T.A. Roberts, M.P. & Kattesh, H.G. (2006). Hormonal profiles, behavioral responses, and short-term growth performance after castration of pigs at three, six, nine, or twelve days of age. *Journal of Animal Science,* 84, 1271-1278.

Cheng, H. (2006). Morphopathological changes and pain in beak trimmed laying hens. *World's Poultry Science Journal*, 62, 41-52.

Chevillon, P. (n.d). Pig castration in France: more animal welfare friendly practices [Powerpoint slides]. *The French Pig and Pork Institute.* Retrieved from: http://slideplayer.com/slide/2374782/

Chicken standards: Breeder Layers [PDF Document]. (2014). Retrieved from: http://assurance.redtractor.org.uk/resources/000/965/987/Poultry_Scheme_-_Breeder_Layers_Standards.pdf

Clark, P. (2015) *Germany agrees voluntary beak trim ban for layers*. Retrieved, 12 November, 2015 from: http://www.fwi.co.uk/poultry/germany-agrees-voluntary-beak-trim-ban-for-layers.htm

Clonan, A., Holdsworth, M., Swift, J., Wilson, P. (2010). *UK Consumers Priorities for Sustainable Food Purchases.* Edinburg: United Kingdom.

Cohen, N.E., Brom, F.W.A., Stassen, E.N. (2009). Fundamental Moral Attitudes to Animals and Their Role in Judgment: An Empirical Model to Describe Fundamental Moral Attitudes to Animals and Their Role in Judgment on the Culling of Healthy Animals During an Animal Disease Epidemic. *Journal of Agricultural Environmental Ethics,* 22, 341-359.

Compassion in World Farming [CIWF]. (2013). *Statistics laying hens* [PDF Document]. Retrieved from: https://www.ciwf.org.uk/media/5235021/Statistics-Laying-hens.pdf

Compassion in World Farming [CIWF]. (n.d.-a). *Policies of UK Supermarkets – Pigs*. Retrieved, 21 November, 2015 from: https://www.ciwf.org.uk/media/5263422/uk-supermarket-policies-pigs.pdf

Compassion in World Farming [CIWF]. (n.d.-b). *Castration of piglets.* Retrieved, 2 November, 2015 from: http://www.ciwf.org.uk/farm-animals/pigs/welfare-issues/castration/

Compassion in World Farming [CIWF]. (n.d.-c). Pig farming in the EU: Briefing.

Courboulay, V., Eugene, A., & Delarue, E. (2009). Welfare assessment in 82 pig farms: effect of animal age and floor type on behaviour and injuries in fattening pigs. *Animal Welfare*, 18, 515-521.

Courboulay, V., Souffran, H., Guingand, N., Massabie, P., & Dubois, A. (2008). Fogging system: a way to improve the welfare of growing-finishing pigs during summer periods. *Journées de la Recherche Porcine*, 40, 243-246.

Craig, J.V. (1992). Beak trimming benefits vary among egg-strain pullets of different genetic stocks. *Poultry Science*, 71, 2007-2013.

Cultural attitudes towards animals in southern Spain. (n.d.). Retrieved, February 5, 2016 from: http://www.andalucia.com/pets/treatment.htm

Dawkins, M.S., Donnelly, C.A., & Jones, T.A. (2004). Chicken welfare is influenced more by housing conditions than by stocking density. *Nature,* 427, 342-344.

D'Eath, R.B., Arnott, G., Turner, S.P., Jensen, T., Lahrmann, H. P., Busch, M. E., Niemi, J. K., Lawrence, A. B. & Sandøe, P. (2014). Injurious tail biting in pigs: how can it be controlled in existing systems without tail docking?. *Animal*, 8(9), 1479-1497.

de Bock, J. (2015). *Gondola scant de Belgische food retail.* Retrieved, 6 November, 2015 from: http://www.gondola.be/nl/content/gondola-scant-de-belgische-food-retail-76829

de Dierenbescherming. (n.d.). *Waarom krijgt dit varkensvlees het Beter Leven-kenmerk van de Dierenbescherming?* [PDF Document]. Retrieved from: https://beterleven.dierenbescherming.nl/fileupload/20111219-varkensvlees-1-ster.pdf

de Haas, E.N., Bolhuis, J.E., de Jong, I.C., Kemp, B., Janczakc, A.M., & Rodenburg, B. (2014). Predicting feather damage in laying hens during the laying period. Is it the past or is it the present?. *Applied Animal Behavior Science,* 160, 75-85.

de Haas, E.N., Kemp, B., Bolhuis, J.E., Groothuis, T., & Rodenburg, T.B. (2013). Fear, stress, and feather pecking in commercial white and brown laying hen parent-stock flocks and their relationships with production parameters. *Poultry Science,* 92, 2259-2269.

de Kruijf, J.M., & Welling, A.A. 1988. Incidence of chronic inflammations in gilts and castrated boars. *Tijdschrift Diergeneekunde,* 113(8), 415-417.

de Lauwere, C., Hoogendam, K., Zonderland, J., & Bracke, M. (2009). Stoppen met couperen? Varkenshouders over staartbijten en staartcouperen. LEI Wageningen UR, Den Haag, Report 97, 60pp.

de Jong, I.C., Reuvekamp, B.F.J., & Gunnink, H. (2013a). Can substrate in early rearing prevent feather pecking in adult laying hens?. *Animal Welfare*, 22, 305-314.

de Jong, I.C., Gunnink, H., & van Emous, R.A. (2013b). Monitoring van onbehandelde vleeskuikenmoederdieren op een praktijkbedrijf. Wageningen UR Livestock Research, Lelystad, report 716, 34pp.

de Roest, K., Montanari, C., Fowler, T., & Baltussen, W. (2009). Resource efficiency and economic implications of alternatives to surgical castration without anaesthesia. *Animal,* 3(11), pp 1522-1531.

de Simone, F., & Serratosa, J. (2005). Biotechnology, animal health and animal welfare within the framework of European Union legislation. *Scientific and Technical Review of the Office International des Epizooties*, 24(1), 89-99.

Dennis, R.L., & Cheng, H.W. (2012). Effects of different infrared beak treatment protocols on chicken welfare and physiology. *Poultry Science,* 91, 1499–1505.

Department for Environment, Food & Rural Affair. (2010). *New safeguards for chickens*. United Kingdom: Crown copyright. Retrieved from: https://www.gov.uk/government/news/new-safeguards-for-chickens

Department for Environment, Food & Rural Affairs. (2011). *Attitudes and Behaviours around Sustainable Food Purchasing* (SERP 1011/10). Department for Environment, Food and Rural Affairs, London, United Kingdom, Report (SERP 1011/10), 44pp.

Derom, J. (2010). Colruyt stopt met verkoop vlees gecastreerde biggen. . Retrieved, 2 November, 2015 from: http://www.colruytgroup.com/en/node/475

Detecting and preventing boar taint. (2011). Retrieved, 1 November, 2015 from: http://agricultureandfood.co.uk/Current_issues/Danish_Matters/2011/October/Detecting_and_preventing_boar_taint.aspx#.Vq3DI4Tt7tt

Deter, A. (2014). *Niedersachsen startet Projekt "ungekürzter Schnabel"*. Retrieved, 11 November, 2015 from: http://www.topagrar.com/news/Home-top-News-Niedersachsen-startet-Projekt-ungekuerzter-Schnabel-1617214.html

Dierenwelzijn: 1 jaar 'Initiative Tierwohl'. (2015). Retrieved, 30 October, 2015 from: http://www.agroberichtenbuitenland.nl/duitsland/dierenwelzijn-1-jaar-initiative-tierwohl/

Dierenwelzijnsweb. (2013). *Versnelde uitfasering ingrepen bij pluimvee.* Retrieved, 20 November, 2015, from: https://www.groenkennisnet.nl/nl/dierenwelzijnsweb/show/Versnelde-uitfasering-ingrepen-bij-pluimvee.htm

Dunshea, F.R., Colantoni, C., Howard, K., McCauley, I., Jackson, P., Long K.A., Lopaticki, S., Nugent, E.A., Simons, J.A., Walker, J., & Hennessy, D.P. (2001). Vaccination of boars with a GnRH vaccine (Improvac) eliminates boar taint and increases growth performance. *Journal of Animal Science*, 79, 2524-2535.

EFSA. (2004). Welfare aspects of the castration of piglets. Scientific Report of the Scientific Panel for Animal Health and Welfare on a request from the commission related to welfare aspects of the castration of piglets. *EFSA Journal*, 91, 1-18.

EFSA. (2005). The welfare aspects of various systems of keeping laying hens: opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to the welfare aspects of various systems of keeping laying hens. *EFSA Journal*, 197, 1-23.

EFSA. (2007a). The risks associated with tail biting in pigs and possible means to reduce the need for tail docking considering the different housing and husbandry systems. *EFSA Journal,* 611, 1-13.

EFSA. (2007b). Animal health and welfare in fattening pigs in relation to housing and husbandry. *EFSA Journal,* 564, 1-14.

EFSA. (2014). Scientific Opinion concerning a Multifactorial approach on the use of animal and non-animal-based measures to assess the welfare of pigs. *EFSA Journal*, 12(5), 1-101.

EFSA. (2015). Scientific Opinion on welfare aspects of the use of perches for laying hens *EFSA Journal*, 13(6), 4131.

Eicher, S.D., Cheng, H.W., Sorrells, A.D., & Schutz, M.M. (2006). Behavioral and physiological indicators of sensitivity or chronic pain following tail docking. *Journal of Dairy Science,* 89, 3047-3051.

Eurogroup for Animals. (n.d.). *About us.* Retrieved, 16 July, 2015, from: http://eurogroupforanimals.org/about-us/

European Commission. (1998). Council Directive 1998/58/EC. *Official Journal of the European Union*, L 221.

European Commission. (1999). Council directive 1999/74/EC. Official Journal of the European Communities L 203/53.

European Commission. (2007). Treaty of Lisbon. *Official Journal of the European Union, C306/1.*

European Commission. (2007). *Attitudes of EU citizens towards animal welfare: Special Eurobarometer 270* [PDF Document]. Retrieved from: http://ec.europa.eu/public_opinion/archives/ebs/ebs_270_en.pdf

European Commission. (2008a). Council Directive 2008/120/EC. *Official Journal of the European Union, L47/5.*

European Commission. (2008b). Council Directive 2008/119/EC. *Official Journal of the European Union, L10/7.*

European Commission. (2014). *Animal Welfare.* Retrieved, 3 September, 2015, from: http://ec.europa.eu/food/animals/welfare/index_en.htm

European Commission. (2015). *Alternatives to pig castration*. Retrieved, 26 October, 2015 from: http://ec.europa.eu/food/animals/welfare/practice/farm/pigs/castration_alternatives/index_en.htm

European Medicines Agency [EMA]. (2014). *Improvac*. Retrieved, 1 November, 2015 from: http://www.ema.europa.eu/ema/index.jsp?curl=pages/medicines/veterinary/medicines/000136/vet_med_000130.jsp&mid=WC0b01ac058001fa1c

European Parliament. (2013). *How many MEPs will each country get after European Parliament elections in 2014?.* Retrieved, 23 October, 2015, from: http://www.europarl.europa.eu/news/en/news-room/20130308STO06280/How-many-MEPs-will-each-country-get-after-European-Parliament-elections-in-2014

European Parliament. (n.d. a). *Legislative powers*. Retrieved, 23 October, 2015, from: http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00004/Legislative-powers

European Parliament. (n.d. b). *MEPs.* Retrieved, 23 October, 2015, from: http://www.europarl.europa.eu/meps/en/map.html

European Union. (2015a). *How EU decisions are made.* Retrieved, 23 October, 2015, from: http://europa.eu/eu-law/decision-making/procedures/index_en.htm

European Union. (2015b). Regulations, directives and other acts. Retrieved, 23 October, 2015, from: http://europa.eu/eu-law/decision-making/legal-acts/index_en.htm

Eurostat. (2014). *Pig farming sector: statistical portrait 2014.* Retrieved, 20 February, 2016 from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Pig_farming_sector_-_statistical_portrait_2014

Fàbrega, E., Velarde, A., Cros, J., Gispert, M., Suárez, P., Tibau, J., & Soler, J. (2010). Effect of vaccination against gonadotrophin-releasing hormone, using Improvac, on growth performance, body composition, behaviour and acute phase proteins. *Livestock Science,* 132, 53-59.

Factsheet leghennen [PDF document]. (2015). Retrieved from: https://beterleven.dierenbescherming.nl/fileupload/pdf_sterren_consumenten/Tekst_BLk_leghennen.pdf

Factsheet varkens [PDF Document]. (2015). Retrieved from: https://beterleven.dierenbescherming.nl/fileupload/pdf_sterren_consumenten/Tekst_BLk_varkens.pdf

Farm Animal Welfare Council [FAWC]. (2007). Opinion on beak trimming of laying hens.

FeatherWel. (2013). *Improving Feather Cover: A guide to reducing the risk of injurious pecking occurring in non-cage laying hens* [PDF Document]. Retrieved from: http://www.featherwel.org/Portals/3/Documents/Advice_guide_%20V1.2%20%20May%202013.pdf

Fiks-van Niekerk, T.G.C.M., & De Jong, I.C. (2007). Mutilations in poultry in European poultry production systems. *Lohmann Information*, 42(1), 35-46.

Fiks - van Niekerk, T.G.C.M., Ruis, M.A.W., Gunnink H., & Reuvekamp, B.F.J. (2009a, May). *Effect of human animal contact with layer pullets on fearfulness and technical results in the rearing and laying periods*. Paper presented at the 8th European Symposium on Poultry Welfare, Cervia, Italy.

Fiks - van Niekerk, T.G.C.M., De Jong, I.C., Veldkamp, T., Van Krimpem, M.M., & Van Emous, R.A. (2009b). *Ingrepen bij pluimvee. Update 'literatuurstudie ingrepen bij pluimvee, 2006'*. Wageningen UR Livestock Research (formally: Animal Science Group), Lelystad, Report 255, 46pp.

Florek, J. (2011). Allocation of seats in the European Parliament and a degressive proportionality.

Font i Furnols, M., Gispert, M., Diestre, A., & Oliver, M.A. (2003). Acceptability of boar meat by consumers depending on their age, gender, culinary habits, and sensitivity and appreciation of androstenone odour. *Meat Science*, 64, 433-440.

Food Chain Evaluation Consortium [FCEC]. (2015). *Study and economic analysis of the costs and benefits of ending surgical castration of pigs. Workshop on alternatives to pig castration.* [Powerpoint slides]

Fraser, D. (1999). Animal ethics and animal welfare science: bridging the two cultures. *Applied Animal Behaviour Science*, 65, 171-189.

Fraser, D. (2005). *Animal welfare and the intensification of animal production, an alternative interpretation*. Rome, Italy: Food and Agriculture Organization of the United Nations.

Fraser, D. (2008). Understanding animal welfare. *Acta Veterinaria Scandinavia*, 50, S1.

Fraser, D., Weary, D.M., Pajor, E.A., & Milligan, B.N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6, 187-205.

Fredriksen, B., Font i Furnols, M., Lundstro, K., Migdal, W., Prunier, A., Tuyttens, F. A. M., & Bonneau, M. (2009). Practice on castration of piglets in Europe. *Animal,* 3(11), 1480-1487.

Freiland Tierhaltungsstandards [PDF Document]. (2007). Retrieved from: http://www.freiland.or.at/?Mitgliedsbetrieb_werden:FREILAND_Standards

Freire, R., Glatz, P.C., & Hinch, G. (2008). Self-administration of an Analgesic Does Not Alleviate Pain in Beak Trimmed Chickens. *Asian- Australasian Journal of Animal Sciences*, 21(3), 443-448.

Fromwald, S. (2010). *Laying hen case study Austria 1.* In: Compassion in World Farming [PDF Document]. Retrieved from: http://www.ciwf.org.uk/media/3818841/laying-hen-case-study-austria.pdf

Gentle, M.J., & Hunter, L.N. (1991). Physiological and behavioural responses associated with feather removal in Gallus gallus var domesticus. *Research in Veterinary Science* 50(1), 95-101.

Gentle, M.J., & McKeegan, D.E.F. (2007). Evaluation of the effects of infrared beak trimming in broiler breeder chicks. *Veterinary Record*, 160, 145-148.

Ghione, J., Matarrese, A.M., Ponzio, R., & Sardo, P. (2013). *Meat Consumption and Animal Welfare: A Survey of European Slow Food Members* [PDF Document]. Retrieved from: http://www.slowfood.com/sloweurope/wp-content/uploads/ING_sondaggio_benessere.pdf

Giersing, M. Lundström, K., & Andersson, A. (2000). Social effects and boar taint: Significance for production of slaughter boars (Sus scrofa). *Journal of Animal Science,* 78, 296-305.

Gilani, A., Knowles, T.G., & Nicol, C.J. (2013). The effect of rearing environment on feather pecking in young and adult laying hens. *Applied Animal Behaviour Science*, 148, 54-63.

Goossens, X., Sobry, L. Ödberg, F., Tuyttens, F., Maes, D., De Smet, S., Nevens, F., Opsomer, G., Lommelen, F., & Geers, G. (2008). A population-based on-farm evaluation protocol for comparing the welfare of pigs between farms. *Animal Welfare,* 17, 35-41.

Government says 'No' to beak trimming ban. (2015). Retrieved, 13 November, 2015 from: http://www.farminguk.com/News/Government-says-No-to-beak-trimming-ban_37870.html

Green, L.E., Lewis, K., Kimpton, A., & Nicol, C.J. (2000). Cross-sectional study of the prevalence of feather pecking in laying hens in alternative systems and its associations with management and disease. *Veterinary Record,* 147, 233-238.

Gregersen, V.R., Conley, L.N., Sorensen, K.K., Guldbrandtsen, B., Velander, I.H., & Bendixen, C. (2012). Genome-wide association scan and phased haplotype construction for quantitative trait loci affecting boar taint in three pig breeds. *BMC Genomics,* 12, 1-22.

Grunert, K.G. (2013). Vurdering af alternativer til kastration af hangrise på forskellige markeder af relevans for den danske svinekødssektor. Report elaborated for Jensen et al., 2014 Agriculture & Food Council by MAPP Centre for Research on Customer Relations in the Food Sector, Aarhus University, 32 pp.

Gunnarsson, S., Young, B., & Westin, R. (2015, April). *Straw use and prevention of tail biting in undocked pigs in Swedish pig farms -a survey of housing and management routines.* Paper presented at International Conference on Pig Welfare in Copenhagen: "Improving Pig Welfare – What are the ways forward?", Copenhagen.

Hadorn R., Gloor A., & Wiedmer H.(2000). Effect of beak trimming on brown growing pullets and laying hens. *Agrarforschung Schweiz*, 7(2), 62-67.

Handbuch Landwirtschaft Kriterienkatalog Sauenhaltung [PDF Document]. (2014). Retrieved from: http://initiative-tierwohl.de/wp-content/uploads/2015/01/Handbuch-Kriterienkatalog-Sauenhaltung.pdf

Häne, M., Huber-Eicher, B., & Fröhlich, E. (2000). Survey of laying hen husbandry in Switzerland. *World's Poultry Science Journal, 56, 21-31.*

Haugen, J.E., Wagenberg, C., Nielsen, B.E., Borgaard, C., Panella, N., Aluwe, M., Bonneau, M., Mörlein, D., & Doran, O. (2015). R*apid boar taint detection methods used or being developed at slaughter plants in the European Union* [Powerpoint slides]. Retrieved from: http://ec.europa.eu/dgs/health_food-safety/information_sources/docs/ahw/20150226_ahw_pig-castration_pres_8c2_en.pdf

Hay, M., Vulin, A., Génin, S., Sales, P., & Prunier, A. (2003). Assessment of pain induced by castration in piglets: behavioral and physiological responses over the subsequent 5 days. *Applied Animal Behaviour Science,* 82(3), 201-218.

Heres, L., Mulder, H., Knol, E., Bloemhof, S., ten Apel, J., van der Fels, B., & Mathur, P. (2015). *A human nose scoring system for boar taint and its implications for detection in a slaughter line* [Powerpoint slides]. Retrieved from: http://documents.mx/documents/a-human-nose-scoring-system-for-boar-taint-and-its-implications-for-detection-in-a-slaughter-line-lourens-heres-1-han-mulder-3-egbert-knol-2-saskia.html

Hegelund, L., Sørensen, J.T., Hermansen, J.E. (2006). Welfare and productivity of laying hens in commercial organic egg production systems in Denmark. *Netherlands Journal of Agricultural Science*, 54(2), 147-156.

Heinonen, M., Orro, T., Kokkonen, T., Munsterhjelm, C., Peltoniemi, O., & Valros. A. (2010). Tail biting induces a strong acute phase response and tail-end inflammation in finishing pigs. *The Veterinary Journal*, 184, 303-307.

Herskin, M.S., Thodberg, K., & Jensen, H.E. (2015). Effects of tail docking and docking length on neuroanatomical changes in healed tail tips of pigs. *Animal,* 9(4), 677-681.

Hester, P.Y., & Shea-Moore, M. (2003). Beak trimming egg-laying strains of Chickens. *World's Poultry Science Journal*, 59, 458-474.

Hickman, M. (2007, December 1). The pain of tail-docking: a fact of life for millions of pigs. *Independent*. Retrieved from: http://www.independent.co.uk/news/uk/home-news/the-pain-of-tail-docking-a-fact-of-life-for-millions-of-pigs-761687.html

HKScan annual report [PDF Document]. (2011). Retrieved from: http://www2.hkscan.com/attachments/reports-2011/hkscan_annualreport-2011-final.pdf

Hopster, H. (2008). Dierenwelzijn is voor samenleving belangrijk issue. *Syscope*, 20, 4-6.

Horgan, R., & Gavinelli, A. (2006). The expanding role of animal welfare within EU legislation and beyond. *Livestock Science,* 103, 303-307.

Huber-Eicher, B. (1999). A survey of layer-type pullet rearing in Switzerland. *World's Poultry Science Journal*, 55, 83-91.

Hughes, A.L., & Buitenhuis, A.J. (2010). Reduced variance of gene expression at numerous loci in a population of chickens selected for high feather pecking. *Poultry Science,* 89, 1858-1869.

Hunter, E.J., Jones, T.A., Guise, H.J., Penny, R.H.C., & Hoste, S. (1999). Tail biting in pigs 1: the prevalence at six UK abattoirs and the relationship of tail biting with docking, sex and other carcass damage. *Pig Journal*, 43, 18-32.

Ingenbleek, P.T.M,. Harvey, D., Ilieski, V., Immink, V.M., de Roest, K., & Schmid, O. (2013). The European Market for Animal-Friendly Products in a Societal Context. *Animals,* 3, 808-829.

Industry must take a 'stepwise approach' to managing untrimmed flocks. (2014, April 25). *Ranger.* Retrieved from: http://www.theranger.co.uk/News/Industry-must-take-a-stepwise-approach-to-managing-untrimmed-flocks_24021.html

Jacob, J. (2015). *Feather Pecking and Cannibalism in Small and Backyard Poultry Flocks.* University of Kentucky, EXtension.

Jamieson, S. (2004). Likert Scale: how to (ab)use them. *Medical education,* 38, 1212-1218.

Jendral, M. (2005). Alternative Layer Hen Housing Systems in Europe. Alberta Egg Producers and Alberta Farm Animal Care Association.

Jensen, B., Kudahl, A.B., Thomsen, R., Rasmuss, M.K., Kongsted, A.G., Gregersen, V.R., Callesen, H., Bendixen, B., Ekstrand, B., & Jensen, K.H. (2014). Alternatives to surgical castration in danish pig. *Danish Centre for Food and Agriculture*, Tjele, report 42, pp 162.

Joint declaration on animal welfare (NL-Ger-DK). (December 14, 2014). Retrieved from: http://en.mfvm.dk/fileadmin/user_upload/FVM.dk/Nyhedsfiler/JointDeclarationOnAnimalWelfare.pdf

Jongman, E. C., Glatz, P.C., & Barnett, J.L. (2008). Changes in Behaviour of Laying Hens Following Beak Trimming at Hatch and Re-trimming at 14 Weeks. *Asian-Australian Journal of Animal Science*, 21(2), 291-298.

Kallas, Z., Gil. J.M., Panella-Riera, N., Blanch, M., Font-i-Furnols, M., Chevillon, P., … Oliver, M.A. (2013). Effect of tasting and information on consumer opinion about pig castration. *Meat Science,* 95, 242-249.

Kallas, Z., Gil, J.M., Panella-Riera, N., Blanch, M., Tacken, G., Chevillon, P., De Roest, K., & Oliver, M.A. (2012). New EU Policies Towards Animal Welfare: The Relative Importance of Pig Castration. *EuroChoices*, 11(3), 36-43.

KAT guide for laying farms [PDF Document]. (2013). Retrieved from: http://www.was-steht-auf-dem-ei.de/fileadmin/PDF_ENG/Guidelines/EN_Ltf__fuer_KAT-Legebetriebe_Oktober_2013.pdf

KAT. (n.d.). *KAT controlled animal welfare for barn and free-range rearing New "Animal Welfare tested" quality mark*. Retrieved, 11 November, 2015 from: http://www.was-steht-auf-dem-ei.de/index.php?id=40&L=1

Keeling, L.J., Wallenbeck, A., Larsen, A., & Holmgren, N. (2012). Scoring tail damage in pigs: an evaluation based on recordings at Swedish slaughterhouses. *Acta Veterinaria Scandinavica*, 54(32).

Kehlbacher, A., Bennett, R., & Balcombe, K. (2012). Measuring the consumer benefits of improving farm animal welfare to inform welfare labeling. *Food Policy,* 37, 627-633.

Irogbe, K. (2013). Global Political Economy and the Power of Multinational Corporations. *Journal of Third World Studies*, 30(2), 223.

Kielly J., Dewey C.E., & Cochran, M. (1999). Castration at 3 days of age temporarily slows growth of pigs. *Swine Health Production*, 7, 151-153.

Kjærnes, U., Miele, M., & Roex, J. (2007). *Attitudes of Consumers, Retailers and Producers to Farm Animal Welfare.* Cardiff University, Wales, Welfare Quality Reports no. 2, 183pp.

Klompenhouwer, L. (2014, January 17). Agrarische export stijgt naar recordhoogte. *NRC*. Retrieved from: http://www.nrc.nl/nieuws/2014/01/17/waarde-agrarische-export-vorig-jaar-goed-voor-record

Kluivers, M. (2010). Evaluation of pain associated with routine procedures in piglets. *Suis*, 71, 22-27.

Kluivers-Poodt, M., Hopster, H., & Spoolder, H.A.M. (2007). Castration under anaesthesia and/or analgesia in commercial pig production. Animal Sciences Group Wageningen UR, Lelystad, report 85, 82pp.

Knight, S., Nunkoosing, K., Vrij, A., & Cherryman, J. (2003). Using Grounded Theory to Examine People's Attitudes Toward How Animals are Used. *Society & Animals,* 11(4), 307-327.

Krav. (2015). *KRAV 2015 standards* [PDF Document]. Retrieved from: http://www.krav.se/sites/peppes.krav1.krav.phosdev.se/files/krav-standards2015webb.pdf

Krav Standards 2016 [PDF Document]. (2016). Retrieved from: http://www.krav.se/sites/www.krav.se/files/krav-standards-2016.pdf

Kristensen, L., Tørngren, M. & Claudi-Magnussen, C. (2012, August). *Use of tainted boar meat for processed meat products*. Paper presented at the 58th International Congress of Meat Science and Technology, Montreal, Canada.

Kritas, S.K., & Morrison, R.B. (2007). Relationships between tail biting in pigs and disease lesions and condemnations at slaughter. *Veterinary Record,* 160, 149-152.

Kubale, V., Batorek, N., Škrlep, M., Prunier, A., Bonneau, M., Fazarinc, G., & Čandek -Potokar, M. (2013). Steroid hormones, boar taint compounds, and reproductive organs in pigs according to the delay between immunocastration and slaughter. *Theriogenology,* 79, 69-80.

Kuenzel, W.J. (2007). Neurobiological Basis of Sensory Perception: Welfare Implications of Beak Trimming. *Poultry Science*, 86, 1273-1282.

Kupper, F. (2009). *Democratizing Animal Biotechnology: Inquiry and Deliberation in Ethics and Governance* (Doctoral dissertation). Available from University Library VU.

Laverkvist, C.J., Carlsson, F. & Viske, D. (2006). Swedish Consumer Preferences for Animal Welfare and Biotech: A Choice Experiment. *The journal of agribiotechnology management*, 9(1), 51-58

Lagerkvist, C.J., & Hess, S. (2011). A meta-analysis of consumer willingness to pay for farm animal welfare. *European Review of Agricultural Economics*, 38(1), 55-78.

Lambton, S.L., Knowles, T.G., Yorke, C., & Nicol, C.J. (2010). The risk factors affecting the development of gentle and severe feather pecking in loose housed laying hens. *Applied Animal Behaviour Science,* 123, 32-42.

Larsen, J.N., (2014). *A World of Eggs* [Powerpoint slides]. Retrieved from: http://www.foedevarestyrelsen.dk/SiteCollectionDocuments/25_PDF_word_filer%20til%20download/05kontor/Servicetjek_Fjerkraesektoren/1_Introduction-to-the-Danish-egg-sector-Joergen%20N-Larsen-Landbrug-og-Foedevarer.pdf.

Label Rouge: Pasture-Based Poultry Production in France. (2011). Retrieved, 11 November, 2015 from: http://www.thepoultrysite.com/articles/1888/label-rouge-pasturebased-poultry-production-in-france/

Lealiifano, A.K., Pluske, J.R., Nicholls, R.R., Dunshea, F.R., Campbell, R.G., Hennessy, D.P., Miller, D.W., Hansen, C.F., & Mullan, B.P. (2011). Reducing the length of time between slaughter and the secondary gonadotropin-releasing factor immunization improves growth performance and clears boar taint compounds in male finishing pigs. *Journal of Animal Science*, 89, 2782-2792.

Lidl stapt geheel over op Beter Leven keurmerk. (2015b). Retrieved, 11 November, 2015 from: https://beterleven.dierenbescherming.nl/nieuws/lidl-stapt-geheel-over-op-beter-leven-keurmerk

Linden, J. (2015). German egg farmers paid not to beak trim. Retrieved, 11 November, 2015 from: http://www.fwi.co.uk/poultry/german-egg-farmers-paid-not-to-beak-trim.htm.

Lunam, C.A., Glatz, P.C., & Hsu, Y.J. (1996). The absence of neuromas in beaks of adult hens after conservative trimming at hatch. *Australian Veterinary Journal*, 74(1), 46-49.

MacLachlan, M. (2010). Perceptions of animals across cultures: Man's best friend or dirty beast? PERCEPTIONS OF ANIMALS ACROSS CULTURES: MAN'S BEST FRIEND OR DIRTY BEAST? Retrieved, February 5, 2016 from: https://www.communicaid.com/cross-cultural-training/blog/perceptions-of-animals-across-cultures-mans-best-friend-or-dirty-beast/

Marchant-Forde, J.N., Lay, D.C. Jr., McMunn, K.A., Cheng, H.W., Pajor, E.A., & Marchant-Forde, R.M. (2009). Postnatal piglet husbandry practices and well-being: the effects of alternative techniques delivered separately. *Journal of Animal Sciences*, 87, 1479-1492.

Makdisi, F., & Marggraf, R. (2011). *Consumer Willingness to pay for farm animal welfare in germany – the case of broiler* [PDF Document]. Retrieved from: http://ageconsearch.umn.edu/bitstream/115359/2/Makdisi_Marggraf.pdf

Maribo, H. (2012). *Screening af økologiske hangrise*. Videncenter for svineproduktion, Denmark, Report 955, 11p.

Martin, M., Tesouro, M.A., Gonz, Am.N., Pi, A., & Lampreave, F. (2005). Major plasma proteins in pig serum during postnatal development. *Reproduction, Fertility and Development*, 17, 439-445.

Marx, G., Horna, T., Thielebeinb, J., Knubelb, B., & Von Borell, E. (2003). Analysis of pain-related vocalization in young pigs. *Journal of Sound and Vibration,* 266, 687-698.

McCulloch, S.P. (2013). A Critique of FAWC's Five Freedoms as a Framework for the Analysis of Animal Welfare. *Journal Agricultural Environental Ethics*, 26, 959-975.

Mehr Tierschutz in der Schweinehaltung. (n.d.). Retrieved, 28 October, 2015 from: http://www.neuland-fleisch.de/landwirte/informationen-zur-ferkelkastration.html

Meyer, E. (2015). *Why Northern Europe is more egalitarian than Southern Europe*. Retrieved, 14 February, 2016 from: http://uk.businessinsider.com/why-northern-europe-is-more-egalitarian-than-southern-europe-2015-2?r=US&IR=T

Ministerie van Economische Zaken. (2015). Effectief Internationaal. [Presentation] (Confidential&Unpublished)

Ministry for food, agricultural and fisheries. (2015). *International conference on pig welfare: Improving pig welfare – what are the ways forward?*. Copenhagen, Denmark. Retrieved from: http://en.fvm.dk/fileadmin/user_upload/ENGLISH_FVM.DK/Themes/animal-welfare/2015-075_IPWC_Abstract.pdf

Moeder en big. (n.d.). Retrieved, 7 November, 2015 from: http://duurzaamvarkensvlees.nl/dier-milieu/dierwelzijn/moeder-en-big/#non-castratie

Moinard, C., Mendle, M., Nicol, C.J., & Green, L.E. (2003). A case control study of an on-farm risk factors for tail biting in pigs. *Applied Animal Behavior Science*, 81, 333-355.

Moya, S.L., Boyle, L.A., Lynch, P.B., & Arkins, S. (2008). Effect of surgical castration on the behavioural and acute phase responses of 5-day-old piglets. *Applied Animal Behaviour Science*, 111, 133-145.

Mul, M., Vermeij, I., Hindle, V., & Spoolder, H. (2010). EU-Welfare legislation on pigs. Wageningen UR Livestock Research, Lelystad, Report 273, 22pp.

Munsterhjelm, C., Brunberg, E., Heinonen, M., Keeling, L., & Valros, A. (2013). Stress measures in tail biters and bitten pigs in a matched case-control study. *Animal Welfare*, 22, 331-338.

Nannoni, E., Valsami, T., Sardi, L., & Martelli, G. (2014). Tail docking in pigs: a review on its shortand long-term consequences and effectiveness in preventing tail biting. *Italian Journal of Animal Science*, 13(3095), 98-106.

Napolitano, F., Girolami, A., & Braghieri, A. (2010). Consumer liking and willingness to pay for high welfare animal based products. *Trends in Food Science & Technology*, 21, 537-543.

Napolitano, F., Serrapica, M., & Braghieri, A. (2013). Contrasting Attitudes towards Animal Welfare Issues within the Food Chain. *Animals,* 3, 551-557.

Nature&Progres. (2002). *Cahier des charges: Aviculture* [PDF Document]. Retrieved from: http://www.natureetprogres.org/servicepro/sp77.pdf

NEULAND- Richtlinien für die artgerechte Legehennenhaltung [PDF Document]. (2015). Retrieved from: http://www.neuland-fleisch.de/assets/files/Richtlinien/rl-legehennen-02102015.pdf

Newberry. R.C., Keeling, L.J., Estevez, I., & Bilcík, B. (2007). Behaviour when young as a predictor of severe feather pecking in adult laying hens: The redirected foraging hypothesis revisited. *Applied Animal Behaviour Science,* 107, 262-274.

Nicol, C.J., Bestman, M., Gilani, A., de Haas, E.N., De Jong, I.C., Lambton, S., Wagenaar, J.P., Weeks, C.A., & Rodenburg, T.B. (2013). The prevention and control of feather pecking: application to commercial systems. *World's Poultry Science Journal*, 69, 775-787.

Nicol, C.J., Lindberg, A.C., Philips, A.J., Pope, S.J., Wilkins, L.J., & Green, L.E. (2001). Influence of prior exposure to wood shavings on feather pecking, dustbathing and foraging in adult laying hens. *Applied Animal Behaviour Science,* 71, 141-155.

Niemi, J.K. (2010, December). *Eläinten terveyteen liittyvien panostusten taloudellisuus*. Finnish Veterinary Days, Helsinki. Helsinki: Finnish Veterinary Association.

Nocella, G., Hubbard, L., & Scarpa, R. (2010). Farm Animal Welfare, Consumer Willingness to Pay, and Trust: Results of a Cross-National Survey. *Applied Economic Perspectives and Policy*, 32 (2), 275-297.

Norman, G. (2010). Likert scales, levels of measurement and the ‘‘laws’’ of statistics. *Advances in Health Sciences Education,* 15(5), 625-32.

Ohl, F., & Van der Staay, F.J. (2012). Animal welfare: At the interface between science and society. *The Veterinary Journal,* 192, 13-19.

Ott, R.L & Longnecker, M. (2006). *An Introduction to Statistical Methods and Data Analysis, International Edition*. United States of America: Cengage Learning, Inc.

Paul, E.S., Moinard, C., Green, L.E., & Mendl, M. (2007). Farmers' attitudes to methods for controlling tail biting in pigs. *Veterinary Record*, 160, 803-805.

Paul, C., Spring P., O'Doherty, J. V., Ampuero Kragten, S., & Bee, G. (2009). Growth performance, carcass characteristics and meat quality of group-penned surgically castrated, immunocastrated (Improvac®) and entire male pigs and individually penned entire male pigs. *Animal,* 3, 1057-1066.

Perkins, C. (2012). *Carrefour Belgium tightens welfare requirements*. Retrieved, 28 October, 2015 from: http://www.globalmeatnews.com/Industry-Markets/Carrefour-Belgium-tightens-welfare-requirements

Perloff, R.M. (2010). *The Dynamics of Persuasion: Communication and Attitudes in the Twenty-First Century*. New York: Taylor &Amp; Francis Ltd.

Pettipher, J. (2008). *A Soil Association guide to small scale pig keeping* [PDF Document]. Retrieved from: http://www.soilassociation.org/LinkClick.aspx?fileticket=wHA6qvWcNLU=&tabid=204

Phillips, C.J.C., & McCulloch, S. (2005). Student attitudes on animal sentience and use of animals in society. *Journal of Biological Education*, 40(1), 17-24.

Phillips, C.J.C., Izmirli, S., Aldavood, S.J., Alonso, M., Choe, B.I., Hanlon, A., … Rehn, T. (2012). Students' attitudes to animal welfare and rights in Europe and Asia. *Animal Welfare*, 21, 87-100.

Pickett, H. (2008). *Controlling feather pecking & cannibalism in laying hens without beak trimming* [PDF Document]. Retrieved from: http://www.ciwf.org.uk/includes/documents/cm_docs/2009/c/controlling_feather_pecking_and_cannibalism_without_beak_trimming.pdf

PigProgress. (2008). *McDonald's stops pork from castrated piglets.* Retrieved, 28 October, 2015 from: http://www.pigprogress.net/Home/General/2008/1/McDonalds-stops-pork-from-castrated-piglets-PP001219W/

Pihlajaviita, S., Juva, E. (2015). *Atria´s Corporate Responsibility Report 2014* [PDF Document]. Retrieved from: http://www.atriagroup.com/SiteCollectionDocuments/Yritysvastuuraportti%202015/Atria_yritysvastuuraportti_2014_ENG_netti_45336.pdf

Pork processors guarantee boar purchases without deduction. (2012). Retrieved, 30 October, 2015 from: http://www.alternativepig.eu/publications/news/news-detail/article/pork-processors-guarantee-boar-purchases-without-deduction.html

Prosciutto di Parma (Parma ham) protected designation of origin [PDF Document]. (n.d.). Retrieved from: http://www.prosciuttodiparma.com/pdf/en_UK/Specifications.pdf

PROVIEH. (2014). *Campaign success for PROVIEH: Milestone on the way to stop tail docking in Germany and Europe* [PDF Document]. Retrieved from: http://lawyersforanimalprotection.eu/wp-content/uploads/2014/02/140225_Campaign-success-for-PROVIEH.pdf

Prunier, A., Bonneau, M, von Borell, E.H., Cinotti, S., Gunn, M., Fredriksen, B., Giersing, M., Morton, D.B., Tuyttens, F.A.M., & Velarde, A. (2006). A review of the welfare consequences of surgical castration in piglets and the evaluation of non-surgical methods. *Animal Welfare*, 15, 277-289.

Prunier, A., Mounier, A.M., & Hay, M., (2005). Effects of castration, tooth resection or tail docking on plasma metabolites and stress hormones in pigs. *Journal of Animal Science*, 83(1), 216-222.

Raad voor Dierenaangelegenheden [RDA]. (2013). *Grip op ingrepen.* RDA, The Hague, report 2013_01, 34pp.

Redactie. (2014, March 6). Meer varkens geslacht in een jaar dan er Belgen zijn. *HNL.be.* Retrieved from: http://www.hln.be/hln/nl/942/Economie/article/detail/1806314/2014/03/06/Meer-varkens-geslacht-in-een-jaar-dan-er-Belgen-zijn.dhtml

Rewe group. (2015). *REWE Group verbannt Fleisch unbetäubt kastrierter Schweine aus dem Sortiment Leitbild soll Vertragslieferanten zu besseren Haltungsbedingungen von Nutztieren bewegen* [PDF Document]. Retrieved from: http://boars2018.com/wp-content/uploads/2015/09/150811_Schweinekastration_LeitlinieNutztierhaltung.pdf

REWE verzichtet ab 2017 auf Fleisch von betäubungslos kastrierten Schweinen – ISN: Nicht auf Kosten der Tierhalter profilieren. (2015). Retrieved, 30 October, 2015 from: http://www.schweine.net/news/rewe-ebermast-frischfleisch-kastration.html

Riber, A.B., & Forkman, B. (2007). A note on the behaviour of the chicken that receives feather pecks. *Applied Animal Behaviour Science*, 108, 337-341.

Robert, S., Dancosse, J., & Dallaire, A. (1987). Some observations on the role of environment and genetics in behaviour of wild and domestic forms of Sus scrofa. *Applied Animal Behaviour Sciences*, 17, 253-262.

Robic, A., Larzul, C., & Bonneau, M. (2008). Genetic and metabolic aspects of androstenone and skatole deposition in pig adipose tissue: A review. *Genetics Selection Evolution*, 40, 129-143.

Rodenburg, T.B. (2014a). Poultry behaviour and welfare [Powerpoint slides].

Rodenburg, T.B. (2014b). Current research on positive and negative social interactions in poultry [Powerpoint slides].

Rodenburg, T.B., Tuyttens, F.A.M., de Reu, K., Herman, L., Zoons, J., & Sonck, B. (2008). Welfare assessment of laying hens in furnished cages and non-cage systems: an on-farm comparison. *Animal Welfare*, 17, 363-373.

Rodenburg, T.B., van Hierden, Y.M., Buitenhuis, A.J., Riedstra, B., Koene, P., Korte, S.M., van der Poel, J.J., Groothuis, T.G.G., & Blokhuis, H.J. (2004). Feather pecking in laying hens: new insights and directions for research?. *Applied Animal Behaviour Science*, 86, 291-298

Rodenburg, T.B., van Krimpen, M.M., de Jong, I.C., de Haas, E.N., Kops, M.S., Riedstra, B.J., Nordquist, R.E., Wagenaar, J.P., Bestman, M., & Nicol, C.J. (2013). The prevention and control of feather pecking in laying hens: identifying the underlying principles. *Worlds poultry science journal*, 69(2), 361-373.

Roex, J., & Miele, M. (2005). *Farm Animal Welfare Concerns: Consumers, Retailers and Producers*. Cardiff University, Wales, United Kingdom, Welfare Quality Reports no.1, 172.

Rondeel. (n.d.). *Snavels.* 15 November, 2015 from: http://www.rondeeleieren.nl/de-kippen/snavels/

RSPCA. (n.d.-a). *Laying hens - what are we doing?.* Retrieved, 11 November, 2015 from: http://www.rspca.org.uk/adviceandwelfare/farm/layinghens/whatarewedoing

RSPCA. (n.d.-b). *Laying hens*. Retrieved, 11 November, 2015 from: http://www.rspca.org.uk/adviceandwelfare/farm/layinghens

Rutherford, K.M.D., Robson, S.K., Donald, R.D., Jarvis, S., Sandercock, D.A., Scott, E.M., Nolan, A.M., & Lawrence, A.B. (2009). Pre-natal stress amplifies the immediate behavioural responses to acute pain in piglets. *Biology Letters*, 5, 452-454.

Sandilands, V., & Hocking, P.M. (2012). *Alternative Systems for Poultry: Health, Welfare and Productivity*. Presented at CAB International Poultry science symposium series 30th, Glasgow, Scotland.

Savory, C.J. (1995). Feather pecking and cannibalism. *World's Poultry Science Journal,* 51, 215-219.

Schlachtunternehmen Tönnies, Vion und Westfleisch geben Abnahmegarantie für Jungeber. (2012). Retrieved, 30 October, 2015 from: https://www.qs.de/pressemeldungen/schlachtunternehmen-geben-abnahmegarantie-fuer-jun.html

Schmidt, C. (2015). "International Conference on Animal Welfare". International Conference on Animal Welfare. Copenhagen. 29, April, 2015.

Schmidt, C., Bucht, SE., Jørgensen, D., & Dijksma, S. (2015). Revision of Council Directive 2008/120/EC laying down minimum standards for the protection of pigs. International conference on pig welfare. April 29-30, 2015. Denmark.

Schmidt, T., König, A., & Von Borell, E. (2012). Impact of general injection anaesthesia and analgesia on post-castration behaviour and teat order of piglets. *Animal*, 6(12), 1998-2002.

Schönreiter, S., Lohmüller, V., Huber, H., Zanella, A.J., Unshelm, J., & Erhardt, W. (2000). Effects of CO_2/O_2-anaesthesia on behaviour, β-endorphin- and cortisol concentrations of male piglets after castration. KTBL-Schrift, 391, 137-145.

Scollo, A. (2013). *Tail biting in pigs: is it possible to rear the heavy pig avoiding tail docking?* (Doctoral dissertation). Available from Padova Digital University Archive.

Svenskt Sigill. (n.d.). *Sigill kvalitetssytem ab*. Retrieved, 12 November, 2015 from: http://sigill.se

Simoes, A. (n.d.-a). The Observatory of Economic Complexity, Belgium-Luxembourg. Retrieved, 29 October, 2015 from: http://atlas.media.mit.edu/en/profile/country/blx/

Simoes, A. (n.d.-b). *Denmark.* Retrieved, 29 October, 2015 from: http://atlas.media.mit.edu/en/profile/country/dnk/

Simoes, A. (n.d.-c). *Germany.* Retrieved, 29 October, 2015 from: http://atlas.media.mit.edu/en/profile/country/deu/

Simoes, A. (n.d.-d). *Netherlands.* Retrieved, 29 October, 2015 from: http://atlas.media.mit.edu/en/profile/country/nld/

Simoes, A. (n.d.-e). *Which countries export Pig Meat? (2013)*. Retrieved, 29 October, 2015 from: http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/show/all/0203/2013/

Simoes, A. (n.d.-f). *Which country export eggs? (2013).* Retrieved, 13 November, 2015 from: http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/show/all/0407/2013/

Simoes, A. (n.d.-g). *Which country export Poultry? (2013).* Retrieved, 13 November, 2015 from: http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/show/all/0105/2013/

Simoes, A. (n.d.-h). *Where does Portugal export Pig Meat to? (2013).* Retrieved, 6 February, 2016 from: http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/prt/show/0203/2013/

Simoes, A. (n.d.-i). *Where does Poland export Pig Meat to (2013).* Retrieved, 6 February, 2016 from: http://atlas.media.mit.edu/en/visualize/tree_map/hs92/export/pol/show/0203/2013/

Smith, J.H., Wathes, C.M., & Baldwin, B.A. (1996). The preference of pigs for fresh airover ammoniated air. *Applied Animal Behaviour Science*, 49, 417-424.

Smulders, D., Hautekiet, V., Verbeke, G., & Geers, R. (2008). Tail and ear biting lesions in pigs: an epidemiological study. *Animal Welfare,* 17, 61-69.

Sodexo group. (2015). Sodexo Animal Welfare Frequently Asked Questions [PDF Document]. Retrieved from: http://www.sodexo.com/en/Images/Sodexo-Animal-Welfare-FAQ-June-2015342-866031.PDF

Soil Association. (2009). *Organic Poultry Production: An introductory guide* [PDF Document]. Retrieved from: http://www.soilassociation.org/LinkClick.aspx?fileticket=9zNik0Pt378%3D&tabid=135

Sonoda, L.T., Fels, M., Oczak, M., Vranken, E., Ismayilova, G., Guarino, M., Stefano, V., Bahr, C., Berckmans, D., & Hartung, J. (2013). Tail biting in pigs--causes and management intervention strategies to reduce the behavioural disorder. A review. *Berliner und Münchener Tierärztliche Wochenschrift*, 126(3-4), 104-112.

Sortbroget landracegris [PDF Document]. (n.d.). Retrieved from: http://www.dyrenesbeskyttelse.dk/sortbroget-landracegris

Spoolder, H., Bracke, M., Mueller-Graf, C., & Edwards, S. (2011). Preparatory work for the future development of animal based measures for assessing the welfare of pig – Report 2. Preparatory work for the future development of animal based measures for assessing the welfare of weaned, growing and fattening pigs including aspects related to space allowance,floor types, tail biting and need for tail docking, Technical report submitted to EFSA.

Spruijt, B.M., van den Bos, R., & Pijlman, F.T.A. (2001). A concept of welfare based on reward evaluating mechanisms in the brain: anticipatory behaviour as an indicator for the state of reward systems. *Applied Animal Behaviour Science*, 72(2), 145-171.

Staack, M., Gruber, B., Keppler, C., Zaludik, K., Niebuhr, K., & Knierim, U. (2007). Importance of the rearing period for laying hens in alternative systems. *Deutsche tierarztliche Wochenschrift,* 14(3), 86-90.

Statham, P., Green, L.E., Bichard, M., & Mendl, M. (2008). Prediction of tail-biting from behaviour of pigs prior to outbreaks. *Applied Animal Behaviour Science,* 121 (3-4), 157-164.

Struwe, F.J., Gleaves, E.W., & Douglas, J.H. (1992). Stress Measurement on beak-trimmed and untrimmed Pullets. *Poultry Science,* 71, 1154-1162.

Studnitz, M., Jensen, M.B., & Pedersen, L.J. (2007). Why do pigs root and in what will they root? A review on the exploratory behaviour of pigs in relation to environmental enrichment. *Applied Animal Behaviour Science,* 107, 183-197.

Sutherland, M.A., & Tucker, C.B. (2011). The long and short of it: A review of tail docking in farm animals. *Applied Animal Behaviour Science,* 135, 179-191.

Sutherland, M.A., Bryer, P.J., Krebs, N., & McGlone, J.J. (2008). Tail docking in pigs: acute physiological and behavioural responses. *Animal,* 2(2), 292-297.

Sutherland, M.A., Bryer, P.J., Krebs, N., & McGlone, J.J. (2009). The effect of method of tail docking on tail-biting behaviour and welfare of pigs. *Animal Welfare*, 18, 561-570.

Szücs, E., Geers, R., Jezierski, T., Sossidou, E.N. & Broom, D.M. (2012). Animal Welfare in Different Human Cultures, Traditions and Religious Faiths. *Asian-Australasian Journal of Animal Sciences, 2*5(11), 1499-1506.

Tauson, R., Kjaer, J., Maria, G.A., Cepero, R., & Holm, K. (2004). *Welfare implications of changes in production systems for laying hens* [PDF Document]. Retrieved from: http://www.laywel.eu/web/pdf/deliverables%2031-33%20health.pdf

Taylor, N.R., Main, D.C.J., Mendl, M., & Edwards, S.A. (2010). Tail-biting: A new perspective. *The Veterinary Journal,* 186, 137-147.

Taylor, N.R., Parker, R.M.A., Mendl, M., Edwards, S.A., & Main, D.C.J. (2012). Prevalence of risk factors for tail biting on commercial farms and intervention strategies. *The Veterinary Journal*, 194, 77-83.

Taylor, A.A., Weary, D.M., Lessard, M., & Braithwaite, L. (2001). Behavioral responses of piglest to castration: the effect of piglet age. *Applied Animal Behaviour Science,* 73, 35-43.

ten Have-Mellema, A., van Dam, B., van Lent, M., Backus, G., van den Berg, B., Steegmann, C., . . . Thijsse, P. (2013). *Boars on the way*. Wageningen UR Livestock Research.

ter Beek, V. (2012). *Retailer Delhaize: No more pork from physically castrated males*. Retrieved, 30 October, 2015 from: http://www.pigprogress.net/Home/General/2012/8/Retailer-Delhaize-No-more-pork-from-physically-castrated-males-PP009135W/

ter Beek, V. (2015). *German state introduces premium for entire pig tails.* Retrieved, 21 November, 2015 from: http://www.pigprogress.net/Pork-Processing/Slaughtering--Processing/2015/6/German-state-introduces-premium-for-entire-pig-tails-1782989W/

The Association of religion data archives, n.d.a). *National profiles*. Retrieved, February 5, 2016 from: http://www.thearda.com/internationalData/regions/profiles/Region_7_1.asp

The Association of religion data archives, n.d.b). *National profiles*. Retrieved, February 5, 2016 from: http://www.thearda.com/internationalData/regions/profiles/Region_13_1.asp

The Association of religion data archives, n.d.c). *National profiles*. Retrieved, February 5, 2016 from: http://www.thearda.com/internationalData/regions/profiles/Region_7_1.asp

The Association of religion data archives, n.d.d). *National profiles*. Retrieved, February 5, 2016 from: http://www.thearda.com/internationalData/regions/profiles/Region_22_1.asp

The Stray Dogs in Europe. (n.d.). Retrieved, February 5, 2016 from: http://www.esdaw-eu.eu/the-stray-dogs-in-europe.html

The world factbook. (n.d.). Retrieved, 8 February, 2016 from: https://www.cia.gov/library/publications/the-world-factbook/geos/ei.html

Thodberg K., Jensen, K.H., & Jørgensen, E. (2010). *The risk of tail-biting in relation to level of tail-docking*. Paper presented at the 44th Congress of the International Society for Applied Ethology (ISAE): Coping in large groups, Sweden.

Toma, L., Stott, A.W., Revoredo-Giha, C., Kupiec-Teahan B. (2012). Consumers and animal welfare. A comparison between European Union countries. *Appetite*, 58, 597-607.

Toni's Freilandeier. (2015). Retrieved, 12 November, 2015 from: http://www.organic-bio.com/nl/bedrijf/21622-TONI´S-FREILANDEIER

Toolkits. (2009). Management Techniques: Force Field Analysis. Retrieved 15th December, 2015, from: http://www.odi.org/publications/5218-force-field-analysis-decision-maker

Torrey, S., Devillers, N., Lessard, M., Farmer, C., & Widowski, T. (2009). Effect of age on the behavioral and physiological responses of piglets to tail docking and ear notching. *Journal of Animal Sciences*, 87, 1778-1786.

Ursinus, W.W. (2014). *A tale too long for a tail too short? Identification of characteristics in pigs related to tail biting and other oral manipulations directed at conspecifics* (Doctoral dissertation). Available from WUR Wageningen UR.

Ursinus, W.W., Wijnen, H. J., Bartels, A.C., Dijvesteijn, N. van Reenen, C.G., & Bolhuis, J.E. (2014). Damaging biting behaviors in intensively kept rearing gilts: The effect of jute sacks and relations with production characteristics. *Journal of Animal Sciences,* 92, 5193-5202.

Valeeva N.I., Backus G.B.C. & Baltussen W.H.M. (2009, July). *Moving towards boar taint-free meat: an overview of alternatives to surgical castration from a chain perspective*. Paper presented at IFMA congress, Bloomington, USA.

Valros, A., & Heinonen, M. (2015). Save the pig tail. *Porcine Health Management,* 1(2), 1-7.

Valros, A., Ahlström, S., Rintala, H., Häkkinen, T., & Saloniemi, H. (2004). The prevalence of tail damage in slaughter pigs in Finland and associations to carcass. *Acta Agriculturae Scandinavica*, 54(4), 213-219.

van Beirendonck, S., Driessen, B., & Geers, R. (2013). Belgian Consumers' Opinion on Pork Consumption Concerning Alternatives for Unanesthetized Piglet Castration. *Journal of Agricultural Environmental Ethics*, 26, 259-272.

van de Weerd, H.A., Docking, C.M., Day, J.E.L., & Edwards, S.A. (2005). The development of harmful social behaviour in pigs with intact tails and different enrichment backgrounds in two housing systems. *Animal Science*, 80, 289–298.

van der Peet-Schwering, C.M.C., Binnendijk G.P., Vermeer H.M. Vereijken, P.F.G., Classens, P.J.A.M., & Verheijen R.G.J.A. (2013). Op weg naar succesvol beren houden. Wageningen UR Livestock Research, Lelystad, report 733, 45pp.

van Dooren, K. (2013, October). 'Het levert 5 euro per varken op'. *Boerderij,* 9. Retrieved from: http://boars2018.com/wp-content/uploads/2013/10/geroteerd20131017112706300.pdf

van Putten, G. (1969). An Investigation into tail-biting among fattening pigs. *British Veterinary Journal,* 125, 511–517

van Wagenberg, C.P.A., Snoek, H.M., van der Fels, J.B., van der Peet-Schwering, C.M.C., Vermeer, H. M., & Heres, L. (2013). Farm and management characteristics associated with boar taint. *Animal*, 7(11), 1841-1848.

Vanhonacker, F., & Verbeke, W. (2009). Buying higher welfare poultry products? Profiling Flemish consumers who do and do not. *Poultry Science,* 88, 2702-2711.

Vanhonacker, F., & Verbeke, W. (2011). Consumer response to the possible use of a vaccine method to control boar taint v. physical piglet castration with anaesthesia: a quantitative study in four European countries. *Animal*, 5(7), 1107-1118.

Vanhonacker, F., van Poucke, E., Tuyttens, F., & Verbeke, W. (2010). Citizens' Views on Farm Animal Welfare and Related Information Provision: Exploratory Insights from Flanders, Belgium. *Journal of Agricultural Enviromental Ethics,* 23, 551-569.

Vanhonacker, F., Verbeke, W., Van Poucke, E., Buijs, S., Tuyttens. F.A.M. (2009). Societal concern related to stocking density, pen size and group size in farm animal production. *Livestock Science*, 123, 16-22.

Veissier, I., Butterworth, A., Bock, B., & Roe, E. (2008). European approaches to ensure good animal welfare. *Applied Animal Behaviour Science*, 113, 279-297.

Verschuren, P., & Doorewaard, H. (2007). *Het ontwerpen van een onderzoek* (4th ed.). The Hague: Lemma.

Vleesindustrie stuit op grenzen. 2013. Retrieved, 29 October, 2015 from: http://boars2018.com/nl/2013/12/afzet-berenvlees-in-buitenland-moeilijk/

Von Borell, E., Baumgartner, J., Giersing, M., Jäggin, N., Prunier, A., Tuyttens, F. A. M., & Edwards, S.A. (2009). Animal welfare implications of surgical castration and its alternatives in pigs. *Animal*, 3(11), 1488-1496.

Wageningen UR Livestock Research. (2010). Animal welfare risk assessment guidelines on housing and management. *Technical report submitted to EFSA.* Retrieved from: http://www.efsa.europa.eu/sites/default/files/scientific_output/files/main_documents/87e.pdf

Waitrose. (n.d.). *Animal welfare at Waitrose*. Retrieved, 12 November, 2015 from: http://www.waitrose.com/home/inspiration/about_waitrose/the_waitrose_way/waitrose_animal_welfarecommitments.html

Watson, K. (2011, February-March). Beak trimming of laying hens, where doesthe UK go from here?. ISA. Retrieved from: http://www.isapoultry.com/~/media/Files/ISA/Information/magazine%20articles/2011/20110207%20en%20nfuonline%20Beak%20trimming%20of%20laying%20hens%20UK%20r.pdf

Weiler, U., Font i Furnols, M., Fischer, K., & Kemmer, H. (2000). Infuence of differences in sensitivity of Spanish and German consumers to perceive androstenone on the acceptance of boar meat differing in skatole and androstenone concentrations. *Meat Science*, 54, 297-304.

Werkgroep Krulstaart. (2013). Varkens houden met een krul: Zoektocht naar het voorkomen en bestrijden van staartbijten. Werkgroep Krulstaart, Den Haag, 17pp.

White, M. (2015). *Pig health – Tail biting*. Retrieved, 21 November, 2015 from: http://www.nadis.org.uk/bulletins/tail-biting.aspx?altTemplate=PDF

Whole foods market. (n.d.-a). *Animal welfare basics*. Retrieved, 12 November, 2015 from: http://www.wholefoodsmarket.com/mission-values/animal-welfare/animal-welfare-basics

Whole foods market. (n.d.-b). *WE SELL THE HIGHEST QUALITY NATURAL AND ORGANIC PRODUCTS AVAILABLE*. Retrieved, 12 November, 2015 from: http://www.wholefoodsmarket.com/mission-values/core-values/we-sell-highest-quality-natural-and-organic-products-available

World Poultry. (2013). *Netherlands bans beak trimming in layer hens from 2018.* Retrieved, 12 November, 2015 from: http://www.worldpoultry.net/Layers/Health/2013/6/Netherlands-bans-beak-trimming-in-layer-hens-from-2018-1281266W/

Xue, J.L., Dial, G.D., & Pettigrew, J.E. 1997. Performance, carcass and meat quality advantages of boars over barrows: a literature review. *Swine Health and Production,* 5, 21-28.

Zamaratskaia, G. (2004). *Factors involved in the development of boar taint Influence of breed, age, diet and raising conditions* (Doctoral dissertation). Available from Epsilon Open Archive.

Zeichen für ein besseres leben: Kriterienkatalog für einde tiergerechte Haltung and Behandlung von Mastschweinen im Rahmen des Tierschutzlabels „Für mehr Tierschutz" [PDF Document]. (2013). Retrieved from: http://www.tierschutzlabel.info/fileadmin/user_upload/Dokumente/01_16_Kriterienkatalog_Mastschweine.pdf

Zöls, S., & Ritzmann, M. (2006). *Effect of analgesics on the castration of male piglets.* Berliner und Münchener tierärztliche Wochenschrift, 199(5-6), 193-196.

Zonderland, J.J. (2010). *Talking Tails: Quantifying the development of tail biting in pigs* (Doctoral dissertation). Available from WUR Wageningen UR.

Zonderland, J.J., Bosma, B., & Hoste, R. (2011). Financiële consequenties van staartbijten bij Varkens. Wageningen UR Livestock Research, Lelystad, rapport 543, 18pp.

Zonderland, J.J., Wolthuis-Fillerup, M., Van Reenen, C.G., Bracke, M.B.M., Kemp, B., Den Hartog, L.A., & Spoolder, H.A.M. (2008). Prevention and treatment of tail biting in weaned piglets. *Applied Animal Behaviour Science,* 110, 269-281.

Appendices

Appendix A: Determinants on the behavioral willingness of consumers towards animal welfare

1. Access to information

It is shown that access to information about animal welfare of European citizens, will have a significant positive effect on their willingness to buy animal friendly products (Toma et al., 2012). Furthermore, it is shown by Napolitano et al (2010) that the provision of information raises certain expectations about animal welfare, which positively influences citizens to buy more animal welfare produced products. It could be said that providing access to information about animal welfare will lead to a more informed European citizen. This will positively influence the importance attached to animal welfare and consequently in a desire to get even more information. Additionally, a more informed citizen considers animal welfare as more important and as a result in an increased animal friendly behavior (European Commission, 2007; Napolitano et al., 2010; Vanhonacker et al., 2010; Lagerkvist and Hess, 2011; Toma et al., 2012).

2. Perceived responsibility

Citizens that feel personal responsible for the welfare of animals positively effect the willingness to buy animal welfare produced products (Toma et al., 2012). During shopping of groceries, citizens can in terms of animal welfare make a difference (European Commission, 2005).

3. Education and occupation

Higher levels of education and occupation (income) positively influences animal welfare friendly behavior (Toma et al., 2012). This effect can again be explained by the role of knowledge. The Eurobarometer of 2007 have should that socio-demographic factors like age and education play a role in the level of knowledge. Individuals that continue studying with an age of 20 years old appear to have an increased level of knowledge on animal welfare (European Commission, 2007). As a result, it could be said that an increased level of knowledge due to higher education positively influence animal friendly behavior, which in turn positively influence the importance attached to animal welfare.

4. Effect of labeling

Toma et al. (2012) showed that if the perception of finding information on animal welfare easily is high and the thought of using labels on animal welfare products is effective, it will positively affect behavior towards buying more animal friendly products. According to the respondents of the survey of Ghione et al (2013), labels on packages are considered to be of high value for identifying animal welfare friendly products. Vanhonacker en Verbeke (2009) confirm these results and do also consider labeling as an effective way to reduce the time to find animal welfare products.

Appendix B: The questionnaire

Introduction
This questionnaire is set up to gather information about the possibilities to reduce the mutilations of:

1. Beak trimming in laying hens
2. Surgical castration (with or without the use of anesthesia and analgesia) of male pigs
3. Tail docking of slaughter pigs.

In this questionnaire each mutilation will have its own set of questions, which makes it three sets in total. It is possible to skip a set of questions if you feel that you have insufficient knowledge to answer them. The sets will be randomly presented. This survey is anonymous, only demographic questions regarding gender, country of origin and profession will be asked. One set of questions will take up to 7 minutes. We would like to thank you in advance for your participation in this questionnaire.

BT Beak trimming
According to literature, in most of the European member states beak trimming is still carried out in one way or another. This mutilation is performed as a preventive measure for feather pecking behavior in laying hens. However, beak trimming has several negative implications for the welfare on hens. For this reason, from an animal welfare perspective it is desired to reduce the prevalence of this mutilation across the European Union.
This set of questions is about:
- which actions have the greatest chance of success in reducing beak trimming in your country
- which reasons form the biggest obstacles in reducing beak trimming in your country

Q1 Would you like to continue to the questions regarding beak trimming?

- ❍ Yes, sufficient knowledge
- ❍ No, insufficient knowledge

Q2 Do you believe a significant reduction of beak trimming in laying hens is achievable in your country within 3 to 5 years?

- ❍ Yes
- ❍ No

Q3 What is the most important change that need to be made in order to realize a significant reduction of beak trimming in your country within 3 to 5 years?

Q4 What is the main reason a significant reduction of beak trimming is possible in your country within 3 to 5 years?

Q5 Which of the following actions in the list will have the greatest chance of success in reducing beak trimming in your country?

* Please rank the actions from 1 to 9 (number 1 is the most successful), drag the action to the right place.

* Please use number 10 if you can think of an other action that is not mentioned in the list. In case you can not think of an other action, you can leave number 10 blank.

Legislation approach of the national government (1)
Marketing initiatives by the poultry sector (2)
Marketing initiatives by the national retailers (e.g. by means of assurance schemes and labeling) (3)
Non-governmental organizations like animal welfare and protection groups (e.g. the Farm Animal Welfare Organization in the United Kingdom or the Dutch Society for the Protection of Animals) (4)
Subsidy programs of the national government, which stimulate farmers to reduce the number of beak-trimming procedures (5)
Educational programs for consumers to create or enhance awareness of the current situation of beak trimming (6)
Educational programs for farmers to create or enhance awareness of the current situation of beak trimming (7)
Wholesale price increase of more animal friendly products by retailers (products of hens with intact beaks) (8)
Influence of large multinational corporations (e.g. Unilever) (9)
Other (Please specify) (10)

Q6 Can you explain why you think that the top three factors are the most important factors for your country? (e.g. Number 1: a legislative approach is most successful in my country, because..).

Q7 According to literature, the following country-based factors form an obstacle in realizing a reduction of beak trimming in laying hens. In your opinion, how likely is it that the following factors form an obstacle in realizing a reduction of beak trimming for the situation in your country?

* Please choose the most appropriate option for the following six statements.

* Please fill in the final blank statement if you can think of a country-based factor that is not mentioned in the list. In case you can not think of an other factor, you can use the option 'very unlikely' for this blank statement.

	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
Cultural aspects (e.g. religion)	❍	❍	❍	❍	❍
Lack of consumer awareness about the current situation of beak trimming	❍	❍	❍	❍	❍
Lack of willingness to pay of consumers for more animal friendly products (products of hens with intact beaks)	❍	❍	❍	❍	❍
Lack of available land for poultry production	❍	❍	❍	❍	❍
Unsuitable weather conditions for poultry production	❍	❍	❍	❍	❍
Lack of political interest in reducing beak trimming	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍

Q8 In case you have choses the option ‘very likely’ for (a) statement(s), could you explain why you have chosen this option? (e.g. cultural aspects are very likely to be an obstacle for reducing beak trimming in my country, because..).

Q9 The following animal production factors that are listed, are most frequently mentioned in scientific research. They relate to feather pecking behaviors of laying hens and consequently form an obstacle in realizing a reduction of beak trimming.

In your opinion, how likely is it that the following factors form an obstacle in realizing a reduction of beak trimming for the situation in your country?

* Please choose the most appropriate option for following eight statements.

* Please fill in the final blank statement if you could think of an animal production factor that is not mentioned in the list. In case you can not think of an other factor, you can use the option 'very unlikely'.

	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
Housing systems (e.g. cage, aviary, barn, free range)	❍	❍	❍	❍	❍
Feeding management (e.g. pellet feeding, low fiber levels and/or low numbers of crude proteins)	❍	❍	❍	❍	❍
Housing environment of laying hens (e.g. air quality, temperature, light intensity and humidity)	❍	❍	❍	❍	❍
Breed of laying hens used (e.g. brown or white breeds)	❍	❍	❍	❍	❍
High stocking densities and large group sizes	❍	❍	❍	❍	❍
Insufficient or absence of litter materials in the housing systems	❍	❍	❍	❍	❍
Frequent or unexpected changes in feeding management, housing environment and or stockmanship	❍	❍	❍	❍	❍
Poor hygiene of the living environment of laying hens	❍	❍	❍	❍	❍
Others (Please specify)	❍	❍	❍	❍	❍

Q10 In case you have chosen the option 'very likely' for (a) statement(s), could you explain why you have chosen this option? (e.g. housing systems are very likely to be an obstacle for reducing beak trimming in my country, because..).

Q11 What type of housing system of laying hens is most frequently used in your country?

- ❑ Conventional cage systems
- ❑ Furnished cage system
- ❑ Aviary systems
- ❑ Free-range systems
- ❑ Barn systems
- ❑ Others (Please specify) _____
- ❑ I do not know

Q12 Which breed of laying hens is most frequently used for production in your country?

- ❍ Brown breeds
- ❍ White breeds
- ❍ I do not know

TD Tail docking in slaughter pigs

According to literature, in most of the European member states tail docking is still carried out in one way or another. This mutilation is performed as a preventive measure for tail-biting behavior in pigs in the European Union. However, tail docking has several negative implications for the welfare of pigs. For this reason, from an animal welfare perspective it is desired to reduce the prevalence of this mutilation across the European Union.

This set of questions is about:

- which actions have the greatest chance of success in reducing tail docking in your country
- which reasons form the biggest obstacles in reducing tail docking in your country

Q14 Would you like to continue to the questions regarding tail docking?

- ❍ Yes, sufficient knowledge
- ❍ No, insufficient knowledge

Q15 Do you believe a significant reduction of tail docking in slaughter pigs is achievable in your country within 3 to 5 years?

- ❍ Yes
- ❍ No

Q16 What is the most important change that need to be made in order to realize a significant reduction of tail docking in your country within 3 to 5 years?

Q17 What is the main reason a significant reduction of tail docking is possible in your country within 3 to 5 years?

Q18 Which of the following actions in the list will have the greatest chance of success in reducing tail docking in your country?

* Please rank the actions from 1 to 9 (number 1 is the most successful), drag the action to the right place.

* Please use number 10 if you can think of an other action that is not mentioned in the list. In case you can not think of an other action, you can leave number 10 blank.

Legislation approach of the national government (1)
Marketing initiatives by pig sector (2)
Marketing initiatives by national retailers (e.g. by means of assurance schemes and labeling) (3)
Wholesale price increase of more animal friendly products by retailers (products of pigs with intact tails) (4)
Non-governmental organizations like animal welfare and protection groups groups (e.g. the Farm Animal Welfare Organization in the United Kingdom or the Dutch Society for the Protection of Animals) (5)
Subsidy programs of the national government, which stimulate farmers to reduce the number of tail-docking procedures (6)
Educational programs for farmers to create and enhance awareness of the current situation of tail docking (7)
Educational programs for consumers to create and enhance awareness of the current situations of tail docking (8)
Influence of large multinational corporations (e.g. Unilever) (9)
Other (Please specify) (10)

Q19 Can you explain why you think that the top three factors are the most important factors for your country? (e.g. number 1: a legislative approach most successful in my country, because..)

Q20 According to literature, the following country-based factors form an obstacle in reducing tail docking of slaughter pigs.

In your opinion, how likely is it that the following factors form an obstacle in realizing a reduction of tail docking for the situation in your country?

* Please choose the most appropriate option for the following six statements.

* Please fill in the final blank statement if you can think of an country-based factor that is not mentioned in the list. In case you can not think of an other factor, you can use the option 'very unlikely'.

	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
Cultural aspects (e.g. religion)	❍	❍	❍	❍	❍
Lack of consumer awareness about the current status of tail docking	❍	❍	❍	❍	❍
Lack of willingness to pay of consumers for more animal friendly products (products of pigs with intact tails)	❍	❍	❍	❍	❍
Lack of available land for pig production	❍	❍	❍	❍	❍
Unsuitable weather conditions for pig production	❍	❍	❍	❍	❍
Lack of political interest in reducing tail-docking	❍	❍	❍	❍	❍
Other (Please specify)	❍	❍	❍	❍	❍

Q21 In case you have chosen the option 'very likely for (a) statement(s), could you explain why you have chosen this option? (e.g. cultural aspects are very likely to be an obstacle for reducing tail docking in my country, because..).

Q22 The following animal production factors that are listed, are most frequently mentioned in scientific research. They relate to tail-biting behaviors of slaughter pigs and consequently form an obstacle in realizing a reduction of tail docking.

In your opinion, how likely is it that the following factors form an obstacle in realizing a reduction of tail docking for the situation in your country?

* Please choose the most appropriate option for following nine statements. * Please fill in the final blank statement if you could think of an animal production factor that is not mentioned in the list. In case you can not think of an other factor, you can use the option 'very unlikely'.

	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
Floor type of the housing systems (fully slatted, partly slatted or enriched flooring)	❍	❍	❍	❍	❍
Feeding management of pigs (e.g. not enough feeding places for the number of pigs or insufficient feed composition)	❍	❍	❍	❍	❍
Insufficient or absence of enrichment materials for pigs	❍	❍	❍	❍	❍
Housing environment of pigs (e.g. air quality, lightening, temperature and humidity)	❍	❍	❍	❍	❍
Breed of pigs used	❍	❍	❍	❍	❍
High stocking densities, low space allowance per pig and or large group size	❍	❍	❍	❍	❍
Mixing of litters after weaning	❍	❍	❍	❍	❍
Unexpected or frequent changes in environmental conditions or feeding management	❍	❍	❍	❍	❍
Poor hygiene of the living environment of pigs	❍	❍	❍	❍	❍
Others, namely	❍	❍	❍	❍	❍

Q23 In case you have chosen the option 'very likely' for (a) statement(s), could you explain why you have chosen this option? (e.g. type of floor used is very likely to be an obstacle for reducing tail docking in my country, because..).

Q24 Which type of flooring is most frequently used in the housing system of slaughter pigs in your country?

❍ Fully slatted floors
❍ Partly slatted floors
❍ Enriched flooring
❍ Other (Please specify) _____
❍ I do not know

Q25 Which breed is most frequently used for slaughter pigs in your country?

❍ Please specify _____
❍ I do not know

SC Surgical castration of male pigs

According to literature, in most of the European member states surgical castration of male pigs is still carried out in one way or another. This mutilation is performed as a preventive measure for sexual and aggressive behaviors in male pigs and consequently boar tainted meat. However, surgical castration has several negative implications for the welfare of male pigs. For this reason, from an animal welfare perspective it is desired to reduce the prevalence of this mutilation across the European Union.

It is important to keep in mind that the following questions concern a reduction of surgical castration with or without the use of anesthetics and analgesics.

This set of questions is about:

- which actions have the greatest chance of success in reducing surgical castration in your country
- which reasons form the biggest obstacles in reducing surgical castration in your country

Q27 Would you like to continue to the questions regarding pig castration?

- ❍ Yes, sufficient knowledge
- ❍ No, insufficient knowledge

Q28 Do you believe a significant reduction of castration of male pigs is achievable in your country within 3 to 5 years?

- ❍ Yes
- ❍ No

Q29 What is the most important change that need to be made in order to realize a significant reduction of castration of male pigs in your country within 3 to 5 years?

Q30 What is the main reason a significant reduction castration of male pigs is possible in your country within 3 to 5 years?

Q31 Which of the following actions in the list will have the greatest chance of success in reducing pig castration in your country?

* Please rank the actions from 1 to 9 (number 1 is the most successful), drag the action to the right place.

* Please use number 10 if you can think of an other action that is not mentioned in the list. In case you can not think of an other action, leave number 10 blank

Legislation approach of the national government (1)
Marketing initiatives by the pig sector (2)
Marketing initiatives by the national retailers (e.g. by means of assurance schemes and labeling) (3)
Wholesale price increase of more animal friendly products by retailers (products of entire boars) (4)
Non-governmental organizations like animal welfare and protection groups (e.g. the Farm Animal Welfare Organization in the United Kingdom or the Dutch Society for the Protection of Animals) (5)
Subsidy programs of the national government, which stimulate farmers to reduce the number of surgical castration procedures (6)
Educational programs for consumers to create and enhance awareness of the current situation and of its alternatives for pig castration (7)
Educational programs for farmers to create and enhance awareness of the current situation and of its alternatives for pig castration (8)
Influence of large multinational corporations (e.g. Unilever) (9)
Other (Please specify) (10)

Q32 Can you explain why you think that the top three factors are the most important factors for your country? (e.g. number 1: a legislative approach most successful in my country, because..).

Q33 According to literature, the following country-based factors form an obstacle in reducing surgical castration of male pigs.

In your opinion, how likely is it that the following factors form an obstacle in reducing pig castration for the situation in your country?

* Please choose the most appropriate option for the following eleven statements

* Please fill in the final blank statement if you can think of an other country-based factor. In case you can not think of an other factor, use the option 'very unlikely'.

	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
Cultural aspects (e.g. religion)	❍	❍	❍	❍	❍
Restrictions imposed by specialty or regional products (e.g. the Parma ham industry in Italy)	❍	❍	❍	❍	❍
Lack of consumer awareness about surgical castration and its alternatives	❍	❍	❍	❍	❍
Lack of willingness to pay of consumers for more animal friendly products (products of non-castrated boars)	❍	❍	❍	❍	❍
Highly sensitive and low appreciation to/of boar taint of consumers	❍	❍	❍	❍	❍
Lack of market acceptance of products from non-castrated pigs	❍	❍	❍	❍	❍
Cooking habits (e.g. type of pork meat that is consumed)	❍	❍	❍	❍	❍
Lack of available land for pig production	❍	❍	❍	❍	❍
Unsuitable weather conditions for pig production	❍	❍	❍	❍	❍
Lack of acceptance in importing countries of products from non-castrated pigs	❍	❍	❍	❍	❍
Lack of political interest in a reduction of surgical castration	❍	❍	❍	❍	❍
Other (Please specify)	❍	❍	❍	❍	❍

Q34 In case you have chosen the option 'very likely' for (a) statement(s), could you explain why you have chosen this option? (e.g. cultural aspects are very likely to be an obstacle for reducing castration of male pigs in my country, because..).

Q35 The following animal production factors that are listed, are most frequently mentioned in scientific research. They relate to sexual and aggressive behaviors in male pigs and consequently in boar taint.

In your opinion, how likely is it that the following factors form an obstacle in realizing a reduction of surgical castration of male pigs for the situation in your country?

* Please choose the most appropriate option for following eleven statements.

* Please fill in the final blank statement if you can think of an animal production factor that is not mentioned in the list. In case you can not think of an other factor, use the option 'very unlikely'.

	Very Unlikely (1)	Unlikely (2)	Undecided (3)	Likely (4)	Very Likely (5)
Feeding management (e.g. high number of animals per feeder or inappropriate feed composition) (1)	❍	❍	❍	❍	❍
Housing environment (e.g. air quality, temperature, lightening and humidity) (2)	❍	❍	❍	❍	❍
Breed of male pigs used (3)	❍	❍	❍	❍	❍
High stocking densities, low space allowance per pig and large group size (4)	❍	❍	❍	❍	❍
Group composition (single-sex or mixed sexes groups) (5)	❍	❍	❍	❍	❍
Mixing of litters after weaning (6)	❍	❍	❍	❍	❍
Relatively outdated housing equipment (7)	❍	❍	❍	❍	❍
Insufficient or absence of enrichment materials for male pigs (8)	❍	❍	❍	❍	❍
Poor hygiene of the living environment of male pigs (9)	❍	❍	❍	❍	❍
Frequent or unexpected changes in feeding management, housing environment and stockmanship (10)	❍	❍	❍	❍	❍
Unavailable and or insufficient detection method for boar taint (11)	❍	❍	❍	❍	❍
Others, mainly (12)	❍	❍	❍	❍	❍

Q36 In case you have chosen the option 'very likely' for (a) statement(s), could you explain why you have chosen this option? (e.g. feeding management is very likely to be an obstacle for reducing castration of male pigs in my country, because..)

Q37 How are male pigs most frequently housed in your county?

- ❍ Single-sex housing
- ❍ Mixed-sex housing
- ❍ I do not know

Q38 Which breed is most frequently used for male production pigs in your country?

- ❍ Please specify _____
- ❍ I do not know

Q39 What would be the most suitable alternative(s) for surgical pig castration in your country?

* Multiple answers are possible.

- ❑ Immunocastration
- ❑ Raising entire boars
- ❑ Raising entire boars and breeding for boar taint reduction
- ❑ Raising entire boars and more appropriate feeding and housing
- ❑ Raising entire boars and slaughtering at lower weights
- ❑ Raising entire boars and the use of (boar taint) detection methods
- ❑ I do not know

Q40 What is your gender?

- ❍ Male
- ❍ Female

Q41 What is your profession?

- ❍ Policy officer
- ❍ Policy advisor
- ❍ Scientific researcher
- ❍ Employed in a slaughterhouse
- ❍ Veterinarian
- ❍ Representative of a national association of veterinarians
- ❍ Farmer
- ❍ Employed in the retail sector
- ❍ Student (Please specify which study)
- ❍ Other (Please specify) _____

Q42 What is your country of residence?

- ❍ Austria
- ❍ Belgium
- ❍ Bulgaria
- ❍ Croatia
- ❍ Cyrus
- ❍ Czech Republic
- ❍ Denmark
- ❍ Estonia
- ❍ Finland
- ❍ France
- ❍ Germany
- ❍ Greece
- ❍ Hungary
- ❍ Ireland
- ❍ Italy
- ❍ Latvia
- ❍ Lithuania
- ❍ Luxembourg
- ❍ Malta
- ❍ Netherlands
- ❍ Poland
- ❍ Portugal
- ❍ Romania
- ❍ Slovakia
- ❍ Slovenia
- ❍ Spain
- ❍ Sweden
- ❍ United Kingdom

Q43 Please, fill in your email address if you would like to receive a brief summary of the outcomes of this study. This email address will not be linked to the input provided in this questionnaire.

Appendix C: Invitation for participation in this study

Ministry of Economic Affairs
Bezuidenhoutseweg 73
2594 AC The Hague
The Netherlands

16 November 2015

Dear Sir/Madam,

Over the years, the Dutch Ministry of Economic Affairs has put considerable efforts in carrying out animal welfare policy. The Ministry frequently recruits trainees and students of several academic universities, who conduct research that supports the current animal welfare policy.

My name is Sanne van Zanen and I am 23 years old. Currently, I am finishing of my master degree Animal Science at Wageningen University (the Netherlands). My major thesis concerns a study of reducing the number of mutilations on animals within the European Union. The Dutch Ministry of Economic Affairs commissions this study. For this reason, the coordinator of Animal Supply Chains and Animal Welfare, Janny Gooijer, of the Ministry of Economic Affairs, will also sign this letter. We would kindly like to ask for your assistance with my study on mutilations. Could you please fill out a questionnaire regarding this subject? We do understand that you have a busy schedule and frequently receive a request to fill in a questionnaire. However, it will only take up to seven minutes per set of questions and your participation will be highly appreciated. Furthermore, it will be extremely valuable for this study that gathers information about the possibilities to reduce the number of mutilations throughout the European Union. Your participation in this study makes it possible, if this is desired, to receive a brief summary of the outcomes of this study.

The study will focus on the following three mutilations:

1. Beak trimming in laying hens
2. Tail docking in slaughter pigs
3. Castration of male pigs (with or without the use of anesthesia and analgesia)

According to literature, these mutilations have received most attention in the European Union. Furthermore, in most of the European member states these mutilations are frequently carried out. For this reason, we have set-up a questionnaire. The aim of this questionnaire is to find out which actions have the greatest chance of success and which reasons form the biggest obstacles in reducing these mutilations. The questionnaire:

- will be distributed throughout the European Union
- is anonymous > gender, country and profession will be linked to the answers
- includes a set of questions for each mutilation > possible to skip a set of questions
- will take up to 7 minutes per set of questions.

Please, do not hesitate to contact the Dutch department of Economic Affairs (Sanne van Zanen: s.zanen@minez.nl or project coordinator: Eric van der Sommen

e.j.vandersommen@minez.nl) for further questions regarding this study. Additionally, feel free to distribute the questionnaire to your colleagues.

We will be very grateful for your participation in the questionnaire as it will be extremely useful for our study on gathering knowledge about the possibilities to reduce the number of mutilations throughout the European Union.

Please click on the link below to take the questionnaire:
https://wur.az1.qualtrics.com/SE/?SID=SV_emHYxKzP2HuHbgN

We would like to thank you in advance.

Kind regards,

Janny Gooijer
Sanne van Zanen

Appendix D Total overview of the type and number of respondents

Type of respondents	What is your country of residence?																Total
	Austria	Belgium	Croatia	Denmark	Finland	France	Germany	Ireland	Italy	Nether-lands	Poland	Portugal	Slovakia	Spain	Sweden	United Kingdom	
Beak trimming																	
Profession																	
Policy officer/advisor	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	3	5
Scientific researcher	0	4	0	4	1	3	6	0	2	5	0	1	1	0	4	6	37
Employed in a slaughterhouse	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Veterinarian/Veterinary medicine	1	0	0	0	0	0	0	0	0	6	0	0	0	1	1	3	12
Farmer	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	3	5
Student	0	1	0	0	0	0	1	0	0	2	0	0	0	0	0	2	6
NGO	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	3
Other*	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	4
Gender																	
Male	0	3	0	2	1	0	1	0	0	7	0	1	1	1	4	11	32
Female	1	2	0	5	0	3	6	0	2	10	0	0	0	0	2	10	41
Total	1	5	0*	7	1	3	7	0**	2	17	0**	1	1	1	6	21	73
Tail docking																	
Profession																	
Policy officer/advisor	0	0	1	2	0	0	0	0	0	1	0	0	0	0	1	2	7
Scientific researcher	1	2	0	5	2	4	9	1	3	6	0	1	1	2	3	5	45
Employed in a slaughterhouse	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Veterinarian/Veterinary medicine	1	0	0	0	0	0	0	0	0	7	0	1	0	1	1	3	14
Farmer	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Student	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	2	6
NGO	0	0	0	2	0	0	1	0	1	0	1	0	0	0	1	2	8
Other***	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	3	5
Gender																	
Male	0	1	1	2	1	0	3	0	1	11	0	1	2	2	4	6	35

Female	2	1	0	8	1	4	9	1	3	7	1	1	0	1	2	11	52
Total	2	2	1	10	2	4	12	1	4	18	1	2	2	3	6	17	87
Surgical castration																	
Profession																	
Policy officer/advisor	0	0	1	2	1	0	0	0	0	1	0	0	0	0	1	1	7
Scientific researcher	2	4	0	3	2	4	10	0	3	8	0	1	1	2	3	4	47
Employed in a slaughterhouse	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Veterinarian/Veterinary medicine	1	0	0	0	0	0	0	0	0	6	0	0	0	1	1	2	11
Farmer	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Student	0	1	0	0	0	0	1	0	0	3	0	0	0	0	0	1	6
NGO	0	0	0	2	0	0	1	0	1	0	1	0	0	0	1	1	7
Other****	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	4
Gender																	
Male	0	3	1	2	1	0	3	0	1	12	0**	1	2	2	4	3	35
Female	3	2	0	6	2	4	10	0	3	8	1	0	0	1	2	7	49
Total	3	5	1	8	3	4	13	0**	4	20	1	1	2	3	6	10	84
Total number of respondents	3	8	1	11	4	7	15	1	4	31	1	3	2	3	7	29	**130**

*Animal management (University of Applied Science), Animal Welfare Advisor, Independent Consultant on farm animal welfare (with a scientific background) and Poultry consultant with significant welfare experience

**Not filled out by any respondent

***Interest in farming, Lecturer, Animal Welfare Advisor, Chemistry and Independent consultant on farm animal welfare (with a scientific background)

****Animal management (University of Applied Science), Interest in farming, Lecturer and Animal Welfare Advisor

Appendix E Literature study: Surgical castration of male pigs

[26] anesthesia and analgesia

1. General introduction on surgical castration of male pigs

Surgical castration of male pigs is a common procedure in the European Union. About 71% of the male pigs raised for production were surgically castrated in the European Union in 2012. (FCEC, 2015). In 2009, a project called 'PIGCAS' ('attitude, practices and state of the art regarding piglet castration in Europe') showed similar results. They have showed that about 77% of male pigs were castrated without the use of anesthetics in the European Union (Fredriksen et al., 2009). A European law exists that regulates the performance of this mutilation. It includes the directive of the European Union (2008/120/EC) and it states:

"Castration of males without anesthesia is allowed within 7th day of life by other means then tearing of tissue." (European Commission, 2008a, p. 10).

The effects of surgical castration on male pigs and alternatives for castration will be discussed in this Appendix. It is important to mention that this appendix solely discusses the surgical castration procedure of male pigs. Additionally, the term entire boars is used to describe male pigs that are not surgically castrated, but raised entire.

2. Surgical castration of male pigs

As the general introduction mentioned, the majority of male pigs raised for production are surgically castrated. The ability to prevent boar taint (> 99% of the cases) is the main reason for castrating pigs (Fredriksen et al., 2009; Vanhonacker & Verbeke, 2011; FCEC, 2015). Boar taint negatively influences the quality of meat by means of its odor and taste. Consequently, this will make pig meat less appealing for consumption (Valeeva et al., 2009; ten Have-Mellema et al., 2013; van Wagenberg et al., 2013; Backus, 2014). However, surgical castration has consequences for the welfare of pigs, which be discussed in the following paragraphs.

2.1 Positive welfare effects of surgical castration

The procedure of surgical castration decreases aggressive and sexual behaviors in male pigs due to the absence of reproductive hormones (Carroll et al., 2006; Zamaratskia, 2014). These behaviors are considered as undesired, since they impair the welfare of pen mates (Valeeva et al., 2009; Jensen et al., 2014). Fàbrega et al. (2010) have compared the behavior of, among others, entire and castrated male pigs. They have showed that the number of skin lesions and activity is lower in castrated male pigs compared to entire boars. However, this difference was not significant (Fàbrega et al., 2010). Aggressive and sexual behaviors do most frequently occur during puberty, which is the moment of the onset of reproductive hormones (Zamaratskia, 2014).

Furthermore, Zamaratskia (2014) have found a positive relationship between the increase in active boar taint components (androstenone and skatole levels) when testicular steroids in entire boars grow (onset of puberty). The maximum increase in levels of these components is also during puberty. These findings indicate that the risk of boar taint is highest during puberty and is related to aggressive and sexual behaviors. Additionally, it explains why a castrated pig performs less frequent sexual and aggressive behaviors (Zamarkstiki, 2014). Moreover, research of Giersing et al. (2000) confirm the relationship between boar taint and aggressive behaviors. They have found that high levels of androstenone were related to pigs performing aggressive behaviors, indicating an increased risk for boar taint (Giersing et al., 2000).

2.2 Negative welfare effects of surgical castration

It is expected that pigs suffer from pain due to the procedure of surgical castration (Kluivers-Poodt et al., 2007). However, pain is a subjective experience and impossible to directly measure on a pig. For this reason, changes in vocalization, physiology and behavior are used as indicators of pain and consequently of an impaired welfare (Kluivers-Poodt et al., 2007; Von Borell et al., 2009). Several researches have

studied these indicators in pigs that are castrated with or without the use of analgesia and or anesthesia and in sham-castrated pigs (handled twice in an interval of 15 minutes) (Taylor et al., 2001; Marx et al., 2003; Carroll et al., 2006; Kluivers-Poodt et al., 2007; Von Borell et al., 2009). First of all, Kluivers-Poodt et al. (2007) have showed changes in vocalizations. Surgically castrated male pigs make significantly higher frequency calls during the procedure compared to sham-manipulated male pigs. Furthermore, the calls of castrated pigs are of higher intensity, more frequent and persists for a longer period of time compared to sham-castrated or castrated with anesthesia ($P<0.05$) (Kluivers-Poodt et al., 2007). Taylor et al. (2001) have confirmed the higher frequency calls (>1000Hz) of castrated pigs compared to sham castrated pigs ($P<0.001$). Marx et al. (2003) have demonstrated that castrated pigs without anesthesia at day five perform significantly more frequent numbers of screaming sounds compared to castrated pigs with anesthesia (Marx et al., 2003).

Secondly, shortly after the procedure a significant higher level of cortisol is seen in castrated pigs compared to castrated pigs with anesthesia and sham castrated pigs ($P < 0.001$). This physiological change is an indicator of stress, which impairs the welfare of the animal (Kluivers-Poodt et al., 2007).

According to Taylor et al. (2001), the age at which pigs are castrated does not affect the perceived level of pain. They have compared the vocal responses of castrated and sham castrated pigs at different ages (day 3,10,17) and did not find significant interactions (Taylor et al., 2001). These results are similar to Carroll et al. (2006), who have also not found an effect of age on the consequence of surgical castration. The levels of cortisol increased in a similar way in the different age groups (castrated at day 3,6,9 or 12) (Carroll et al., 2006). This suggests that indicators of pain, like vocal responses and stress, do not depend on age.

Moreover, Kielly et al. (1999) have found an impaired growth in surgically castrated piglets (at day 3) on day one to three after the procedure compared to entire boars ($P=0.1$ and $P=0.6$). It is suggested that this could indicate stress and perceived pain due to the procedure or experiencing difficulties in reaching the teats of the sow (Kielly et al., 1999; EFSA, 2004). However, Caroll et al. (2006) have not found significant effects on body weight and growth rates between castrated (on day 3) and entire boars (measurements were taken on day 3 till day 12). Hay et al. (2003) has also not showed significant differences between castrated and entire animals weighted at the first four days after the castration procedure had taken place (at day five). This indicates that a growth reduction due to surgical castration depends on age (Hay et al., 2003).

The third indicator, behavioral changes, for pain will be discussed next. Moya et al. (2008) has found that pigs that are castrated at day five of age show less locomotion ($P<0.05$), more trembling ($P<0.05$), huddled up ($P< 0.001$) and spasms ($P<0.01$) behaviors compared to sham-castrated animals. Additionally, castrated pigs showed more signs of social isolations ($P < 0.05$), less social interactions ($P < 0.1$) and dog-sitting behaviors ($P<0.01$) for a longer period of time (until three days after the castration) compared to sham castrated pigs (Moya et al., 2008). It is suggested that these behaviors reduce the chance that pen mates touch painful areas, which implies that pigs try to prevent that these areas are hit (Moya et al., 2008; Von Borell et al., 2009). In line with Moya et al. (2008), Hay et al. (2003) have found that castrated pigs perform significantly more abnormal behaviors like tail wagging and scratching compared to entire boars and this difference remains present beyond 24 hours after the castration procedure ($P<0.001$). The piglets were castrated at day five of age. Besides the indicators of pain, surgical castration impairs the integrity of pigs and makes it impossible to perform natural behaviors (EFSA, 2004). Finally, the risk for infections and inflammations is increased due to an open wound of surgery (de Kruijf and Welling, 1988; EFSA,

2004;CIWF,n.d.-b). However, no recent scientific research could be find that support the risk of diseases.

3. Surgical castration with the use of anesthesia and analgesia

Anesthesia and analgesia could be administered prior to the procedure of surgical castration. Anesthesia can either be locally injected (in the testicles) or administered in a more general way (e.g. by means of inhalation) (EFSA, 2004; Kluivers-Poodt et al., 2007). The following paragraphs discuss the positive and negative effects of the use of anesthesia and or analgesia compared to sham-castrated pigs.

3.1 Positive welfare effects of the use of anesthesia and analgesia

The use of local anesthesia during the procedure of castration lowers significantly the cortisol levels compared to castrated animals without anesthesia or pigs administered with solely analgesia or with both local anesthesia and analgesia ($P<0.001$) (Kluivers-Poodt et al., 2007). Furthermore, a significantly higher skin temperature was seen in animals with local anesthesia and pigs administered both analgesia and local anesthesia compared to castrated pigs without administration of any of the pharmaceuticals ($P<0.001$) (Kluivers-Poodt et al., 2007). However, pigs that were only administered with analgesia (Meloxicam) did not differ significantly in skin temperature from the pigs that were treated without anesthesia (Kluivers-Poodt et al., 2007). Generally, a reducing skin temperature indicates stress (Kluivers-Poodt et al., 2007). Research of Zöls & Ritzmann (2006) has found that the use of an analgesia (Meloxicam) prior to castration does not significantly increase the concentration of cortisol in the serum compared to sham castrated pigs. These contrasting results, an increased or not increased level of stress due to the use of an analgesia, can possibly explained by a difference in time between administering the analgesia and taking samples of blood between the two studies (study of Kluivers-Poodt et al. (2007) respectively 20 minutes and the study of Zöls & Ritzmann (2006) respectively 35-75 minutes).

3.2 Negative welfare effects of the use of anesthesia and analgesia

The use of anesthesia and or analgesia does also impair the welfare of pigs. The administration is an extra handling, making it more stressful for the animal and the pig has to recover from the pharmaceutical (EFSA, 2004; Von Borell et al., 2009; Schmidt et al., 2012). Researches have indicated that this extra-handling only shows minor differences in behavior and cortisol levels in sham-castrated pigs and pigs that were not handled et al (Hay et al., 2003; Prunier et al., 2005; Zöls & Ritzmann, 2006). However, the injection of a local anesthesia could causes damage and irritation in the underlying tissue of the scrotum. This is suggested by the research of Kluivers-Poodt et al. (2007), they have found a significant increase in the performance of abnormal behavior like tail wagging in pigs treated with a local anesthesia compared to sham castrated pigs and even to castrated pigs without any analgesia and or anesthesia ($P< 0.05$) (Kluivers-Poodt et al., 2007). As a result, it is suggested that a local injection induces an extra pain reaction in pigs (Kluivers-Poodt et al., 2007). Furthermore, sham-castrated pigs have a significantly lower cortisol level than pigs castrated with local anesthesia. This indicates that castrated with local anesthesia still suffer in some degree of stress compared to pigs that are not castrated (Kluivers-Poodt et al., 2007).

The use of general anesthesia has not been proven successful in significantly reducing pain in castrated pigs, because the general sedation increases the risk of injury by the mom and a reduced suckling frequency (Prunier et al., 2006; Von Borell et al., 2009). Additionally, higher levels of cortisol were shown in pigs administered with CO_2 (general anesthesia) compared to unaesthetic pigs, four hours after the procedure (significance is unknown) (Schönreiter et al., 2000). However, after 24 hours the cortisol

levels were lower in anaesthetized pigs compared to non-anaesthetized pigs. This indicates a relief of stress and pain on the long term. Moreover, research of Schmidt et al. (2012) has found that pigs castrated with general anesthesia and analgesia spend more time away from the sow ($P < 0.001$) and showed a reduced stability in suckling order ($P < 0.004$) compared to pigs castrated with solely analgesia or castration without any pharmaceuticals. These results indicate that castrated piglets administered both analgesia and general anesthesia experience more stress compared to pigs solely administered analgesia. However, as is previously mentioned by Kluivers-Poodt et al. (2007), a higher level of stress in castrated pigs with analgesia has been found compared to pigs administered both analgesia and local anesthesia. The inconsistent effects of the studies could be explained by the fact that the indicators of stress and type of pharmaceuticals used differed, which makes it difficult to draw a conclusion on the use of analgesia (Kluivers-Poodt et al., 2007; Schmidt et al., 2012). Furthermore, Schmidt et al. (2012) did not have treatment groups of pigs castrated with solely anesthesia and sham-castrated pigs.

Finally, according to the Raad van Dieraangelegenheden (2013), who recently developed an assessment tool to determine if a certain mutilation is allowed in the Netherlands, concluded that pig castration with the use of the CO_2/O_2 anesthesia (a general anesthesia) should not be allowed. This decision is based on the following aspects: the integrity of pigs is impaired, levels of pain are perceived, unable to perform certain natural behaviors and the procedure is carried out to meet the necessary objective of the farmer and not for the pigs (RDA, 2013).

4. Immunocastration

An alternative of surgical castration is immunocastration. Immunocastration is a way to castrate pigs without surgery, but by means of the vaccine (e.g.) Improvac. It delays maturity due to the stimulation of the immune system. As a result, antibodies are produced against the reproductive hormones, which depresses their functioning. Immunocastrated pigs do not have to suffer from the castration procedure, which is beneficial for their welfare (Vanhonacker & Verbeke, 2011). Moreover, the lack of surgery lowers the risk for infections (EFSA, 2004; CIWF, n.d.-b). This will reduce the use of antibiotics and a reduction of 1.5% in mortality of piglets compared to surgically castrated pigs (Derom, 2010). The vaccine needs to be injected at least two times, but are administered in a later stage (couple of weeks old) compared to the moment of castration (within seven days after birth). As a result, these pigs have the opportunity to grow up in more a natural way compared to castrated pigs (EFSA, 2004; Vanhonacker & Verbeke, 2011; Jensen et al., 2014). Studies have proven that administration of the injections do not impair the welfare of the animal in terms of pain and stress, as long as it is provided in an aqueous adjuvant, which is the case with Improvac (Dunshea et al., 2000; Vanhonacker & Verbeke, 2011; Paul et al., 2009; EMA, 2014). However, the time between the injections lead to an increase of mounting and aggressive behaviors and skin injuries compared to surgical castrated animals. As a consequence, the levels of stress in pen mates increases, which impairs their welfare.

Furthermore, the risk of boar taint in pigs is increased by 1%, a slight increase compared to surgical castration (expected to be 0%) (Vanhonacker & Verbeke, 2011; Jensen et al., 2014). For this reason, the second injection needs to be provided as soon as possible to limit the negative impact on welfare (Vanhonacker & Verbeke, 2011; Jensen et al., 2014). Fàbrega et al. (2010) have showed that a fully immunocastrated pig performs less aggressive behaviors and have a significant lower number of skin lesions compared to entire boars. Moreover, researchers have shown that boar taint is below the sensory detection level of humans within two weeks after the second injection

(Lealiifano et al., 2011; Kubale et al., 2013). Additionally, management and feeding methods have proven, among others, to be successful in reducing the number of these undesired behaviors and in turn the risk of boar taint (Jensen et al., 2014), which will be discussed in subparagraphs 5.1.3 and 5.1.4.

5. Methods to reduce the risk of boar taint in entire boars

5.1 Raising entire boars

A second alternative for surgical castration of pigs is raising entire boars. The number of male pigs reared as entire is increasing, but highly differs within European countries (Fredriksen et al., 2009; Backus et al., 2014. In 2009, about 5% of the pigs were raised entire in the Netherlands, which is increased to 65% in 2014. In contrast to the Netherlands, France has a much lower percentage of raising entire males (respectively 2% in 2009 and 8% in 2014) (Backus et al., 2014).

The use of entire boars has several welfare benefits compared to surgically castrated pigs. Entire boars do not experience the painful and stressful castration period, which is beneficial for their welfare (Zamaratskaia , 2014; Jensen et al., 2014). Additionally, entire pigs have a significantly lower number of chronic inflammations compared to castrated pigs. This is related to the absences of the castration procedure (de Kruijf and Welling, 1988). As a consequence, they are less often diseased (Kallas et al., 2012). Moreover, the integrity of the animal remains and the pig is able to perform its natural behaviors like sexual behaviors. However, this results in a higher number of mounting and aggressive behaviors in entire boars compared to castrated males (Valeeva et al., 2009; Fàbrega et al., 2010; Jensen et al., 2014). Fàbrega et al. (2010) have found that the levels of activity, aggressive and mounting behaviors are higher in entire boars compared to castrated and immunocastrated pigs. Such behaviors may be a safety and welfare issue for the pen mates, because pen mates can become stressed and injured by such behaviors. Fàbrega et al. (2010) have found the highest number of skin lesions in entire boars compared to females and immunocastrated male pigs ($P < 0.05$). As is discussed in paragraph 4, the period between the two injections of the immunocastration procedure does also lead to an increase in undesired behaviors. However, this period is shorter in immunocastrated pigs compared to entire boars. For this reason, it is suggested that if solely taken into account the effects of these undesired behaviors the welfare is better in immunocastrated pigs (Jensen et al., 2014).

The increase in aggressive and sexual behaviors will in turn lead to an elevated risk of boar tainted meat of entire boars, especially in pigs slaughtered at an older age when they have reached sexual maturity (Zamaratskaia, 2014). ten Have-Mellema et al. (2011) have found an average prevalence of boar taint of 3.31% in entire boars raised in conventional systems. This research used the Human Nose as a way to detect boar taint (subparagraph 5.1.6) and was conducted in the Netherlands (ten Have-Mellema et al., 2011). In Denmark it is assumed that raising entire boars have an 8-10% risk for boar taint, which is based on skatole levels that is above the detection threshold of 0.25 μg/g (Maribo, personal communication, 2013). However, the risk of boar taint in organic farming is higher, respectively 18% based on skatole levels (> 0.2 μg/g) and 66% due to androstenone levels (>1 μg/g). This research used pigs with a weight of 75-93kg and the human nose method as a detection method for boar taint (Maribo, 2012). Several management and feeding methods are, among others, able to lower the risk of boar taint and undesired behaviors (subparagraphs 5.1.3 and 5.1.4) (EFSA, 2004; van Wagenberg et al., 2013; Jensen et al., 2014). The following subparagraphs will discuss several methods to reduce the risk of boar taint in meat of entire boars.

5.1.1. Breeding

First of all, selective breeding is a way to reduce the level of boar taint in entire boars. Danish research of Gregerson et al. (2012) has found that pig breeds differ in levels of boar taint. Landrace and Duroc breeds are shown to have the highest levels of boar taint (respectively: skatole-levels and androstenone levels), while Yorkshire have the lowest levels (skatole) (Gregerson et al., 2012). Moreover, research of Robic et al. (2008) has shown that the components of boar taint are mild to high heritable, especially androstenone. For this reason, it is advised to select against the overall incidence of boar taint, which will make surgical castration unnecessary. It should be noted that the genetic traits involved are very complex and the full genetic potential is not known yet, which will make it a difficult and time consuming task to think of an effective selection strategy. Finally, genetic selection possibly increases the risk for long-term morphological changes, in terms of growth performance, and requires further research (Valeeva et al., 2009; Jensen et al., 2014).

5.1.2 Sexen of semen

Secondly, in theory it is feasible to select only semen of females before the fertilization-phase. However, this technique is not available in the short term, because further research is needed if it is possible in practice (Backus et al., 2008; Jensen et al., 2014).

5.1.3. Feeding measures

Appropriate feeding can significantly reduce the levels of undesired behaviors and boar taint in entire boars ($P<0.10$) (van der Peet-Schwering et al., 2013; van Wagenberg et al., 2013). Ad libitum feeding results in a significantly reduction of undesired behaviors (like mounting), especially at the end of the fattening period ($P < 0.10$). Restricted feeding leads to high levels of competition around the feeder, which increases the levels of stress and in turn the number of aggressive behaviors (van der Peet-Schwering et al., 2013; van Wagenberg et al., 2013; Zamaratskaia, 2014). Furthermore, according to van Wagenberg et al. (2013), restricted feeding of at least six hours before slaughtering is desirable, because it significantly decrease the level of boar taint ($P<0.021$). However, these pigs should be fed ad libitum before to the last period (van Wagenberg et al., 2013). Use of long troughs and lower numbers of animals per feeder (maximum of five) has also showed to reduce the levels of aggressive behaviors ($P<0.10$) (van der Peet-Schwering et al., 2013). Furthermore, feeding systems that are not clean and provide an insufficient water supply reduce the intake of pigs, which will make them restless and in turn start behaving in an undesired way ($P < 0.10$). As a consequence, good hygiene of the feeders and sufficient water supply is of high importance (van der Peet-Schwering et al., 2013). Finally, an appropriate feed composition and wet by-products like wheat starch and raw potato starch giving the animals a feeling of saturation, which reduces stress and in turn undesired behaviors and injuries. Good quality feeds like high levels of digestible amino acids reduces undesired behaviors ($P < 0.10$) (van der Peet-Schwering et al., 2013; Jensen et al., 2014). Additionally, bioactive feed compounds (e.g. chicory root) and pure grain are also suggested to reduce the levels of boar taint (skatole compound) when fed 4 to 7 days before slaughtering (Jensen et al., 2014). All in all, appropriate feeding reduces the levels of stress and discomfort, which will lower the risk of undesired behaviors and in turn boar taint (van der Peet-Schwering et al., 2013; Jensen et al., 2014).

5.1.4. Additional management measures

Not only is appropriate feeding an important management factor for a significant reduction of aggressive and sexual behaviors and the prevalence of boar taint in entire raised boars, but aspects like, housing and environment of pigs, are also involved in this issue and need to be considered (van der Peet-Schwering et al., 2013; van Wagenberg et

al., 2013). First of all, appropriate ventilation, partly open pens and the use of a maximum of 32 lux of light lead to lower levels of aggressive and sexual behaviors and in turn the number of skin lesions ($P < 0.10$) (van der Peet-Schwering et al., 2013). Furthermore, good hygiene of the pens significantly reduces the number of undesired behaviors and the level of boar taint ($P < 0.10$) (van der Peet-Schwering et al., 2013). Moreover, as is mentioned in subparagraph 5.2.1, the type breed does influences the number undesired behaviors and lesions ($P < 0.10$) (van der Peet-Schwering et al., 2013). Moreover, low stocking densities (<30 pigs per pen) ($P<0.10$) and a reduction of the mixing of litters will also lower the levels of aggressive behaviors and lesions (EFSA, 2007b; van der Peet-Schwering et al., 2013; van Wagenberg et al., 2013). Another aspect relevant to consider in terms of boar taint is the way pigs are housed. Raising entire male pigs together with females will increase the risk of sexual and aggressive behaviors and in turn the prevalence of boar taint (Jensen et al., 2014; Zamaratskaia, 2014). Zamaratskaia (2014) has found that housing of a sow and entire boar together speeds up the onset of puberty, which is shown in an increase of skatole (pigs of 115kg and fed raw potato starch) and androstenone levels (pigs of 90kg) in mixed-sex groups compared to single sex groups (significance is unknown). Moreover, raising pigs on slippery floors, due to manure and urine, speeds up the onset of aggressive behaviors in castrates (EFSA, 2007b). Finally, in terms of pen sizes it is concluded that smaller pen sizes are in favor of aggressive behavior but it is not seen as animal friendly, more research needed to confirm this (van Wagenberg et al., 2013). It could be said that meeting the need of pigs in terms of the above (subparagraphs 5.1.3 and 5.1.4) mentioned management factors lead to a more healthy animal, which performs lower numbers of aggressive and sexual behaviors and in turn lower levels of boar taint ($P<0.10$) (van der Peet-Schwering et al., 2013). It is important to mention that only the most frequently mentioned management factors in literature are included in this study, more factors do exists.

5.1.5. Slaughtering of pigs at younger age and weight

Pigs slaughtering at a younger age (up to 85kg), when the pigs have not reached maturity yet, will reduce the levels of boar taint (Valeeva et al., 2009; Zamaratskaia, 2014). Moreover, Zamaratskaia (2014) has found a significant higher level of skatole in higher weight pigs (115kg) compared to the lower weight pigs (90kg). For this reason, it is suggested that slaughtering pigs at a lower age reduce the risk of boar taint. However, it does not eliminate the boar taint completely (Backus et al., 2008; Valeeva et al., 2009). The specific number of reduction in boar taint prevalence is difficult to say, due to differences in breeds, age and weight (Zamaratskaia, 2014).

5.1.6. On-line detection of boar taint

Furthermore, the use of detection techniques at the slaughter line excludes tainted carcasses from the production. However, it does not reduce the levels of boar taint in entire boars (Valeeva et al., 2009). This method could be seen as a safety net, a final attempt to prevent boar taint (Backus et al., 2008). Currently, no such technique is internationally accepted and validated (Jensen et al., 2014). However, the sensory method called: Human Nose Scoring system has showed promising results (Backus, 2013; Haugen et al., 2015; Heres et al., 2015). Heres et al. (2015) have looked into the reproducibility of the human nose score approach. According to their findings the test-retest reliability between testers was significant. A 9% variance was seen between testers, but when the time given for scoring increased (from 7 to 14 seconds) the variance lowered to 0% (Heres et al., 2015). Further development and evaluation is needed before it can become a standard procedure for detecting boar taint (Haugen et al., 2015)

5.1.7. Processed meat products

Final attempts to prevent the risk of tainted meat is the use of species, which masks the undesirable smell and taste of tainted meat, and the use of a mixture of untainted with tainted meat. However, this technique is during the processing phase and is for this reason not able to reduce the levels of boar taint in pigs, similar to on-line detection of boar taint (subparagraph 5.1.6). More research is needed to conclude if this method is applicable in the pig industry (Valeeva et al., 2009).

6. Economic consequences of alternatives to surgical castration

6.1 Introduction of the economic consequences

Several studies have looked into the financial feasibility of the alternatives for surgical castration (de Roest et al., 2009; FCEC, 2015). It is a challenging task to do, because it highly depends on the farm size, use of a veterinarian or not, market acceptance, risk of boar taint and the varying cost prices of pharmaceuticals between the different studies and countries (de Roest et al., 2009). The following paragraphs will elaborate on the economic impact of the different alternatives, which are all relative to the standard surgical procedure of castration (without the use of anesthesia and analgesia). The focus will be on the factors that have an influence on the economic feasibility of the alternatives.

6.2 Economic impact of surgical castration with the use of anesthesia and or analgesia

It goes without saying that the use of anesthesia and or analgesia during the procedure of surgical castration of pigs will enhance the costs compared to not using them (de Roest et al., 2009). According to de Roest et al. (2009), it is economically less feasible for small-scale farmers (less than 400 pigs) to use anesthesia when they can not administer the drug themselves compared to farmers that are able to administer it themselves. Consequently, the total average cost will be highly affected (of about 80%) by veterinary costs. A difference between the use of local and general anesthesia is also relevant, in many countries farmers are not allowed to administer a local anesthesia and need the use of a veterinary. However, the use of a local anesthesia is less expensive than the use of a general anesthesia if a veterinarian is not needed. As a result, the use of general anesthesia is often more expensive than a local anesthesia, but depends heavily on farm size (>200 pigs increase the costs) and the use of equipment (inhalation or injection) (de Roest et al., 2009). According to de Roest et al. (2009), the use of both analgesia and anesthesia is the most expensive option of this alternative due to an increase in labor and pharmaceutical use.

6.3 Economic impact of immunocastration

Immunocastration increases the costs in terms of labor and pharmaceutical costs of Improvac. These costs need to be balanced against its benefits of an increased weight (up to 32%) and a better feed efficiency (7-17%) of the immunocastrated pig compared to surgical castrated pigs. The benefits of this alternative are able to compensate for the costs involved of immunocastration if an appropriate feeding strategy is applied (de Roest et al., 2009). However, it depends on moment when pigs are immunocastrated, which influences the feed efficiency and weight gain, and the cost of the vaccine (de Roest et al., 2009). Besides the just mentioned influencing factors, there are two final important aspects that need to be discussed. First of all, the risk boar taint is possibly the most crucial determining factor in the economic feasibility of immunocastration. Although, the risk is rather small (about 1%), in case it will happen it will lead to enormous financial losses (Vanhonacker & Verbeke, 2011). As a consequence, it is important to inject the vaccines on the right time and detection methods at the slaughter line need to be used (Valeeva et al., 2009). Finally, an expert is needed to inject the vaccine due to the risk of self-injection. The immune-vaccine may be active in humans as

well (de Roest et al., 2009; Vanhonacker & Verbeke, 2011; Jensen et al., 2014). Costs will rise when a farmer has to hire someone to administer the vaccines (de Roest et al., 2009).

6.4 Economic impact of raising entire boars

6.4.1. Slaughter weight >90kg

Raising entire boars will reduce the costs in terms of surgery, pharmaceutical use, feeding and labor. Xue et al. (1998) have found that entire boars have an improved feed conversion (3-20% depending on type of rearing condition), which leads to a reduced feed intake (up to 9%) and a better growth rate (up to 13%, depending on type of diet) compared to surgical castrated pigs (de Roest et al., 2009). However, the performed aggressive and sexual behaviors of entire boars lead to skin lesions. Consequently, carcasses are condemned, which lowers the price and quality of the meat (EFSA, 2004). Furthermore, the risk of boar taint is increased in entire boars, resulting in increasing costs of detection methods. All together, entire boars show to be the best economical alternative if there is no tainted meat detected or when the use of entire boars and its risk for boar taint is accepted (paragraph 7) (de Roest et al 2009; Jensen et al., 2014; FCEC, 2015). The economic impact of entire boars is intensively studied. However, the results are difficult to compare because it highly depends on the risk of boar taint, type of feeding and rearing (Jensen et al., 2014)

6.4.2. Slaughter weight < 90kg

Baltussen et al. (2008) have proven that slaughtering entire boars at younger age is not economically feasible. However, this study assumed that solely one country would raise entire boars, while the remaining countries of the European Union surgically castrate them. This possibly biases the results, since that is not the case in the European Union anymore (Backus et al., 2014). On the other hand, this study hypothesized a zero percentage of boar taint, which is neither a realistic number in practice (Baltussen et al., 2008; ten Have-Mellema, 2013). Additionally, slaughtering at a younger age automatically leads to a lower weight, which lowers the revenues of farmers. The slaughtering of pigs at a younger age will be beneficial in terms of feed cost, due to their lower feed efficiency, but it is not enough to compensate for the lower slaughtering weight (Backus et al., 2008; Valeeva et al., 2009)

7. Influencing stakeholders

As is shown in paragraph 5, useful and promising methods to reduce boar taint prevalence in entire boars exists. However, reducing the procedure of surgical castration of male pigs and implementing alternative methods can only be successful when important stakeholders (consumers, pig producers, the retail and export) fully trust and accept them (Valeeva et al., 2009). Generally, concerns about the procedure of castration and the effects grow in society. As a consequence, pig castration has become socially unacceptable and alternatives for surgical castration are more and more considered (EFSA, 2004; Fredriksen et al., 2009; Valeeva et al., 2009; ten Have-Mellema et al., 2013). The following paragraphs will go more into details about the attitude of the (pig) society.

7.1 Consumers

Consumers are of high importance when it comes to market acceptance and economic feasibility of alternative strategies for surgical castration of male pigs (Beakert et al., 2011; Jensen et al., 2014). Several factors determine and influence the attitude of consumers towards the alternatives and will be briefly explained in the following subparagraph.

7.1.1. Sensitivity to boar taint

First of all, it is important to know the sensitivity of the boar taint compounds (skatole and androstenone) in order to determine the impact of it on consumers when

pigs are raised as entire (Beakert et al., 2011; Jensen et al., 2014). Researches have shown that people differ in levels of sensitivity to the compounds active in boar taint. While nearly everyone (99%) is sensitive to skatole, the sensitivity to androstenone depends on genetics, age, gender and even by country (Weiler et al., 2000; Beakert et al., 2011; Blanch et al., 2012). Bekeart et al. (2011) have showed that 45.5% of the respondents are sensitive to androstenone and this significantly differed between gender (female 51.1% and male 38.3%, $P<0.001$) and age (older people were less sensitive compared to young people, $P<0.001$). This study is solely conducted in Belgium (Beakert et al., 2011). Additionally, the level of androstenone in meat does also influence the sensitivity for it (Font i Furnols et al., 2003). For this reason, the sensitivity can either be low (18%) or high (74%), depending on the level of androstenone used in the studies (Jensen et al., 2014). Moreover, consumers differ in appreciation of the smell of androstenone. Font i Furnols et al. (2003) have showed that some people appreciate it (18.1%), while other do not appreciate it (33%). This study solely included Spanish consumers (Font i Furnols et al., 2003). Combining these results shows that sensitivity and appreciation of the androstenone smell determine the acceptance of boar taint (Font i Furnols et al., 2003; Jensen et al., 2014; Backus, 2015). Font i Furnols et al. (2003) have found that a more sensitive individual reduces the appreciation of boar tainted meat ($P< 0.0001$). As a result, the sensitivity to androstenone plays a crucial role for the acceptability of pork meat (Weiler et al., 2000; Font i Furnols et al., 2003).

7.1.2. Knowledge about surgical castration and its alternatives

Furthermore, the level of knowledge about pig castration and its alternatives is proven to be rather limited (Vanhonacker & Verbeke, 2011; Kallas et al., 2012). However, providing consumers more information on the situation of surgical castration of pigs and its alternatives, increase the acceptance towards alternatives for castration (Vanhonacker & Verbeke, 2011; Kallas et al., 2012; van Beirendonck et al., 2013).

7.1.3. Experience with boar taint in the meat

Another factor that influences the acceptability of non-castrated pigs is related to experience. It goes without saying that having a bad experience with boar taint reduce the change that consumer will buy the same product again (Font i Furnols et al., 2003).

7.1.4. Cooking habits of pork meet

Pork meat that is cooked will increase the risk of boar taint, in contrast to meat that is consumed cold or only slightly warm. However, most pork meat for consumption need to be heated (Beakert et al., 2011; Kristensen et al., 2012). Additionally, the risk of boar taint depends on the type of meat, especially fresh meat and a higher fat-content have a higher prevalence of boar taint (Chevillo, n.d.). Thirdly, the use of herbs can cover the smell of boar taint, as is mentioned in subparagraph 5.1.7. (Valeeva et al., 2009). Moreover, the acceptability of tainted meat will increase if pork meat is cooked ($P < 0.05$) and consumed ($P <0.001$) more frequently (Font i Furnols et al., 2003). This effect will be stronger if fresh pork meat is consumed weekly and fortnightly, compared to a monthly consumption of fresh pork. Furthermore, the acceptance of odor of the boar taint has also shown to have more effect when pork meat is consumed weekly instead of once a month or less (Font i Furnols et al., 2003).

The final aspect related to cooking is about the importance of product attributes. According to Kallas et al. (2012), taste and odor are the most crucial characteristics of products for western-European consumers. More generally, research of Backus (2015) has concluded that quality, price and health of pork meat are most important according to the European member states. The attribute animal welfare is of much lower importance. However, it is unknown if these differences in both studies were significant (Kallas et al., 2012; Backus, 2015). Additionally, Kallas et al. (2012) and Backus (2015) differed in the number of countries and product attributes studied. Nonetheless, the

studies do show that in order to determine consumers acceptance towards tainted meat, multiple product attributes need to be taken into account (ten Have-Mellema et al., 2013).

7.2 Pig producers

Secondly, the pig producers or farmers are also of high relevance to consider, since they are the ones who have to implement the strategy (Jensen et al., 2014). Economic feasibility, market acceptance and labor intensity are important factors that determine the attitude of farmers towards the alternatives (Jansen et al., 2014). An alternatives for surgical castration is immunocastration of pigs (paragraph 4), which uses genetic modification technologies for the production of the vaccine. Furthermore, consumers worry that rests of the vaccine can be found in the meat, a food safety issue. As a consequence, consumers have difficulties in accepting this technique. In turn, farmers are not willing to use it, since the acceptance of consumers is the key for marketing success (EFSA, 2004; Valeeva et al., 2009; de Roest et al., 2009). However, scientific research has indicated that it is completely safe to use, since the vaccine is not found in the meat (Jensen et al., 2014 and Vanhonacker & Verbeke, 2011). Cross-country research of Vanhonacker & Verbeke (2011) has proven that pork consumers, who have knowledge of the effects of pig castration and its alternatives, do accept the immunocastration technique. This shows the importance of increasing the knowledge not only of consumers, but also of the pig farmers. Additionally, experience with an alternative, for example raising entire boars, have also proven to be a successful way of creating acceptance for it by farmers (Jensen et al., 2014).

7.3 Importance of retailers and export

Finally, the importance of retailers and the export will be discussed. For some countries, like the Netherlands and Belgium, export is of high importance. As a consequence, these countries need to be sure that whatever they decide to do with their pigs for production (e.g. surgical castration or not) is accepted abroad. It will lead to high financial loss if an importing country does not accept the procedure that has taken place with the pigs ("Vlees industrie stuit op grenzen," 2013; Redactie, 2014). Currently, it seems that countries differ in their acceptance towards surgical castration and tainted meat (paragraph 8). Market acceptance is of high importance for retailers, as is for the farmers. Additionally, the producers and industry need to make sure that the meat is boar taint free, because consumers hold them responsible for it. Recently, several retailers have made steps towards supporting alternatives of pig castration, suggesting that they are accepting and trusting it more and more (Jensen et al., 2014).

8. Status of surgical castration of male pigs in the European Union

8.1 Introduction of surgical castration in the European Union

As is mentioned in the general introduction, the European commission allows the procedure of surgical castration if it is carried out before day seven of life and without tearing of tissue (European Commission, 2008a). However, in practice the majority (71-80%) of pigs are surgically castrated (with or without the use of analgesia or anesthesia) (EFSA, 2004; FCEC, 2015). In 2010 a European declaration on alternatives for surgical castration of male pigs was introduced. This declaration aims for abandoning the procedure by 2018 (European Commission, 2015). It is signed by the European Commission and several European animal welfare organizations, pig farmers, meat industry, veterinarians, scientists and retailers on a voluntary basis (van Wagenberg et al., 2013; Jensen et al., 2014). The European member states have not yet introduced national legislation that exceed the legislation set by the European Commission on a ban of surgical castration of pigs. However, several national non-legislative initiatives of the member states make efforts to phase out this mutilation. As a consequence, views and

the status regarding pig castration and its methods to reduce boar taint differ not only between the stakeholders, but also within in European member states (Valeeva et al., 2009; Jensen et al., 2014), which will be discussed next. It is important to mention that only a selected part of the member states are discussed, this is based on the availability of information. Moreover, the national non-legislative initiatives are found by means of an online web search, it is expected that more initiatives do exist.

8.2. Austria

About 100% of the male pigs are surgically castrated in Austria (EFSA, 2004; Fredriksen et al., 2009; FCEC, 2015). The majority (95%) of these pigs are administered with analgesia prior to the procedure (FCEC, 2015).

8.3. Belgium

Market-driven efforts have led to the fact that male pigs used for the domestic market are not surgically castrated, but are either held entire or immunocastrated in Belgium. This is about 8-10% of the Belgian produced pigs, which is in line with the estimated number of pigs surgically castrated (about 85-90%) (FCEC, 2015). Additionally, about 62% of the total number of Belgian produced pig meat was exported in 2012, which makes the export market of pig meat more important than the domestic market in Belgium (Redactie, 2014). Export of pig meat is about 21% of the Belgian total export of agricultural products in 2013, which shows the high importance of export of Belgium (Simoes, n.d.-a). Currently, it is suggested that the majority of importing countries do not accept non-castrated meat, because of the risk of boar taint (Valeeva et al., 2009; Backus et al., 2014; Jensen et al., 2014). As a consequence, pigs used for the export market (62%) will all be surgically castrated with the use of analgesia (Backus et al., 2014). This figure, 62%, is much lower than the results of FCEC (2015), who estimated a percentage of 85-90% of surgical castrated pigs. This difference could be explained by the fact that their data is retrieved in a different way. Redactie (2014) based their data on a research of the Federal Public Services Economy, while FCEC (2015) conducted an in-depth desk research and the use of a questionnaire to key Belgian stakeholders and experts.

In recent years the Belgian retailers have made numerous steps towards a reduction in the number of surgically castrated male pigs (Derom, 2010; Brandes, 2011). Since 2010, Colruyt and Okay do not sell meat of castrated pigs anymore. They only sell meat of animals that have been immunocastrated by means of Improvac (Derom, 2010). These retailers, both part of the Colruyt group, have a market share of 24,7% (De Bock, 2015). Furthermore, the Lidl has stopped selling castrated boar tainted meat as well since 2012 (Brandes, 2011). They have a market-share of 6,6% (De Bock, 2015). Furthermore, Delhaize (22% market share), Carrefour (21,3% market share) and the Belgium parts of Sodexo and Mc Donald's do not sell pork meat of surgical castrated male pigs anymore (PigProgress, 2008; Perkins, 2012; ter Beek, 2012; De Bock, 2015; Sodexo group, 2015).

8.4. Denmark

National legislation has made surgery with analgesia compulsory (Backus et al., 2014). In 2014 a declaration on improving pig welfare standards is signed by the former Danish minister for food, agriculture and fisheries and Danish organizations that consider the welfare of pigs important. One of the goals is to make an end to pig castration without anesthetics by 2018 (Backus et al., 2014; Jensen et al., 2014). According to a study of the FCEC (2015), currently none of the pigs that are surgically castrated receive an anesthesia. Additionally, the declaration does not consider the use of entire boars as an alternative for surgical castration, which is clearly demonstrated by the low number (about 5%) of pig farmers that raise entire boars (Backus et al., 2014). This low percentage could be explained by the fact that Denmark highly depends on its

export, like Belgium. Denmark is the second biggest exporter of pig meat in the world (11%), only Germany exports a higher number of pig meat. The pig meat is the most important agriculture export product (27%) and on place four of the total exporting products in Denmark (3.4%). Furthermore, about 18% of the Danish pig meat is exported to Japan (a third country). The figures used are based on calculations made in 2013 (Simoes, n.d.-b). As is mentioned in paragraph 8.3, it is suggested that the rest of Europe and more importantly third countries do not accept the meat of entire boars. This expectation is based on assumptions of expert groups on consumer attitude in these Asian countries (Grunert, 2013).

A second explanation for the low numbers of entire pigs is the financial fiasco of Denmark in 1990s. During this time, Denmark raised high numbers of entire pigs and invested heavily in an online-detection method for boar taint. However, this method was not accepted in Germany, which is Denmark's biggest exporting country. As a consequence, Denmark had an enormous financial problem. For these reasons, Denmark likes to hold on to surgical castration ("Boar taint,", 2011; Gruntert, 2013; Simoes, n.d.-b). Finally, the only (organic) initiative that is known is called Velfaerdsdelikatesser, which does not use meat of surgical castrated pigs. This initiative accounts for 1% of the entire pig production of Denmark ("Sortbroget landracegris," n.d.).

8.5. Eastern European- and Northeastern Mediterranean countries

Poland is one of the biggest pig producing countries within the European Union (Eurostat, 2014). In terms of surgical castration, the majority of Eastern European countries surgically castrate their pigs without the use of analgesia and anesthesia (FCEC, 2015). However, the majority (60%) of pigs are raised as entire boar in Romania (FCEC, 2015). More specific research about the status of surgical castration of pigs is unavailable in Eastern European countries. However, information provided by the Copa-Cogeca have revealed that Eastern European countries slaughter pigs at high carcass weights (exact weight is unknown). For this reason it is expected that they consider alternatives for castration not as a reliable option (Backus et al., 2014). In contrast to Eastern Europe, it is known that the number of raising entire boars is up to 45% in Cyprus, 24% in Greece and 90% in Malta (Fredriksen et al., 2009; FCEC, 2015).

8.6. France

France is one of the biggest pig producing countries within the European Union (Eurostat, 2014). France does not have national legislation that forbids surgical castration or is more strict compared to the standards set by the European Union, like the previous countries mentioned. However, 95% of the pig producers belong to the French Pork Meat scheme. This scheme has made it compulsory to use prolonged analgesia when castrating French pigs (Backus et al., 2014). Furthermore, the Cooperl Arc Atlantique, the largest pork products group of France, introduced the use of entire males in 2013. They have a market share of 20%, making this effort a big step towards more animal friendly production. In 2014, the Cooperl pig production accounted for 70% entire boars (Backus et al., 2014), which equals to 7% of the entire male pig production of France (Backus et al., 2014). Farmers that deliver their pigs to this product group have so far a positive experience, because they do not have to castrate pigs anymore, improved their financial situation and have not yet received any complaints about boar taint. The success of this project group is mainly because of their high export to England, a country where raising entire males is considered as normal (van Dooren, 2013). As a result, it shows the importance of market acceptance in places were it is not very common to raise entire pigs (Backus et al., 2014; van Dooren, 2013).

8.7. Finland

Finland castrates nearly all animals, which means that only a few percent (up to 5%) of the farmers raise entire boars (Backus et al 2014; FCEC, 2015). According to

information of the Copa-Cogeca, Finland does consider the use of anesthesia or analgesia as possible alternatives for castration (Backus et al., 2014), which is shown by the biggest slaughterhouses in Finland (HKScan and Atria). They demand the use of analgesia (pain relief) during the surgical castration of pigs ("HKScan," 2011; Pihlajavitta and Juva, 2014). Moreover, Atria Finland (market share of 25%) aims to abandon pig castration by 2016. Currently, farmers that deliver their animals to this food company need to castrate their animals by using analgesia (Pihlajavitta and Juva, 2014).

8.8. Germany

Germany is one of the biggest pig producing countries within the European Union (Eurostat, 2014). Currently, the procedure of surgical castration is allowed without the use of analgesia or anesthesia. However, the national government will make the use of analgesia (in 2017) and anesthesia compulsory (in 2019) in the near future ("Pork processors," 2012; Schmidt, 2015). Moreover, the declaration of Dusseldorf, which is signed by several stakeholders in the Germany pork industry, takes actions in order to forbid castration by 2018 ("Pork processors," 2012). Moreover, Germany has introduced guidelines to prevent the undesired behavior of the boars (e.g. to keep boars in small groups), which supports raising entire boars (Mul et al., 2010). Additionally, the German quality and security supervisor QS initiated (1 July 2012) a policy for the human nose detection method to detect tainted meat on the slaughtering line. This detection method will remain active until a better and valid detected is developed. Furthermore, farmers that accept the regulations of QS scheme have to castrate animal with using analgesia, which started in 2009 ("Pork processors," 2012; Backus et al., 2014). The actions taken by the national government, the declaration of Dusseldorf and the introduced policy of the German quality and security supervisor QS led to an initiative of the three leading slaughterhouses in Germany ("Pork processors," 2012). Vion, Westfleisch and Tönnies, which together have a market share of 55%, announced that they will purchase entire boars without price reduction. Consequently, this will make it easier for farmers to decide to raise entire boars ("Pork processors," 2012; "Tönnies, Vion und Westfleisch," 2012). Furthermore, Germany is the biggest exporting country in Europe of pig meat (17%), which makes this initiative in terms of export a serious possibility to market tainted boar meat (Backus et al., 2014; Simoes, n.d.-c.).

Several other assurance schemes and initiatives are active in reducing the number of surgical castration (with or without anesthesia or analgesia). First of al, German farmers have the possibility to participate in an initiative called Tierwohl. This initiative is set up in such a way that when farmers adopt more animal welfare measures, the money they receive will increase. Recently, this initiative also stimulates the raise of entire boars ("Initiative Tierwohl," 2015). Currently, it is compulsory to use anesthesia during the procedure of castration ("Handbuch Landwirtschaft," 2014). Another non-legislative initiative that has made the use of anesthesia compulsory is "Für mehr Tierschutz"Tierschutzlabel . This initiative also requires the presence of a veterinarian to carry out the procedure ("Für mehr Tierschutz", 2013). Finally, Neuland (assurance scheme) made the use of prolonged analgesia and anesthesia (administered by a veterinarian) compulsory. However, only 200 farmers accepted the regulations of Neuland, making it a very small label ("Mehr Tierschutz in der Schweinehaltung," n.d.).

Moreover, movements towards a non-castration policy without the use of analgesia of the German retail are also seen. Two clear examples are of the German REWE-group and ALDI, who will no longer sell meat of castrated boars that have not received any analgesia in 2017. This only counts for the meat sold with their own brand (Best, 2015; Rewe Group, 2015; Rewe, 2015). Although, the number of initiatives taken to reduce surgical castration of pigs with or without anesthesia or analgesia in Germany is high, the level of entire pigs raised remains considerably low (5-10%) in 2014 (Backus

et al., 2014). This could be explained by the fact that Germany exports high numbers of pig meat to Italy (19%), Poland (11%), Russia (6.1%) and Czech Republic (6.9%) (Simoes, n.d.-c). These countries are generally not in favor of non-castrated pig meat (Grunert, 2013; Backus et al., 2014).

8.9. Ireland

Nearly 100% of the pigs are raised as entire boars. However, they are slaughtered at a younger age (until a weight of about 80 kilo's), to reduce the risk of boar taint. National legislation does not forbid surgical castration of pigs, which makes the high numbers of entire boars raised a non-legislative initiative (Fredriksen et al., 2009; Backus et al., 2014).

8.10. Italy

Italy castrates all its male pigs and mainly without the use of anesthesia or analgesia for the production of the Parma Ham industry. A minor part (20%) is surgically castrated with the use of analgesia (Backus et al., 2014; FCEC, 2015).

8.11. Spain and Portugal

Spain is one of the biggest pig producing countries within the European Union (Eurostat, 2014). The majority (about 80%) of the Spanish and Portuguese male pigs are not castrated but raised as entire and slaughtered at a younger age. The high number of raising entire boars is realized by marketing efforts, since there is no national legislation that forbids the procedure of surgical castration. The remaining 20% is surgically castrated; these are Iberian pigs that produce 'high' quality meat (Backus et al., 2014; FCEC, 2015). According to these countries castration of these pigs is essential in order to prevent boar taint. The ' high' quality products contain high percentages of fat, resulting in pigs slaughtered at an older age and this increases the risk of boar taint, which is similar to Spain (Backus et al., 2014).

8.12. Sweden

Currently, national legislation forbids surgical castration of male pigs without the use of analgesia (Spoolder et al., 2011). However, from 2016 onwards the uses of analgesia plus anesthesia are compulsory when castrating pigs. This information is received from the Copa Cogeca (Backus et al., 2014). The Swedish label KRAV and Svenskt Sigill association have already made the use of anesthesia and analgesia compulsory during the surgical castration procedure of male pigs ("Krav Standards," 2016; Svenskt Sigill, n.d.) Furthermore, immunocastration is only used by a very small part (5%) of the farmers and the percentage of raising entire boars is 1-2% (FCEC, 2015).

8.13. The Netherlands

The Dutch legislation allows surgically castration of pigs without the use of analgesia or anesthesia in conventional production. However, castration is not allowed in the organic pig production (Wageningen UR Livestock Research, 2010; Spoolder et al., 2011). National initiatives have taken numerous efforts to reduce the number of surgical castration in the Netherlands. First of al, in 2007 the declaration of Noordwijk is signed by several stakeholders in the Dutch pig sector aiming for abandoning castration in the Netherlands in 2015 (Valeeva et al., 2009; ten Have-Mellema et al., 2013). As part of this declaration a lot of research on the alternatives of pig castration is done (ten Have-Mellema et al., 2013), which suggest that the knowledge on this topic is increased. Additionally, Keten Duurzaam Varkensvlees, Good Farming Star Animal Health Management scheme and Beter Leven (Star 1) are Dutch non-legislative initiatives that have already forbidden surgical castration pigs (Backus et al., 2014; De Dierenbescherming, n.d.; "Agriculture," n.d.; "Moeder en big," n.d.).

Furthermore, the Dutch retail has decided to not sell fresh meat from castrated boars anymore in 2014 (Backus, 2013). Recently, Backus (2013) have proven that these

actions do not have to influence the Dutch pork consumption, but follows a similar trend in other European countries (Germany, France and Belgium). This indicates that consumers are willing to buy meat of entire boars. However, it could also be that consumers are unaware of the fact that they buy meat of non-castrated pigs. These actions have possible lead to the increase in raising entire boars, 5% in 2009 to about 65% in 2014 (Frediksen et al., 2009; Backus et al., 2014). It is important to mention that the remaining part of pigs that are surgically castrated are administered with an anesthetics (inhalation of CO_2/O_2) (FCEC, 2015). Furthermore, the Dutch parts of McDonalds do no longer sell pork meat of surgical castrated male pigs (PigProgress, 2008). The confidence of Dutch farmers towards the success of alternatives for castration is increased due to the several initiatives taken (Backus et al., 2014). However, the pig industry does not only sell their meat to Dutch retailers, but more importantly to the exporting countries. Currently, the Dutch market is saturated with non-castrated pork meat. This makes the export of pigs even more important ("Vlees industrie stuit op grenzen," 2013). The Netherlands was the second biggest exporter of agricultural products in the World in 2014 (Klompenhouwer, 2014). About 15% of the total agricultural products that are exported by the Netherlands are pigs or pig meat (Simoes, n.d.-d). The majority (82%) of the pigs are exported to Germany and the rest to mainly the Belgium-Luxembourg (5.2%) and Poland (3.2%). Pig meat is mainly exported to Italy (17%), Germany (14%) and Greece (13%) (Simoes, n.d.-d). As a consequence, the Dutch situation of the export of pig(meat) is comparable to Denmark and Belgium. The Dutch has problems selling pigs across the European countries, due to the low acceptance and knowledge of entire boars in these countries. This means that a non-castration policy puts valuable export markets at risk. Moreover, the Netherlands can not develop further in terms of pig welfare if other countries are not following. Otherwise, lots of competition between countries will arise ("Vlees industrie stuit op grenzen," 2013). As a consequence, farmers are in favor of alternatives for pig castration as long as they can sell their meat for a reasonable price (Valeeva et al., 2009).

8.14. United Kingdom

The United Kingdom does not castrate pig males, but raise them as entire boars and slaughter them at younger age (until a weight of about 80 kilo's) (FCEC, 2015). National legislation does not force the pig industry to do this, since it does have any laws implemented on this. However, castration is forbidden for the organic production (Wageningen UR Livestock Research, 2010; Backus et al., 2014). For this reason, the efforts made towards a better welfare for conventional production originated from the market. Several British initiatives and retailers that do not allow surgical castrated of pigs or make efforts to reduce the number of it, are: Red tractor Assured Food Standards, RSPCA Assured, Soil association, Tesco, The Co-operative and Waitrose (CIWF, n.d.-a-,b). However, the raise of entire boars increases the risk of boar taint (Valeeva et al., 2009). A spokesman of the British pig executive once said about the British way of treating pigs and the issue of boar taint:

> "It is one of the things that distinguishes us from the rest of Europe. "We don't get the problem and we also get a better feed conversion rate." (as cited in "Balancing Pig Welfare," 2009).

Furthermore, the United Kingdom is a very small exporting country of pigs and pig meat (0.065%, 1.2%) in 2013 compared to Germany (8.9%, 17%), Denmark (18%, 11%) and The Netherlands (30%, 7.2%). For this reason, they do not highly depend on the attitude towards meat of entire boars of importing countries (Simoes, n.d.-b,c,d,e)

Appendix F Literature study: Tail docking of pigs

1. General introduction of tail docking

Tail-biting behavior of pigs is one of the most frequently seen animal welfare problems in the pig industry (Sonoda et al., 2013; Valros & Heinonen, 2015). As a consequence, tails are docked in order to reduce the chance that these behaviors occur. A procedure that is about 75-100% of the cases carried out in Europe. However, this procedure does also impair the welfare of pigs (Nannoni et al., 2014; Ursinus et al., 2014). Additionally, the European council directive (2008/120/EC) on the protection of pigs states:

> "Neither tail-docking nor reduction of corner teeth must be carried out routinely but only where there is evidence that injuries to sows' teats or to other pigs' ears or tails have occurred. Before carrying out these procedures, other measures shall be taken to prevent tail-biting and other vices, taking into account environment and stocking densities. For this reason inadequate environmental conditions or management systems must be changed." (European Commission, 2008a, p. 10).

First of all, this Appendix F will elaborate on the concept of tail-biting behaviors and its risk factors. Further on, it will focus on the implications for welfare of having a tail and of a docked tail. Moreover, the economic impact of tail-biting behaviors will be discussed. The final part will provide an overview of the current states on tail docking in the European member states.

2. Tail-biting behavior

2.1 The term tail-biting behavior

Taylor et al. (2010) described three distinct types of tail-biting behavior: two-stage, sudden-forceful and obsessive tail biting. The first type, two-stage, is a pre-damage stage. It includes gentle manipulation of tails and does not cause detectable tail damage or distress in the victim. In contrast to this, the second type (sudden-forceful) is described as aggressive and forceful biting behaviors, which results in severe tail damage. The third type, obsessive tail biting, does also lead to severe tail damage. These pigs are completely fixated on finding and biting tails (Taylor et al., 2010; D'eath et al., 2014). Tail-biting behavior starts at young age, even pre-weaning or in farrowing crate, with a tail-in-mouth behavior. However, it is unclear if this behavior also leads to tail damage. It is known that severe tail-damage happens post-weaning until slaughtering (Ursinus, 2014).

2.2 Underlying behavioral cause of tail-biting behavior

The underlying behavioral cause that leads to tail-biting behavior is not being able to perform natural behaviors like exploring and foraging (Ursinus, 2014; EFSA, 2014). About 75% of the time pigs perform exploring and foraging behaviors (like: sniffing, chewing, biting, rooting, touching and nibbling) in natural conditions. These behaviors are crucial for their survival in nature. Exploring behavior is shown to gather information about their environment (e.g. finding suitable resting areas). Foraging behavior is often called 'appetitive' behavior and has a more direct goal like feed intake. In current husbandry systems pigs have not the opportunity to perform these types of behaviors, because animals are kept under barren conditions like, among others, without suitable enrichments and poor environmental conditions (Ursinus, 2014). As a consequence, their motivation to forage and explore is heightened in barren conditions and in turn a stress response is induced. Pigs redirect their nibbling and biting behaviors towards pen mates, which is seen as a way to cope with stress. Ultimately, this leads to welfare problems like tail-biting behaviors (Studnitz et al., 2007; EFSA, 2014; Ursinus, 2014). Several risk factors are related to the inability of pigs to perform natural behaviors like exploring and foraging (Taylor et al., 2010; Ursinus, 2014). The most studied risk factors and its effects will be discussed in the following paragraph.

3. Risk factors of tail-biting behaviors

A tail-biting outbreak is difficult to stop, which makes it challenging to manage a herd till slaughter (EFSA, 2007a). Additionally, once a tail-biting situation has started, the chance that a second one will appear is very likely (EFSA, 2007a; D'eath et al., 2014). For this reason, risk factors of tail-biting behaviors are important to study.

3.1. Animal characteristics

First of all, pigs that are tail biting and pigs that are not tail biting have different genotypes. While tail-bitters have a more bold coping style and are more stress-sensitive, non-bitters show less explorative behaviors and a different functioning of the immune system (Werkgroep Krulstaart, 2013;Ursinus, 2014). Additionally, it is shown that not all pigs kept under the same circumstances develop tail-biting behaviors (Sutherland & Tucker, 2011). Moreover, tail biting-behavior fluctuates over time (Ursinus et al., 2014). These findings indicate that personalities differ between pigs and as a consequence are a risk factor for performing tail-biting behaviors. It is shown that traits like exploration and foraging, which are involved in the onset of tail-biting behaviors, are heritable. Consequently, they could play a role in reducing tail-biting behaviors (Robert et al., 1987; Breuer et al., 2003; Werkgroep Krulstaart, 2013).

Secondly, Breuer et al (2003) have showed that the breed Duroc more often performs tail-biting behaviors compared to Large White and Landrace breeds (Breuer et al., 2003). This shows that tail-biting behavior is related to a specific boar line and in turn breeding is an useful technique to lower the risk of tail-biting behaviors (Breuer et al., 2003; Ursinus et al., 2014).

Furthermore, Kritas & Morrison (2007) have showed that carcasses of castrated male pigs have significantly ($p=0.027$) more tail lesions than females. Moreover, they have demonstrated that in mixed-sex groups the damage of tails in castrated males was 21%, while in females 9.8%. Zonderland (2010) have showed similar results, females perform more tail-biting behaviors than males. This was concluded due to an increased duration of tail damage and a lower 40% tail-damage incident of females compared to males and mixed-sex groups ($P<0.05$) (Zonderland, 2010). The difference can be explained by the fact that females are more active then males and when females reach sexual maturity it increases their interest in males (Sutherland & Tucker, 2011). However, van der Weerd et al. (2005) have found that males are more likely to be tail-biters than females. As a result, conclusions about gender should be interpreted with caution, because contrasting evidence exists.

The final important animal characteristic that is related to the onset of tail-biting behaviors is weight. Zonderland (2010) have found that heavier pigs significantly become more likely a victim of tail-biting behaviors than lower weight pigs ($P = 0.03$). These results are in line with Sutherland et al. (2009), they have shown that the pigs involved in tail-biting behaviors have a lower body weight at the end of their study. This difference could be explained by the fact that pigs with a lower weight have a lower rank at the feeder. Consequently they have a lower feed intake, which lead to frustration and start in turn tail-biting behaviors (Sutherland, 2009).

3.2. Pregnancy

Rutherford et al. (2009) have showed that prenatal stress of sows have the possibility to significantly increase a pain response during the procedure of tail-docking in piglets compared to piglets that were not exposed to prenatal stress ($P=0.028$). This indicates the importance of preventing prenatal stress in sows (Rutherford et al., 2009).

3.3. Rearing conditions

A maladjusted environment during the early life stages of piglets increases the risk of developing tail-biting behaviors in later life (Smulders et al., 2008; EFSA, 2014). According to Smulders et al. (2008) the number of feeding places per animal ($P= 0.0029$)

and temperature (P= 0.0106) are significant risk factors for tail-biting behaviors during the nursery phase of piglets. A reduction in the number of feeding places will induce a stress response in pigs, because they prefer to eat simultaneously. This will in turn increase the prevalence of tail damage on pigs. Furthermore, pigs are unable to adapt to high temperature during the nursing phase (temperature scale of 23-30degrees), which lead to frustration and the performance of maladaptive behaviors. Moreover, during the farrowing phase floor type is of significant influence (P<0.001) on the risk of tail-damage. A higher percentage of slatted area (> 25%) will increase the prevalence of tail-damage (Smulders et al., 2008).

During the growing phase, the type of feeding (P<0.035) has also shown to be of significant influence for the risk of tail damage. The provision of wet feeding during the growing phase is a better alternative for reducing the risk of tail-biting behavior than dry feeding. Smulders et al. (2008) have indicated an average score of pens with tail-damages of about 0.21 for wet feeding, while the score for dry feeding was about 0.27 (on a scale of zero-to-one). Dry feeding leads to more dust concentration and consequently to respiratory diseases, which lowers the health status and in turn are more likely to perform tail-biting behaviors during the fattening phase (Smulders et al., 2008). The influence of health status on the onset of tail-biting behaviors will be discussed in paragraph 3.4.

Additionally, Ursinus (2014) has demonstrated that piglets kept in barren environments significantly (P<0.001) perform more tail-biting behaviors and have a higher prevalence of tail damage compared to piglets held in enriched environments during the pre-weaning phase. This shows the importance of enrichment, which will also discussed in detail later in paragraph 3.4.

Moreover, tail-biting pigs are often born and raised in heavier (P=0.03-0.04) and larger litters (P=0.01-0.05) and have a faster growth (P=0.05-0.08) compared to non-tail biters (Ursinus et al., 2014; Ursinus, 2014). These results are in contrast with the earlier mentioned scientific facts in paragraph 3.1, which have showed that small and light pigs are more likely to develop tail-biting behaviors (Sutherland et al., 2009; Zonderland et al., 2011). It could be suggested that both, small pigs and pigs with faster growth, develop these behaviors more rapidly compared to an average pig due to its higher demands (Ursinus, 2014). Small pigs have a high-energy demand due to a lower feed intake or perhaps an impaired health status or a combination of both. On the other hand, faster growing or heavier pigs possibly have a higher energy demand due to a higher protein deposition in the body (Ursinus, 2014).

3.4. Social environment in the adult phase

As is previously mentioned, suitable enrichment materials have a significant effect on preventing the onset of tail-biting behaviors (Ursinus, 2014). Pigs are not able to perform natural behaviors when enrichment materials are absent or insufficiently provided. Consequently, the pig becomes frustrated and stressed, which leads to tail-biting behaviors (Studnitz et al., 2007; Ursinus, 2014). Scientists suggest that absence or insufficient enrichment material is the main risk factor of tail biting, because enrichment materials stimulate the pig to perform exploring and foraging behaviors (EFSA, 2007a; EFSA, 2014).

Several researches have looked into the welfare effects for pigs of several enrichment materials like: peat, straw, metal chains, saw dust, jutesacks, compost and hay (Studnitz et al., 2007; Taylor et al., 2012; Zonderland et al., 2011; Ursinus et al., 2014). It is important to mention that up until now not one enrichment material is able to completely eliminate tail-biting (Studnitz et al., 2007; Taylor et al., 2012; Ursinus et al., 2014). In this study the use and effects on reducing tail-biting behaviors of straw, metal chains and jutesacks will be explained in more detail. First of all, Zonderland et al.

(2008) have found that when straw is provided twice a day, it significantly reduces the incidence of tail damage compared to the use of a chain and rubber hose ($P<0.05$). They have showed that providing straw is able to reduce the prevalence of tail-biting behaviors up to 50% (Zonderland et al., 2008). Moreover Moinard et al. (2003) have suggested that providing at least once a day straw reduces the risk of tail-biting behaviors by ten times compared to a situation when no straw is provided or when it is not renewed. Courboulay et al. (2009) have found that pigs housed on straw have less frequently severe tail damage compared to pigs housed on concrete floors. Consequently, the effect of certain types of floors highly depends on the use of enrichment materials, which is previously discussed in paragraph 3.3 (Scollo, 2013). Furthermore, pigs that have access to jutesacks perform significantly lower numbers of tail-biting behaviors (up to 50%, $P < 0.001$-0.004) compared to pigs without the availability of jutesacks. However, it is suggested that straw bedding is better at reducing tail-biting behaviors than jutesacks (Ursinus et al., 2014). In contrast to straw and jutesacks, farmers most frequently use metal chains as enrichment material for pigs (de Lauwere et al., 2009). However, metal chains do not keep the interest of pigs over a longer period of time, which makes it an unsuccessful material to reduce tail-biting behavior (D'eath et al., 2014). These metal chains could also harm the pigs, which is also not beneficial for their welfare (EFSA, 2014). Moreover, not only is the material itself important to consider, but also the way it is provided. It must be possible for pigs to get close to the materials in order to examine it, without having to perform too many fighting behaviors (Studnitz et al., 2007). Finally, the attractiveness of enrichment materials reduces if they get contaminated with feces and therefore it is suggested to provide them in racks or hang (D'eath et al., 2014).

A second risk factor for tail-biting behavior related to the social environment of pigs is stocking density and space allowance of pigs. Goossens et al. (2008) have found that the prevalence of tail lesions was increased with a stock density of less than $0.31 m^2$ per pig (growing pigs) ($P<0.01$). Furthermore, Moinard et al. (2003) have showed that the risk of tail-biting increases with a stock density of $110 kg/m^2$ or higher during the growing phase (OR =2.7). A high stock densities and lower space per pig will increase the number of contacts with pen mates, which reduces the resting time due to disturbances and competition and the area for movement to root and forage. Consequently, pigs become frustrated and the risk of tail-biting behaviors is increased (Taylor et al., 2010; Scollo, 2013; EFSA, 2014).

Thirdly, a recent research of White (2015) has concluded that not one housing system is capable of eliminating tail-biting behaviors completely. However, they have found that the prevalence of tail biting in growing pigs on floors covered with straw (0.4%) is lower compared to slattered floors (2%). Studies of Smulders et al. (2009) and Courboulay et al. (2008) have confirmed this result by showing the importance of enrichment in the housing systems of pigs, these studies are already discussed (paragraph 3.3 and the beginning of 3.4). On top of this, Moinard et al. (2003) have found an increased risk of tail biting behaviors when growing pigs are kept on fully or partially slatted floors, compared to pigs housed on solid floors (OD = 3.2). Furthermore, pigs housed indoor are have a higher risk (50%) of getting bitten, compared to outdoor housing (White, 2015).

Furthermore, a nutritional imbalance state increases the motivation of pigs to perform exploring and foraging behaviors (e.g. to look for food). Consequently, this increases the risk of tail-biting behavior of pigs that are not able to perform these natural behaviors to fulfill their nutritional requirements (Taylor et al., 2010; EFSA, 2014). First of al, the feeding composition is important. Taylor et al. (2010) and Scollo (2013) suggest that a low salt, tryptophan and protein-content increase foraging

behaviors and in turn the risk of tail-biting behaviors. Secondly, the level of satiation and energy intake are important for reducing the risk foraging and exploratory behaviors. For this reason, fermentable and longer fibers are suggested fulfill the level of satiation (Taylor et al., 2010). Finally, the way the food is provided is also important to prevent tail-biting behaviors. Ad libitum feeding and multiple feeding places successfully lower the incidence of tail-biting behaviors (Moinard et al., 2003). Moinard et al. (2003) concluded that five or more growing pigs per feeder increases the risk of tail-biting with 2.7 times compared to a lower number of pigs per feeder. Additional aspects that influence the incidence of tail-biting behaviors are delayed or absence of food provision, daily routine of the farmer and proper functioning of the feed-and water systems (Taylor et al., 2010; Scollo, 2013)

While factors as feeding and floor type are relatively stable, the weather is a variable factor. Consequently, famers consider this as the most important risk factor for tail-biting behaviors (Taylor et al., 2012; Bracke et al., 2013; Werkgroep Krulstaart, 2013). Especially during fall and spring when temperatures highly fluctuate during day and night. Pigs have difficulties in adapting to these changing temperatures. Furthermore, temperatures outside the thermal comfort area of a pig lead to (chronic) stress and in turn increase the risk of tail-biting behaviors (Taylor et al., 2010; D'eath et al., 2014). Moreover, Courboulay et al. (2008) have demonstrated that pigs suffering from heat stress have more lesions compared to pigs that did not experience high summer temperatures. However, it is unknown if this increase is significant (Courboulay et al., 2008). Finally, suboptimal air quality (e.g. poor ventilation) increases carbon dioxide and ammonium in the housing system, which is aversive for pigs and could induce a stress response and in turn more tail-biting behaviors (Smith et al., 1996).

Suboptimal health on a farm could also induce the risk of tail-biting behaviors. This is related to an increased motivation to explore and forage, a change in feed intake and not able to resist the biting behavior of others due to sickness (Taylor et al., 2010). An induced immune response, due to sickness, changes the voluntary feed intake, parturition of nutrients and the required amino acids balance (Taylor et al., 2010). As a consequence, the diseased pigs have a lower growth rate and a lower weight. As is previously mentioned in paragraph 3.1 and 3.3, these animals are less capable of competing for food and in turn they will become frustrated. This will further enhances their motivation to perform exploring and foraging behaviors, which possibly ends up in tail-biting behaviors (Taylor et al., 2010). Finally, Smulders et al. (2008) have found that strict hygiene protocols significantly reduce the prevalence of tail-biting behaviors, which is possibly due to a reduced risk of a disease outbreak ($P = 0.002$). In line with this result, they have showed that farms, following a hygiene protocol, have a reduced incidence of tail damage on pigs (about 0.24 vs. 0.32 on a scale of zero-to-one) (Smulders et al., 2008).

Finally, sudden changes in environmental conditions can also induce a stress response . Changes in feeding management or feeding composition, lightening or the behavior of the farmer have shown to induce stress response. In turn, the induced stress response could increase the risk of tail-biting behavior (Taylor et al., 2010; Scollo, 2013).

4. Intact tails

Pigs are naturally born with a tail (Studnitz et al., 2007). However, in Europe only 5-10% of the pigs raised for production have intact tails (EFSA, 2007a; Nannoni et al., 2014; Valros & Heinonen, 2015). In the following paragraphs the welfare implications of having a tail will be discussed.

4.1 Positive welfare effects of having a tail

First of all, pigs use their tail to communicate about their emotional state to other pen mates (Nannoni et al., 2014). Additionally, they are able to perform natural behaviors like covering the anus or vagina of the animal by means of its tail (Werkgroep Krulstaart, 2013). Finally, the integrity of the animal will not be compromised if the tail remains intact (Sutherland & Tucker, 2011).

4.2 Negative welfare effects of having a tail

The most severe implication for the welfare of pigs that have a tail is the risk of tail-biting behaviors, which varies between 2-12% (Valros & Heinonen, 2015). This risk is significantly higher compared to pigs with a docked tail (Thodberg et al., 2010). The following two sub-paragraphs will discuss the short- and long-term welfare effects of tail-biting behaviors in pigs. However, the study of tail-biting behavior is challenging, because the occurrence of this behavior is unpredictable, as it can suddenly appear and it can spread very rapidly in a group (D'eath et al., 2014). Furthermore, studies of tail biting are difficult to compare, because different definitions and measurements of tail biting are used. Furthermore, it depends on (among others) the population studied (e.g. in a pen or an abattoir), location of the study (e.g. farm or abattoir) and the level studied (individual or population, male or female). As a consequence, the observation of tail-biting behaviors and tail damages is a difficult task and often miscalculated (D'eath et al., 2014).

4.2.1 Short-term negative welfare effects

First of all, pigs with bitten tails suffer from pain (Statham et al., 2009; Sutherland & Tucker, 2011). The posture of the tail is a commonly used indicator for pain caused by tail-biting behaviors (Statham et al., 2009). Statham et al. (2008) have shown that pigs keep their tails between their legs during an outbreak of tail biting. It is suggested that this tail posture is used to prevent any more biting of the tails (Statham et al., 2009). Secondly, tail-biting behaviors damage the surrounding tissue of the tail, which leads to an activation of an inflammatory response and in turn causes primary infections (Sutherland et al., 2009; Heinonen et al., 2010). This shows that the health status of pigs is not only a cause of tail-biting behaviors but also a consequence (Kritas & Morrison, 2007). Heinonen et al. (2010) has found that the number of acute phase proteins is significantly higher in tail-bitten pigs compared to healthy control pigs ($P< 0.01$), which is a sign of an inflammation in the tail and in turn shows the activity of the immune system. Sutherland et al. (2009) confirm the activation of the acute phase response, because they have found significantly increased levels of c-reactive protein levels in pigs with intact tails, compared to docked tails in week seven of age ($P < 0.05$). It is assumed that C-reactive protein is a protein involved in the acute phase response (Sutherland et al., 2009). An active immune system leads to an impaired health status and is in turn a sign of impaired welfare (EFSA, 2007a; Heinonen et al., 2010).

4.2.2 Long-term negative welfare effects

Not only lead tail-biting behaviors to primary infections at the tail, but also secondary infections in the respiratory tract are a result of these behaviors (Kritas & Morrison, 2007; Heinonen et al., 2010). More severe tail lesions often cause these secondary infections, because they increase the intensity of the inflammatory response (Heinonen et al., 2010). Bacteria from the bitten tail go through the blood stream and further induce the inflammatory responses and the acute phase response (Kritas & Morrison, 2007; Heinonen et al., 2010). As a result, respiratory diseases like lung infections and long abscesses occur and negatively affect the welfare of pigs (Kritas & Morrison, 2007). The relation between the severity of tail damage and the existence of lung abscesses and or pleuritic lesions is shown to be significant ($P<0.0001$) (Kritas & Morrison, 2007).

Secondly, Munsterhjelm et al. (2013) have showed that victims of tail-biting pigs suffer in a higher degree from chronic stress compared to pigs that are not bitten. This is concluded due to a significant higher evening saliva cortisol ($P = 0.01$) compared to control pigs in the same pen and a significant ($P = 0.04$) lower triiodothyronine (T3) serum compared to tail-biting pigs. The thyroid is involved in the regulation of the metabolism. It is expected that stress delays the functioning of this organ (Munsterhjelm et al., 2013). Moreover, a significantly ($p=0.001$) larger adrenal area was seen in tail-bitten pigs compared to a control pig, both housed in different pens. A large adrenal area indicates a long-term activation of the hypothalamic-pituitary-adrenocortical-axis (stress-axis) (Munsterhjelm et al., 2013).

Thirdly, an increased pathology was found due to bitten tails, which is a sign of an impaired health status (Munsterhjelm et al., 2013). Chronic activation of a stress response impairs the welfare of pigs, because high levels of welfare desire low levels of stress (Munsterhjelm et al., 2013).

Furthermore, Niemi (2010) has demonstrated a reduction in growth of 41g per day in tail-bitten pigs, compared to pigs without bitten tails. Serious tail lesions could even lead to a reduction of 120g per day. A lower growth rate is probably caused by stress and the impaired health status of pigs that have bitten tails. It is problematic for their health in later life, because lower growth lead to lower weighted and smaller pigs. As a result, they have a lower rank at the feeder, which lowers their daily feed intake and increases the risk of performing tail-biting behaviors themselves (as is discussed in paragraph 3.4) (Sutherland, 2009). Sutherland et al. (2009) have showed that pigs with intact tails have a lower bodyweight compared to docked animals ($P<0.05$), which is in line with the significant increased risk of tail-biting behaviors in pigs with intact tails compared to docked tails (Thodberg et al., 2010).

Finally, severe tail damage could lead to extreme blood losses and trauma, which could lead to cannibalism and eventually lead to death (van Putten, 1969; Bracke et al., 2013).

5. Tail docking

Currently, it is unclear how tail-biting behaviors can entirely be prevented when raising pigs with intact tails. For this reason, the majority (75-100%) of tails are docked in Europe as a preventive measure for a tail-biting outbreak (Taylor et al., 2010). Several methods are used to dock tails; the two most commonly used are hot ironing and cold clipping ("blunt trauma cutters" are used). However, the procedure of tail docking, irrespective of which method is used, impairs the welfare of pigs (Sutherland et al., 2009; Taylor et al., 2010; Sutherland & Tucker, 2011).

5.1 Positive welfare effects of tail docking

The tail docking procedure reduces the prevalence of tail-biting behaviors (Sutherland et al., 2009; Sutherland & Tucker; 2011; D'eath et al., 2014). This is beneficial for the welfare of pigs in terms of perceived pain, health status, the level of stress and growth rate (Statham et al., 2009; Sutherland et al., 2009; Heinonen et al., 2010; Munsterhjelm et al., 2013). Researches have shown that the prevalence of tail-biting behaviors of intact tails is about 2-12%, while the prevalence of this in pigs with docked tails is respectively lower (1-3%) (Scolo, 2013; Valros & Heinonen, 2015).

Moreover, Thodberg et al. (2010) have showed that having an intact tail increases the risk of tail-biting behaviors with 4.6 times, compared to pigs that have a tail of which is 75% docked. The risk of tail-biting behaviors in pigs with an intact tail is 2.4 times higher compared to pigs that have a tail of which is 25% or 50% docked. A significant reduction in tail biting behaviors is only seen when 75% of the tail is docked (Thodberg et al., 2010). Furthermore, Hunter et al. (1999) have showed that pigs with long tails

become a victim of tail-biting behaviors over three times more likely compared to pigs whose tail is docked shortly (1.5cm remained) (respectively 8.5% vs. 2.4% of the pigs being bitten). A long tail meant either an intact tail or tipped docked, which is removing the tail end only (Hunter et al., 1999). These results show the importance of considering the length that is docked, which is of influence on the onset and severity of tail-biting behaviors (Hunter et al., 1999; Thodberg et al., 2010). Additionally, Sutherland et al. (2009) have indicated that pigs with docked long (5cm of the tail remained) have a significant increased appearance of injuries ($P<0.001$) and blood ($P < 0.06$) at the tails compared to docked short (2cm of the tail remained) during the treatment period. However, it is important to mention that docking short increases the risk of infections and the time needed for the wound to heal due to a bigger wound compared to docking at a longer length (Werkgroep Krulstaart, 2013).

5.2 Negative welfare effects of tail docking

5.2.1. Short-term negative effects

Torrey et al. (2009) have showed an acute pain response during the procedure of tail docking in piglets. Behavioral and physiological changes were used as indicator for pain. An increase in high frequency vocalizations ($p=0.016$) and a general increase in vocalization frequency ($P<0.001$) were seen compared to sham docked animals (animals which are only manually manipulated) (Torrey et al., 2009). Furthermore, Torrey et al. (2009) have found abnormal behaviors in tail-docked animals compared to sham-docked. Tail jamming and spending less time laying and more time standing were significantly higher in tail docked pigs compared to sham docked pigs ($P < 0.001$). Sutherland et al. (2008) have shown more scooting behaviors between 31-45 minutes after the procedure ($P<0.05$) and more time sitting than standing in hot ironing pigs ($P<0.01$) and in cold cutting pigs ($P<0.08$) in tail docked pigs compared to pigs with intact tails. These abnormal behaviors were not absorbed before the procedure (Sutherland et al., 2008). However, the abnormal behaviors were normal again 90min after the procedure, indicating short term-negative effects of the procedure on tail docked pigs (Sutherland et al., 2008). Moreover, clear differences were found in the level of stress response between the hot ironing and cold cutting methods (Sutherland et al., 2008). The procedure of tail docking increases the cortisol levels of pigs, which is an indicator of stress. It is shown that this stress response is significantly higher 60min after the procedure when blunt trauma cutters (cold cutting method) are used compared to pigs with intact tails or tail docked by means of hot ironing ($P <0.05$) (Sutherland et al., 2008). Additionally, Marchant-Ford et al. (2009) have concluded that hot ironing increases the vocalizations in pigs compared to the cold cutting method, which could be explained by the fact that this procedure takes longer and as a consequence more handling time. Marchant-Ford et al. (2009) have also showed that tail-docking procedures lead to growth impairments. The use of hot ironing leads to significantly lighter pigs compared to pigs with intact tails or cold cutting pigs, up to 14 days. Contrary to this, Sutherland et al., (2009) did not find a significant weight difference between the two method, but did find increased body weights of docked pigs (irrespective of the method used) compared to non-docked pigs at week 7 of age ($P<0.05$). This shows the short-term effect of possible growth impairments during the first weeks of tail-docked pigs.

Not only is the level of cortisol an indicator for stress, but also the number of white blood cells (Sutherland et al., 2008). These cells significantly reduces after a pig is tail docked compared to pigs held intact ($P<0.05$). This, possibly, shows that leukocytes (white blood cells) prepare the body for more stressors (Sutherland et al., 2008). As a consequence, the declined number of white blood cells is an indicator of acute stress (Sutherland et al., 2008). No difference could be found in the number of blood cells

between cold cutting or hot ironing and they returned after treatment (30-60min later) back to normal levels (Sutherland et al., 2008). Moreover, the procedure of tail docking reduces the IgG concentration in the blood compared to sham docked pigs (P=0.029) (Marchant-Ford et al., 2009; Torrey et al., 2009). This is possible caused by stress in response to the procedure and at an age when maternal IgG decreases, while the immune system is not fully developed yet (Martin et al., 2005). A lower number of white blood cells and IgG concentration impairs the functioning of the immune system, which makes pigs more vulnerable to diseases (Martin et al., 2005). As is shown, tail-docking does lead to short term pain and a change in the immune status, the effect of this does not differ between pigs docked at day one or day three of age (Torrey et al., 2009).

The final point to make in this subparagraph is related to the use of pharmaceuticals. Anesthetics or analgesics are not commonly used during the procedure of tail docking (Sutherland 2011 and Nannoni et al., 2014). Furthermore, Kluivers (2010) concluded that no pain relievers are registered for the procedure. Moreover, the administration of an analgesic or anesthetic is more labor intensive for the farmer and stress for the animal and more importantly it does not significantly reduce the physically and behavioral responses during the procedure (Nannoni et al., 2014). However, cold analgesic spray and wound spray is proven to be effective in reducing the pain during tail docking (Nannoni et al., 2014).

5.2.2. Long-term negative effects

First of al, the procedure of tail docking impairs the integrity of pigs (Sutherland & Tucker, 2011). Pigs are not able to express natural behavior, for example, they are no longer able to use their tail as a way to communicate about its emotional state to conspecifics (Nannoni et al., 2014).

Herskin et al. (2015) have showed that docked tails (either at 25%, 50% or 75% length docked) lead to the formation of neuromas ($P<0.001$), which increase the sensitivity in the tip of the tail (Sutherland et al., 2009; Nannoni et al., 2014). The increased sensitive tails make pigs more alert when pen mates touch it and make them stop doing it or move away (Sutherland et al., 2009). Furthermore, Eicher et al. (2006) have showed that tail-docked heifers were more sensitive to changing temperatures (hot and cold). These findings suggest that neuromas are painful, and it may even be chronic pain. Additionally, it is suggested that this is one of the reasons why tail-biting behaviors are reduced in tail-docked pigs (Eicher et al., 2006; Sutherland et al., 2009; Nannoni et al., 2014). According to Herskin et al. (2015) the length of the tail docked plays an important role in the formation of neuromas. They suggested that more neuromas form with an increasing length of the tail that is docked by means of hot ironing. This is concluded because, more neuromas formed in tails that were docked for 75% compared to the number of neuromas formed in tails that were for 50% or 25% docked. However, this difference was not significant (Herskin et al., 2015).

Furthermore, it is suggested that tail docking does not solve the underlying cause of tail-biting behaviors (Nannoni et al., 2014; Ursinus, 2014), because tail docking does not entirely eliminate the behaviors (Ursinus, 2014). Additionally, the prevalence of ear biting is higher in docked pigs (tail almost completely docked) compared to long docked tails (50% of the tail) ($P < 0.005$). Ear biting is related to tail-biting behaviors, because it has similar causes and consequences (Goossens et al., 2008). Consequently, pigs still have problems with their welfare, because the behavioral needs (like foraging and exploring behaviors) are not met.

Finally, tail-docking procedures impair tissue around the tail. Consequently, bacteria have the possibility to enter the body to cause infections. However, bacterial infections caused by tail docking are very rare and is more common in tail-bitten pigs (Nannoni et al., 2014).

6. Economic impact of tail-biting behaviors

Tail damage negatively influences the economic profitability of the pig sector. The net income of pig farmers decreases due to increased production costs (e.g. treatment costs, impaired growth, weight loss and lower market value) (Smulders et al., 2008; Sutherland et al., 2009; Niemi, 2010). Moreover, a lower market value is caused by the formation of abscesses that condemn carcasses, which results from tissue trauma due to tail-biting behaviors. Slaughterhouses reject or pay a lower amount of money for the condemned carcasses. As a result, farmers mainly bear the consequences of tail-biting behaviors (Heinonen et al., 2010). Zonderland et al. (2011) have looked into the economic effects of tail-biting behaviors in the Netherlands in 2011. They estimated the costs to be of about €8.000.000 due to tail-lesions of tail-docked pigs. They have taken into account a prevalence of 1-2% for tail-biting behaviors. It includes treatment and production costs due to the tail damage. These costs would be even higher when the costs for tail docking itself are also taken into account and when the prevalence of tail-biting behavior is higher (like in pigs with intact tail) (Zonderland et al., 2011; Werkgroep Werkgroep Krulstaart, 2013). The costs for the slaughterhouses are rather limited (€2,19 for 1000 slaughtered pigs), because about 66.6% of this amount will be charged on the farmer (Zonderland et al., 2011). Currently, no other recent research is available that specifies the economic impact of tail-biting behaviors.

7. Attitude of influencing stakeholders towards tail docking of pigs

Pig producers, consumers and retailers are important stakeholders that need to be willing to accept pigs with intact tails and or can make a difference in order to successfully reduce the procedure of tail-docking (Paul et al., 2007; Boogaard et al., 2011; Werkgroep Krulstaart, 2013). First of al, according to Paul et al. (2007) farmers in the United Kingdom consider tail docking as the most effective way to prevent tail-biting behaviors of pigs (Paul et al., 2007). Other methods like adding enrichment materials and reduce the stocking densities are seen as second best to prevent tail-biting behaviors. However, these options are considered as costly (Paul et al., 2007). de Lauwere et al. (2009) performed a similar study about the attitude of farmers towards tail docking in the Netherlands. According to conventional Dutch farmers, the tail-docking procedure is also for them the most important measure to prevent tail-biting behaviors (de Lauwere et al., 2009). Secondly, consumers do express their concerns more and more about the welfare of animals. As a consequence, it is suggested that mutilations (like tail docking) are of highly importance to get rid of in favor of animal welfare (Boogaard et al., 2011; Nannoni et al., 2014). However, no research has been done specifically on the attitude of consumers towards the procedure of tail docking. A possible explanation for this lack of scientific research is that tail docking does not have a direct affect on consumers. In contrast to this, pig castration does have a direct effect due to the risk of tainted meat. For this reason, it is expected that consumers lack specific knowledge about tail docking. This might lead to problems for the acceptance of pigs with intact tails if wholesale prices of pork meat increase due to pigs with intact tails and management measures need to be taken (Boogaard et al., 2011). Nonetheless, non-governmental organizations exists that represent the interest of consumers that are aware and concerned about this procedure (Boogaard et al., 2011; Nannoni et al., 2014). The attitudes of retailers, a third important stakeholder, have shown to be in favor of reducing the number of tail-docking procedures (eg. Dutch retailers (Werkgroep Krulstaart, 2013)).

8. Status of tail docking in the European Union

8.1 Introduction of tail docking in the European Union

As is mentioned in the general introduction, the European council directive (2008/120/EC) concerning tail-docking of pigs uses a 'no, unless..' principle (European Commission, 2008a). Furthermore, the European council directive (2008/120/EC) concerning enrichment materials states:

> "Pigs must have permanent access to sufficient quantity of material to enable proper investigation and manipulation activities, such as straw, hay, wood, sawdust, mushroom compost, peat or a mixture of such, which does not compromise the health of the animals." (European Commission, 2008a, p. 10)

The majority of the European member states allows tail docking and provides enrichment materials, like the regulations of the European Commission. However, several national non-legislative initiatives are introduced in countries in order to reduce or ban docking of tails, like in Austria and the Netherlands ("Freiland Tierhaltungsstandards," 2007; Werkgroep Krulstaart, 2013). As a consequence, the number of docked and intact tails of pigs and the prevalence of tail-biting behaviors differ widely across Europe (Taylor et al., 2010; Scollo, 2013; Nannoni et al., 2014). As is mentioned before (paragraph 4.2), it is difficult to compare the number and prevalence of the tail-docking procedures and tail-biting behaviors between European studies. As a consequence, they are often over- or underestimated and should be interpreted with caution (Taylor et al., 2010; Sutherland & Tucker; 2011; Nannoni et al., 2014). In the following paragraphs the current status of this procedure and the prevalence of tail biting behavior in several European member states will be discussed. It is decided to not elaborate on each member state, due to a lack of available information. Furthermore, the national non-legislative initiatives are found by means of an online web search. It is expected that more initiatives do exist, especially related to the retail sector.

8.2 Austria

Nearly 100% of the pigs are docked in Austria (EFSA, 2007a; Wageningen UR Livestock Research, 2010). However, according to the national legislation of Austria, enrichment materials need to be harmless to pigs and in sufficient amounts be provided. Furthermore, the Austrian organic initiative, called Freiland Standard, forbids the procedure of tail docking of pigs ("Freiland Tierhaltungsstandards," 2007).

8.3 Belgium

About 100% of the pigs have docked tails in Belgium, like Austria (EFSA, 2007a). Goossens et al. (2008) have found tail lesions on 3.7% of the growing pigs and 2.4% of fattening pigs. These are average figures of tail lesions (Goossens et al., 2008). Smulders et al. (2008) have showed similar results, 2.1% of the tail-docked fattening pigs had tail lesions. These researches were conducted solely on Belgian pig farms (Goossens et al., 2008; Smulders et al., 2008).

8.4 Denmark

Denmark does also perform the procedure of tail docking in nearly 100% of the time (EFSA, 2007a; Wageningen UR Livestock Research, 2010). It is important to note that national legislation does not allow docking for more than 50% of the tail. Furthermore, it is only allowed on day 2-4 and it is generally forbidden in the organic production (Mul et al., 2010; Spoolder et al., 2011; D'eath et al., 2014). Additionally, the use of straw and other manipulable materials is more strictly regulated than the directive of European Council on enrichment materials states. It needs to be a natural product that is provided on the floor and used for rooting behaviors (Mul et al., 2010; D'eath et al., 2014). Additionally, in 2015 the use of fully slatted floors is forbidden and pigs (except from piglets and farrowing sows) have an increased space allowance compared to the European council directive (Mul et al., 2010; D'eath et al., 2014).

In 2014 a petition was send to the European commission by the Danish Animal Welfare Society to complain about the lack of implementation in Denmark (and the other EU countries) for regulations regarding tail docking (Ministry of food, agricultural and fisheries of Denmark, 2015). Moreover, an action plan about a better welfare for pigs set up by several stakeholders of the Danish pig industry and signed by the former Danish minister for food in 2014. They aim for a significant decrease in the proportion of tail docked pigs by means of scientific research on avoiding tail docking, reserving money for development of new technology to increase the provision of straw in barns and more strict control of enrichment materials in the stables (Ministry of food, agricultural and fisheries of Denmark, 2015). It is unknown when this document will be published. Up to now, only one initiative is known that completely forbids the procedure of tail docking in Danish pigs, which is called Velfaerdsdelikatesser (organic pig production) ("Sortbroget landracegris," n.d.).

8.5 Finland

The procedure of tail docking is forbidden in Finland. As a consequence, the percentage of tail-docked pigs is very low (about 5%) (EFSA, 2014). In general the farms are smaller compared to the United Kingdom and Denmark, for this reason it is expected that the detection of tail-biting behaviors is easier and measures can be taken (D'eath et al., 2014). Additionally, Finnish farms frequently use solid floors with deep bedding, which lowers the risk of tail-biting behaviors (Mul et al., 2010; D'eath et al., 2014; EFSA, 2014). Moreover, according to Finish legislation, pigs need permanent access to enrichment materials and the amount need to be sufficient in order to make it into small piles. In case the materials are not permanently provided, they need to be reshapable and refreshed twice a day (D'eath et al., 2014). On top of this, pigs have an increased space allowance and solid area compared to the regulations of the European Commission (D'eath et al., 2014)

According to Valros et al. (2004) the prevalence of mild to severe tail damage is about 34.6% and severe tail damage was seen in 1.3% of the animals in Finland. A more recent study of Valros & Heinonen (2015) have found lower number of tail damage (2.3%). It is important to mention that the ban on the procedure of tail docking started in 2003, which explains the difference in tail damages between the two studies (Valros et al., 2004; Valros & Heinonen, 2015). Additionally, the pigs used in the research of Valros & Heinonen (2015) were provided daily with enrichment materials.

8.6 France

French farmers dock the tails of pig in approximately 100% of the time (EFSA, 2007a; Wageningen UR Livestock Research, 2010). Several national initiatives exist that completely forbidden tail docking of pigs, like: Nature&Progres (Nature and Progress, 2002).

8.7 Germany

About 100% of the tails of pigs are docked in Germany (EFSA, 2007a). However, according to Compassion in World Farming the prevalence of tail docking is lower (79%) (CIWF, n.d.-b). These differences could be explained by the fact that CIWF (n.d-c) gathered data of 19 farms in Germany, but these farms were located in the main pig-producing areas (CIWF, n.d.-b). According to the German law the provision of enrichment materials need to be enough and harmless (Mul et al., 2010). However, Compassion in World Farming have shown that 89% of the enrichment used is ineffective in reducing tail-biting behaviors or completely absent (CIWF, n.d.-b).

Several German initiatives are found that aim for a reduction of tail docking or have already forbidden the procedure within their initiative. A joint declaration in North-Rhine Westphalie (NRW) is signed by the minister of agriculture of NRW to stop routine tail docking of pigs by 2016 (PROVIEH, 2014). In order to successfully achieve

this objective, massive campaigns and information sessions for farmers are held as a way to increase their knowledge on how to manage pigs with intact tails. The NRW region is about 25% of Germany's pig producing region (PROVIEH, 2014). Moreover, since July 2015 the lower Saxony state of Germany has introduced a premium for farmers that raise entire pigs, which is called "Ringelschwanzprämie" (ter Beek, 2015). Finally, several non-legislative efforts have been taken actions on phasing out tail-docking in Germany, like: "Für mehr Tierschutz"Tierschutzlabel and Bioland (both do not allow tail docking) ("Für mehr Tierschutz", 2013; "Bioland richtlinien," 2015).

8.8 Ireland

Boyle et al. (2012) have concluded that over 99% of the tails in pig in Ireland are docked. Additionally, 58.1% of these docked tails have showed tail lesions, only 1% of them had severe tail lesions. A second study indicated even a higher prevalence (72.5%) of mild tail lesions (Boyle et al., 2012). It is reasoned that the high numbers of observed mounting behaviors are the main cause of these lesions. Mounting behaviors result from the high number of raising entire boars. In contrast to Ireland, the United Kingdom also raises high numbers of entire boars but has lower percentage of tail-biting behaviors. This can be attributed to the fact that straw bedding is commonly used in the United Kingdom, while this is not the case in Ireland (Boyle et al., 2012).

8.9 Italy, Spain and Portugal

Similar to other European member states, about 100% of the pigs have docked tails in Italy. Furthermore, low incidences of tail-biting lesions (0.15%) have been shown (Scollo, 2013). Possibly caused by the high number of docked pigs and the long length of the tail that is docked. Italians consider docking as very important, because the Italian pigs are slaughtered at a higher weight and age that increases the severity of tail damages (Scollo, 2013). In Spain and Portugal have about 90 to 95% of the pigs a docked tail (EFSA, 2007a).

8.10 Lithuania and other Eastern European countries

It is forbidden to tail-dock pigs in Lithuania (Valros & Heinonen, 2015). Additionally, Latvia has about 75% of the pigs a docked tail and in Estonia it is about 90% (EFSA, 2007a). However, no further sufficient information is available about the procedure of tail docking in the other Eastern European member states (EFSA, 2007a; Wageningen UR Livestock Research, 2010).

8.11 Sweden

Similar to Finland and Lithuania, tail docking is forbidden in Sweden. Consequently, the number of docked-pigs is zero (EFSA, 2014). Additionally, the use of enrichment materials (access to straw) is compulsory to use (Mul et al., 2010; D'eath et al., 2014). Furthermore, more strict national regulations on top of European commission are set regarding space allowance and air quality (Mul et al., 2010). Keeling et al. (2012) have conducted a research on farm level, which docked pigs at different lengths. They have found a prevalence of 7% of tail-damage in Sweden. This prevalence includes any type of damage and the different lengths docked (no docked at all, half tail or less than half tail left). Tail-biting injuries were seen on 1,5-1,9% of the case when only taking into account the docked tails of 50% or more (Keeling et al., 2012). Furthermore, Gunnarsson et al. (2015) have found a prevalence of 1,6% of tail-bitten finisher pigs per batch. The pigs remained their tail and were provided with straw materials. Swedish farms commonly use solid floors with deep straw bedding, like Finland. As a result the use of straw is frequently used, which explains the low number of tail-biting behavior (EFSA, 2014).

Since national legislation forbids tail-docking, national initiatives are not considered as needed. However, Sweden has introduced two labels Svenskt Sigill and

KRAV. These labels communicates that products are produced of Swedish pigs ("Krav Standards," 2016; Svenskt Sigill, n.d.).

8.12 The Netherlands

Nearly all (100%) of the farmers perform tail docking on pigs (CIWF, n.d.-b; EFSA, 2007a; Wageningen UR Livestock Research, 2010). According to CIWF, the majority (88%) of the Dutch pigs receive no or ineffective enrichment to reduce tail-biting behaviors, which is similar to Germany (CIWF, n.d.-c). However, in the organic production, tail docking is forbidden and the use of straw is compulsory. Moreover, the prevalence of tail biting in docked pigs is estimated to be 1-2% (Zonderland et al., 2011). According to Lauwere et al. (2007) tail-biting behaviors does not have a higher prevalence in pigs with intact tails (organic production) compared to docked tails pigs (conventional production). They have found that respectively 45,2% of the organic finisher pig farmers suffer from tail-biting behaviors on their farm, in contrast to 56% of the conventional finisher pig farmers.

In 2013 the declaration of Dalfsen was voluntary signed by several stakeholders in the Dutch pig sector and the government. The objective of this declaration is to completely stop the procedure of tail docking on the long term (Werkgroep Krulstaart, 2013). An additional non-legislative initiatives that make efforts to stop tail docking of pigs is the Dutch food label Beter Leven (2 or 3 Star) ("Factsheet varkens," 2015).

8.13 United Kingdom

EFSA (2007) have found that 81% of the pigs are docked in the United Kingdom. Figures of the British leading groceries stories have shown similar results, 88% of the pigs produced in the United Kingdom have at least partly docked tails in 2007 (Hickman, 2007). Research of CWIF (n.d.-a) has shown a lower prevalence (54%) of tail-docking in the United Kingdom. These differences could be explained by the fact that CWIF only gathered data of 11 farms. The docking of tails in pigs is forbidden in the British organic pig production (D'eath et al., 2014). Research of Hunter et al. (1999) has found a prevalence of tail lesions of 9.2% in pigs with intact tails and 3.1% in docked pigs (respectively 0.5% and 0.1% of severe tail lesions). The data was collected in six British slaughterhouses (Hunter et al., 1999). Additionally, the United Kingdom has more strict regulations regarding the use of enrichment materials compared to the European council directive (D'eath et al., 2014), pigs must have permanent access and sufficient amounts of enrichment materials in the 'Freedom food' and 'Organic' systems (D'eath et al., 2014). According to CIWF (n.d.-c), only about 36% of the provided enrichment materials in the UK are insufficient or completely absent. This indicates that the majority of farmers comply to the British law of enrichment materials. Additionally, this country provides more often outdoor space compared to other European countries, it suggested that about 40% of the sows in the United Kingdom are raised in free rang outdoor systems (CIWF, n.d.-c). However, this is not mentioned in the British national legislation (Mul et al., 2010). Finally, several non-legislative initiatives and retailers have been made efforts to reduce tail-biting behaviors or eliminate tail-docking completely, like: RSPCA assured, Soil association, Marks &Spencer and Waitrose (CIWF, n.d.-a).

Appendix G Literature study: Beak trimming in laying hens

1. General introduction

Severe feather pecking is the most common behavioral problem in laying hens, which leads to serious welfare issues (Gilani et al., 2013; Rodenburg et al., 2013; de Haas et al., 2014). Generally, feather pecking that leads to welfare problems is defined as:

"The feather is grasped and firmly pulled, and this may cause the recipient to squawk and withdraw. Sometimes the feather is removed and may be eaten. It causes both feather damage and feather loss." (Savory, 1995, p. 216)

Laying hens frequently (65-89%) perform this pecking behavior with intact beaks (Bestman et al., 2009; Lambton et al., 2010; Gilani et al., 2013). For this reason, beaks are trimmed for about one third or one half of the length to reduce the risk of feather pecking behavior. However, this procedure of beak trimming does also negatively affect the welfare of hens (Nicol et al., 2013; de Haas et al., 2014). The Council Directive (1999/74/EC) of the European Commission on the welfare of laying hens states:

"In order to prevent feather pecking and cannibalism, however, the Member States may authorise beak trimming provided it is carried out by qualified staff on chickens that are less than 10 days old and intended for laying." (European Commission, 1999, p. 57)

Consequently, beak trimming is a routine husbandry procedure in the European Union (Nicol et al., 2013; de Haas et al., 2014).

This Appendix G will start of with an overview of feather pecking and its risk factors. Secondly, the welfare effects of an intact beak will be discussed. Furthermore, the welfare effects of laying hens with trimmed beaks will be explained. Additionally, the economic consequences of feather pecking behaviors will be shown. Finally, the role of important stakeholders and an overview of the status in the European Union on beak trimming will be provided.

2. Feather pecking

2.1 Feather pecking behavior

As is mentioned in the general introduction, feather pecking is a behavior that is commonly performed in laying hens (Savory, 1995; Gilani et al., 2013). Two types of feather pecking exist, namely: gentle and severe (Savory, 1995). Gentle feather pecking are mainly soft pecks at the tips of the feathers, which does not lead to much damage and is often not paid much attention to by the victim (Rodenburg et al., 2013). Severe feather pecking, are repeated severe pecks and pulls of the feathers. As a consequence, the second type of feather pecking is considered as a major welfare issue (paragraph 4)(Rodenburg et al., 2004; Rodenburg et al., 2013).

2.2 Underlying cause of feather pecking

The cause of feather pecking behavior is related to a mismatch between the natural and husbandry conditions. In nature laying hens perform about 65% of their time behaviors like: dust bathing and foraging behaviors (like scratcing and ground pecking) (Pickett, 2008; Rodenburg, 2014a). However, in current husbandry systems chickens are either not able or do not have to perform these natural behaviors, because feed is provided by the farmer and or the housing conditions do not allow the performance of these behaviors. As a consequence, the behavioral needs of hens are not met, which increases their motivation to perform this behavior and in turn leads to stress in the hens. Stress is associated with discomfort and ultimately results in the expression of abnormal harmful behaviors, like feather pecking behavior, as an attempt to cope with stress (Pickett, 2008; Rodenburg et al., 2013; de Haas et al., 2014). The onset of this behavior is similar to tail-biting behaviors in pigs (Taylor et al., 2010).

In line with the inability of laying hens to meet their behavioral needs, feather pecking is suggested to be a redirected foraging behavior. As a result, they redirect their foraging behavior from litter (is either insufficient or absence) towards conspecifics (Pickett, 2008). However, Rodenburg (2014a) argues that is could only be true if feather pecking fulfills the same motivation as foraging behavior does. This is not the case, since ground pecking (a form of foraging behavior) and feather pecking frequently occur both in the adult phase. As a result, feather pecking does not replace ground-pecking behaviors (Rodenburg, 2014a). Newberry et al. (2007) have also indicated that severe feather pecking does not sit in for foraging behavior. They have found no significant relationships between foraging behavior as a young chick and high levels of severe feather pecking as an adult, because high levels of foraging behavior were also performed in the adult phase. As a consequence, Rodenburg (2014a) and Newbery et al. (2007) reject the redirect foraging hypothesis, since feather pecking does not substitute for foraging behavior (Newberry et al., 2007; Rodenburg, 2014a).

Furthermore, feather pecking is not a form of aggressive behavior. These types of behaviors are often seen during establishing or maintaining dominance structures, which indicates a different motivation compared to feather pecking behaviors. Moreover, aggressive behavior is often directed at the head and neck and do not lead to severe feather damage (FeatherWel, 2013; Rodenburg et al., 2013; Rodenburg, 2014a,b). Additional factors that do have a significant effect on onset of feather pecking behavior will be discussed in the next paragraph.

3. Risk factors of feather pecking

As the previous paragraph showed, feather-pecking behaviors are related to the inability of hens to perform their natural behaviors (Pickett, 2008; de Haas et al., 2014; Rodenburg, 2014a). Furthermore, multiple indicators and factors related to the onset of feather pecking behaviors are known. The most commonly mentioned factors in literature will be discussed (Rodenburg et al., 2004; Newberry et al., 2007; Rodenburg et al., 2013; de Haas et al., 2014).

3.1. Animal characteristics

First of all, young chicks that actively perform ground pecking behavior, a foraging behavior, during early life are prone to develop severe feather pecking behaviors in later life (Newberry et al., 2007). However, as the previous paragraph mentioned, these behaviors do not replace each other (Newberry et al., 2007).

Furthermore, a highly fearful chick is more sensitive to stress, which results in an increased likelihood of performing feather-pecking behaviors in the adult phase (Rodenburg et al., 2004; Rodenburg et al., 2013; de Haas et al., 2014).

Additionally, severe feather pecking is a heritable trait, which results in the possibility to select against it (Newberry et al., 2007;Pickett, 2008). Selection for low mortality in chicks, reduces the chance of feather pecking and cannibalistic behaviors due to a less fearful and stressed chick (Rodenburg et al., 2014a). Furthermore, research has shown that white breeds of laying hens are fearful and have the most damages on the belly region, which implies aggressive and vent pecking behaviors and leads to damage of the feathers. In contrast to white breeds of laying hens, brown breeds have shown to have damages on the whole body. This implies that they are involved in injuries pecking, which results in severe feather pecking behaviors and high mortality rates (Bilcík & Keeling, 1999; Tauson et al., 2004; de Haas et al., 2014; de Haas et al., 2013). These differences show the existence of individual variation between laying hens due to the involvement of different genetic strains (Newberry et al., 2007; Rodenburg et al., 2014; de Haas et al., 2014). The role of cannibalism, vent and aggressive pecking will be explained in paragraph 4.

3.2. Rearing conditions

Early living conditions (especially the first four weeks) can reduce the levels of feather pecking in later life (Bestman et al., 2009; Rodenburg et al., 2013). The availability of litter during the rearing phase (first four weeks of life) has a significant effect on the reduction of feather pecking behaviors in later life ($P=0.008$) (Bestman et al., 2009), which is probably related to stimulation of ground pecking behaviors (de Haas et al., 2014). However, absences of litter during rearing (up to day 20) does not always lead to the onset of severe feather pecking behaviors in the adult phase. It is important to mention that in this situation litter was provided after day 20 (de Jong et al., 2013a; de Haas et al., 2014). The onset of gentle feather pecking is significantly increased in a situation when litter is absent during early life (up to day 20) compared to chickens housed with litter in early life (de Jong et al., 2013a).

3.3. Social environment in the adult phase

The previous paragraph showed the crucial effect of the rearing phase on the onset of feather pecking behaviors. This effect of social environment is also seen in the adult phase (Dawkins et al., 2004; Rodenburg et al., 2013; de Haas et al., 2014). Nicol et al. (2001) have found that raising hens their entire life on wire floors compared to enriched floors lead to a significant increase in feather pecking behaviors. Furthermore, in case litter is provided during the adult phase (irrespective of the situation in early life) it also leads to a significant reduction of feather pecking behaviors ($P<0.05$) and an increase in foraging behaviors (floor pecking, $P<0.001$) compared to hens raised on wire floors without substrates (Nicol et al., 2001).

Not only are enriched floorings crucial to consider for feather pecking behaviors, but also the housing system used (Pickett, 2008; de Haas et al., 2014; EFSA, 2015). According to Riber & Forkman (2007), inactive laying hens become more frequent victims of feather pecking behaviors compared to active hens. As a consequence, the housing systems of laying hens need to include distinct resting areas like perches, which gives inactive animals the possibility to escape from active animals (Riber & Forkman; EFSA, 2015). Secondly, the use of ranging areas need to be created and in turn be stimulated, these areas significantly reduce feather-pecking behaviors (Green et al., 2000; Nicol et al., 2013). However, currently, each type of housing (cage or non-cage) systems initiates feather pecking and cannibalistic behaviors (Rodenburg et al., 2008; Bestman et al., 2009). This indicates that not one system, which is currently used, is able to fully meet the behavioral and psychological needs of the chicken (USDA; Rodenburg et al., 2008). It is important to mention that it is has been forbidden to house laying hens in cage systems since 2012 (Rodenburg et al., 2008).

Furthermore, the aspect feeding is another important factor that is able to stimulate foraging behavior and in turn a decrease in abnormal behaviors. The composition of the diet is the most important aspects that relates to feeding. The risk of the onset of severe feather pecking behaviors is increased when the diet composition does not provide satiety and gut motility in laying hens (Pickett, 2008; Rodenburg et al., 2013). This happens when insufficient numbers of crude protein and minerals are provided. Furthermore, high-energy diets and low fibre levels are also unfavorable in terms of a stimulation of the gut motility. The low amounts of these components reduce the time that laying hens spend on feeding behavior, which increase the possibility of severe feather pecking behaviors (Pickett, 2008; FeatherWel, 2013; Rodenburg et al., 2013).

Finally, aspects like temperature, air quality and humidity need also be taken into account. They are positively correlated with the onset of diseases in laying hens, when these conditions are suboptimal to them (e.g. temperatures out of their thermal neutral zone) (Dawkins et al., 2004). A diseased state of chickens leads to a stress responses,

which is undesirable as will be discussed in the following paragraph (de Haas et al., 2014).

3.4. Social environmental factors related to stress sensitivity

The factors described in the previous subparagraphs (animal characteristics, rearing conditions and social environment) are all related to a reduction foraging behaviors, which leads to the abnormal behaviors, like feather pecking. Stress is another second aspect that is associated with discomfort and in turn the onset of feather pecking (Rodenburg et al., 2013; de Haas et al., 2014). For this reason, factors related to the environment of the hen that induce a stress response need to be prevented.

First of all, changes in feeding management, climate and stockmanship are stress-related events and result frequently in outbreaks of feather pecking behaviors (Dawkins et al., 2004; Rodenburg et al., 2004; de Haas et al., 2014; Rodenburg, 2014b). Moreover, a disease-state changes and often reduces normal feeding behaviors. As a result, these chickens have an increased motivation to forage, which leads to stress in chicks (de Haas et al., 2014).

Additionally, large group and high stocking densities are also frequently associated with stress. In the commonly used non-cage systems large groups of chickens (up to 30.000 laying hens) are held together and enhance the risk of feather pecking behaviors due to stress (Pickett, 2008; Rodenburg et al., 2008; de Haas et al., 2014).

Finally, high intensity lighting (>40W) and long periods of light (>10-13hours of light per day) increases the risk of feather pecking (Nicol et al., 2013; Jacob, 2015). In contrast to high intensity and long period of lights, low dimmed white light is able to reduce the levels of feather pecking and cannibalistic behaviors, because the hens can not see each other very well and stress levels are reduced (Hester & Shea-Moore, 2003; Lambton et al., 2010; Rodenburg, 2014a). However, this way of using light possibly impairs the visual development of hens (Lambton et al., 2010; Rodenburg, 2014a).

4. Intact beaks

Beak trimming of laying hens is a routine practice in the European Union, which results in low numbers of laying hens with intact beaks. Specific figures of the number of laying hens with intact beaks are unknown (Nicol et al., 2013; Rodenburg et al., 2013; de Haas et al., 2014). The following paragraphs will discuss the welfare effects of having a beak.

4.1 Positive welfare effects of having a beak

Laying hens with intact beak are able to perform natural behaviors like exploring and foraging behaviors (FeatherWel, 2013). The beak is used to sense materials during the performance of these behaviors (Hester & Shea-Moore, 2003; Pickett, 2008; Rodenburg, 2014a). Furthermore, de Jong et al. (2013b) have conducted a research on laying hens with intact beaks in the United Kingdom and Poland. They have concluded that these hens show more uniformity and have a lower mortality rate compared to hens that are beak trimmed (respectively 0.20% vs. 0.25% of the trimmed during the rearing phase and 5.92% vs. 9.23% of the trimmed during laying phase) (de Jong et al., 2013b). It is suggested that this difference is due to a better feed-intake and a lower pressure on selection of hens with intact beaks compared to beak-trimmed hens (de Jong et al., 2013b). Additionally, feather pecking behavior was higher in beak-trimmed hens during the rearing period compared to laying hens with intact beaks, which is probably due to the changed sensitivity in the beak of beak-trimmed chicks. It is important to mention that this study has not made a distinction between gentle and severe pecking.

Finally, de Jong et al. (2013b) have concluded that laying hens with intact beaks do not negatively influence the condition of the feathers. It is important to clarify that

this research does not show any significance results, a limited number of farms are included and is solely conducted in the United Kingdom and Poland (high number of free-range area). As a consequence, this research gives rather an indication than a solid conclusion of the positive effect of hens with intact beaks (de Jong et al., 2013b).

4.2 Negative welfare effects of having a beak

4.2.1. Gentle vs. severe feather pecking behaviors

Laying hens with intact beaks often perform feather-pecking behaviors; these behaviors have consequences of the welfare of hens (Gilani et al., 2013). Gentle feather-pecking behaviors are not expected to cause serious damage on the hens (Rodenburg et al., 2013). However, the performance of stereotypic gentle feather pecking possibly reveals a behavioral problem in hens (Rodenburg et al., 2013). It is suggested that the behavioral needs are not met of this hen; consequently she starts to redirect their foraging behavior to feathers of conspecifics (de Haas et al., 2014; Rodenburg, 2014a). However, according to Lambton et al. (2010) this type of behavior is significantly lower in hens with intact beaks compared to beak-trimmed hens ($P < 0.001$). For this reason, gentle feather pecking is not of much concern for hens with intact beaks.

In contrast to gentle feather pecking, severe feather pecking is significantly more performed in chickens with intact beak compared to beak trimmed (Staack et al., 2007; Lambton et al., 2010). Lambton et al. (2010) have found a significantly higher number of severe feather pecking behaviors in hens with intact beaks compared to beak trimmed (mean bouts/bird/min: 0.032±0.003 vs. 0.017±0.003 in beak trimmed, $P=0.028$). In this research, all the laying hens were reared in free-range areas with optimal litters (Lambton et al., 2010). The condition of the feathers is another way that indicates an increased level of severe feather peaking in hens with intact beaks compared to beak-trimmed hens. Plumage damage is often used as an indicator of feather pecking, since it is suggested that a lower number of damage indicates a reduced level of severe feather pecking (Nicol et al., 2013). However, it is not a completely solid measurement, since damage on the feather can also occur due to aggression or abrasion of the beak (Nicol et al., 2013). Staack et al. (2007) have showed a higher percentage of feather damages in hens with intact beaks compared to trimmed beaks during the laying phase (respectively 50% and 23% and, $P=0.007$). Additionally, Lambton et al. (2010) have also found a lower number of plumage damage in beak-trimmed hens compared to intact beaks ($P=0.040$). Furthermore, Tauson et al. (2004) have also indicated a better condition of the feathers in beak-trimmed compared to intact beaks (respectively 41% and 55%, $P<0.001$).

It needs to be said that gentle feather pecking does often not lead to severe feather pecking, which can be explained by distinct gene patterns and motivational backgrounds for the two forms of feather pecking (Hughes & Buitenhuis, 2010; Lambton et al., 2010; Newberry et al., 2007; Rodenburg et al., 2004). Furthermore, gentle feather pecking frequently occurs during rearing, while severe feather pecking is most often seen during the laying phase (Lambton et al., 2010; Gilani et al., 2013; Nicol et al., 2013).

4.2.2. Short-term negative welfare effects

This paragraph will elaborate on the short-term negative welfare effects of severe feather pecking behaviors, which more frequently occur in hens with intact beaks (Gilani et al., 2013). Severe feather pecking behavior is painful for the recipient and causes severe damage on the plumage and tissue of hens (Rodenburg et al., 2013). Gentle & Hunter (1991) have examined the behavioral and cardiovascular responses of feather removal by chickens as an indicator for pain. They have indicated that feather pecking is a painful event, due to an increase in blood pressure and heart rate (no significance differences were shown). Furthermore, changes in behavior are observed when feathers were removed. In the beginning hens tried to move away by means of

jumping and wing flapping behaviors and an increased vocalization. After a while, if the removal continued, they remain still by means of crouching in a corner, lowering their head and closing the eyes (no significance). It is unknown if this study looked at gentle or severe feather pecking (Gentle & Hunter, 1991). It is unknown if the pain perceived by the pulling out of feathers results in long-term chronic pain.

4.2.3. Long-term negative welfare effects

Not only is pain a negative welfare effect of severe feather pecking behaviors, but also several long-term implications on the effects of hens are observed. Struwe et al. (1992) have looked into levels of stress in laying hens with intact beaks compared to beak trimmed laying hens. They have concluded that beak trimmed hens have lower levels of chronic stress compared to hens with intact beaks (heavier adrenal glands and hearts, $P<0.05$), due to a lower number of feather pecking behaviors (Struwe et al., 1992). It is again unclear of this study observed gentle or severe feather pecking. A more recent research on the level of stress in feather pecked laying hens could not be found. It is known that the performance of severe feather pecking behaviors indicate an insufficient ability of laying hens to meet their behavioral needs, which leads to stress and is a sign of reduced welfare (Rodenburg et al., 2004; de Haas et al., 2014). Stress possibly makes animals more susceptible to diseases, which increase the susceptibility of disease in the entire flock (Green et al., 2000; FeatherWel, 2013). Green et al. (2000) have found a significant positive relationship between egg peritonitis and infectious bronchitis (diseases in chickens) and feather pecking behaviors. It is not mentioned on which type of feather pecking (severe or gentle) it is about. Additionally, it is unclear if these diseases cause or result in feather pecking behaviors (Green et al., 2000).

Another welfare issue of severe feather pecking behavior is that victims of this behavior have problems with their thermoregulation. Hens lose their feathers, which results in an increased food ratio (up to 40% at temperatures of 18-20°C) compared to hens that do not lose or only lose low numbers of feathers to keep warm (Tauson et al., 2004). It is suggested that it will become a welfare problem when the loss of heat is even higher in environments with lower temperatures, like outdoor areas, and feed can not compensate anymore for the losses (Tauson et al., 2004).

Moreover, severe feather pecking can lead to cannibalistic behaviors (e.g. tissue and vent pecking), which results from the loss of feathers and in turn an exposed skin of the hen (Rodenburg et al., 2004; Rodenburg et al., 2013). Tissue pecking are pecks on the exposed skin, which leads to tissue damage and wounds and in turn to infections. Ultimately, it can lead to the death due to extensive blood loss. The second type of cannibalism, vent pecking, may even lead to taking out organs of victims (Rodenburg et al., 2004; FeatherWel, 2013; Rodenburg et al., 2013). These cannibalistic behaviors often happens at the onset of the laying phase, the period that severe feather pecking is highest (Nicol et al., 2013). Vent and tissue pecking lead to a significant increase in mortality of the hens (up to 20% in non-cage systems) (Tauson et al., 2004; Sandilands & Hocking, 2012). The mortality rates highly depend on: intact beaks or beak trimmed laying hens, the type housing system, group size and laying breed used (Tauson et al., 2004; Sandilands & Hocking, 2012). First of al, Tauson et al. (2004) have showed that intact beaks lead to a significantly higher mortality rate compared to beak-trimmed hens ($P < 0.01$), which is understandable due to an increase in feather pecking behavior (Tauson et al., 2004). Furthermore, Hegelund et al. (2006) have looked into the mortality rates of organic laying hens in Denmark. The laying hens of the Danish organic production have intact beaks. They have found an average mortality of 22,5%, which was attributed due to diseases (over 50%) and abnormal behaviors (3.4%). A disease-state and abnormal behaviors are both related to feather pecking behaviors (paragraph 2 and 3). Moreover, Hadorn et al. (2000) have examined the differences in mortality

rates between beak trimmed and intact hens in aviary systems. They have concluded that the mortality rate is 5.6 times higher in laying hens with intact beaks compared to hens with trimmed beaks (12.3% vs 2.2%) and this is mainly due to cannibalistic behaviors (7.5% vs. 0.3%). Research of Tauson et al. (2004) has showed that increased flock size leads to a significantly higher mortality rate ($P< 0.001$), which was mainly caused by pecking behavior. These results are based upon three different cage systems (large, medium and small), the specific number of hens per cage could not be found (Tauson et al., 2004).

The type of housing system used does also influence the mortality rates due to feather pecking behaviors. However, currently feather-pecking behaviors does occur in each type of housing system. As a consequence, it is not easy to predict which system is best in reducing the abnormal behaviors. It is known that free-range outdoor areas and enriched systems are desired when it comes to successfully reducing feather-pecking behavior and in turn the mortality rates. Furthermore, the use of cage systems have also showed to lower the number of feather pecking behaviors (Tauson et al., 2004; Pickett, 2008; Nicol et al., 2013). However, these systems are no longer allowed in the European Union due to other welfare issues (Rodenburg et al., 2013). The third aspect related to mortality in laying hens is the type of breed used. As is mentioned before (subparagraph 3.1), brown breed have generally higher mortality rates than white breeds (de Haas et al., 2014).

A final important aspect of severe feather pecking and need to be taken into account is, once such a situation of feather pecking arises, it is difficult to stop and chronic damage may be the result (FAWC, 2007).

5. Trimmed beaks

At this point, it is unknown how feather-pecking behaviors can completely be avoided. For this reason, the procedure of beak trimming is frequently carried out as a preventive measure for feather pecking behavior across the European Union (Nicol et al., 2013; de Haas et al., 2014). Hot ironing on chicks of day five onwards is the most commonly used method for beak trimming. The use of a second technique called, infrared method, is raising. This technique is used on one-day-old chicks (FAWC, 2007; Fiks- van Niekerk et al., 2009a; Nicol et al., 2013; EFSA, 2015). Additionally, during the procedure of beak trimming analgesia are not frequently used (Freire et al., 2007).

5.1 Positive welfare effects of trimmed beaks

As is mentioned in subparagraph 4.2.1, the procedure of beak trimming significantly lowers the levels of severe feather pecking and cannibalistic behaviors and in turn the mortality rates (Hadorn et al., 2000; Tauson et al., 2004; Hegelund et al., 2006; Lambton et al., 2010). Furthermore, a reduction of severe feather pecking is also related to a significant better condition of the feathers, which is beneficial in terms of maintaining a sufficient body temperature (Tauson et al., 2004; Staack et al., 2007; Lambton et al., 2010). Finally, as is explained in subparagraph 2.2, feather-pecking behavior is related to stress. A reduction in feather pecking behavior will result in lower levels of stress, which is seen as positive for the welfare of laying hens (Hester & Shea-Moore, 2003; Rodenburg et al., 2004; de Haas et al., 2014). Differences in implications for welfare exist between the methods used for the procedure of beak trimming. The infrared method uses a high intensity infrared beam on the beak of one day-old chicks. As a result, no open wounds or blood loss occurs, which reduces the negative effect on the welfare of chicks. This is in contrast to the hot ironing method, because this procedure does lead to wounds and a risk of infections (Cheng, 2006; FAWC, 2007; Fiks-van Niekerk et al., 2009a; Fiks- van Niekerk et al., 2009b; Dennis & Cheng, 2012). An other advantages of infrared is that the beak falls of a couple of days later, which gives

the chick time to adapt its behaviours like feeding (Fiks- van Niekerk et al., 2009a; Dennis & Cheng, 2012).

5.2. Negative welfare effects of trimmed beaks

Although, feather-pecking behaviors are significantly reduced, the procedure of beak trimming has negative welfare effects of its own (Freire et al., 2007; Kuenzel, 2007). Additionally, irrespective of the method used, beak trimming has implications for the welfare of laying hens (Kuenzel, 2007; EFSA, 2015). The negatives welfare effects of beak trimming are split up in two categories: short term and long-term effects.

5.2.1. Short-term negative welfare effects

Generally, chickens have the ability to perceive pain due to a direct connection between the nerves of the beak and the head and face of the chicken (Fiks-van Niekerk & de Jong, 2007). Beak trimming by means of both methods, Infrared and hot blade techniques, lead to short term acute pain (Kuenzel, 2007). Indicators for pain that are frequently used are: resistance to restraining, increased heart rate and vocalizations (Kuenzel, 2007). A literature study of Kuenzel (2007) have proven by means of these indicators a significant increase in acute pain in beak trimmed laying hens of a couple of weeks old compared to beak trimmed chicks at day one. Additionally, a significant increase in acute pain could not be found in chicks that were beak trimmed on day one (Kuenzel, 2007). Freire et al. (2007) have used pecking force as an indicator to measure pain. A low pecking force is suggested to be a sign of pain on the beak due to the procedure. A significant lower pecking force was seen in beak trimmed laying hens of 10 weeks old compared to hens with intact beak and beak-trimmed hens at a young age (one-day old), which could be a sign of pain due to the treatment on the beak ($P< 0.01$) (Freire et al., 2007). The pecking force did not differ between one-day old chicks that were beak trimmed by means of the infrared technique and laying hens with intact beaks (Freire et al., 2007). Moreover, Freire et al. (2007) have proven that the use of an analgesia (Carprofen) increases the pecking force of chicks only if high amounts are consumed ($P=0.03$). As a consequence, these studies indicate that age is a determining factor on the level of pain, younger chicks (day-old) experience significantly less pain compared to older hens (days or weeks) (Freire et al., 2007; Kuenzel, 2007).

Furthermore, research of Dennis & Cheng (2012) has looked into behavioral changes of chicks that were beak trimmed (either infrared or hot blade), an other possible indicator of pain. They have proven a significant increase in acute pain due to the procedure. First of al, they have found a reduced level of activity in hot blade trimmed chicks (day 7 of age) compared to infrared trimmed (day 1 of age) at week five of age ($P< 0.049$). A lower activity level could be a sign of short-term pain. However, it gradually restored and no differences were found on week 10-30 of age ($P > 0.97$) (Dennis & Cheng, 2012). Secondly, a similar difference is found in drinking behaviors. Hot blade chicks drunk significantly less shortly after the treatment compared to infrared treated chicks ($P <0.042$), the differences is no longer seen in week 10 of age (Dennis & Cheng, 2012). As a result, one-day-old chicks that are beak trimmed with the hot blade method suffer from acute pain (Dennis & Cheng, 2012).

Furthermore, laying hens that have undergone the beak trimming procedure have lost their beak. Consequently, these hens have to adapt its feeding behavior, which results in temporary weight losses (Hester & Shea-Moore, 2003; Gentle & McKeegan, 2007). Gentle & McKeegan (2007) have found significantly lower body weights in beak trimmed laying hens (infrared and hot blade) compared to hens with intact beaks at day 21 of age (respectively: $p=0.04$ and $P<0.01$). Especially, hot blade treated laying hens resulted in lower body weights compared to infrared treated and hens with intact beaks, this difference maintained until day 35 ($P<0.05$) and 42 of age ($P<0.01$). However, in the

long term (around sexual maturity) the feeding levels, behavior and growth rate will return to normal (Fiks- van Niekerk & de Jong, 2007; Hester & Shea-Moore, 2003).

Finally, it is important to mention that the level of pain perceived highly depends on the length of the beak that is removed, which will be discussed in long term welfare effects (5.2.2.).

5.2.2. Long-term negative welfare effects

According to Lambton et al. (2010) gentle feather pecking behavior is significantly higher in beak-trimmed hens compared to hens with intact beaks during the rearing phase ($P < 0.001$). It is expected that the performance of (natural) exploratory behavior cause a pain response in hens that have undergone the procedure of beak trimming. As a result, gentle feather pecking, often considered as stereotypic gentle feather pecking, is shown due to the failure of performing natural behaviors (Lambton et al., 2010). An absence of litter material could not be an possible reason for the onset of this abnormal behaviors, because the rearing systems that were provided for this study contained deep litter and perches (Lambton et al., 2010). In line with this result, Staack et al. (2007) have found an increased percentage of damaged feathers in beak trimmed hens compared to hens with intact beaks during the rearing phase, which is possibly due to an increased level of gentle feather pecking (respectively 53% vs. 30%, $p=0.022$). As is mentioned before (subparagraph 4.2.1.), the performance of stereotypic gentle feather pecking behaviors may indicate that the behavioral needs of these laying hens are not met. This is in line with the fact that laying hens with trimmed beaks suffer from chronic stress and discomfort due to the inability meet their behavioral needs as performing natural behaviors in the number and way that is preferred (FAWC, 2007).

Moreover, the procedure of beak trimming does not treat the underlying behavioral problem, which is indicated by the high numbers of gentle feather pecking and the fact that severe feather pecking is not completely eliminated during the laying phase (Lambton et al., 2010; Sandilans & Hocking, 2012; Nicol et al., 2013).

Furthermore, an important functional and sensory organ is lost due to removals of parts of the beak, which impairs the integrity of laying hens (Hester & Shea-Moore, 2003; Cheng, 2006; FAWC, 2007; Fiks- van Niekerk & de Jong, 2007; Kuenzel, 2007). Most of the sensory receptors are located at the tip of the beak (Gentle 1997; Freire et al., 2007). As a result, crucial functions like food seeking and preening, nest building behavior and self-defense behaviors can no longer be performed by the hens (Fiks- van Niekerk & de Jong, 2007). It reduces the ability to eat and drink, because the animal has to adapt its feeding behavior due to the trimmed beak. As a consequence, the body weight of laying hens are also reduced the first weeks after the procedure (subparagraph 5.2.1.) (Hester & Shea-Moore, 2003; Gentle & McKeegan, 2007; Fiks- van Niekerk & de Jong, 2007;Dennis & Cheng, 2012).

Moreover, Jongman et al. (2008) have looked into behavioral changes of laying hens as an indicator for pain due to the procedure of beak trimming. They have found an increased number cage pecks ($P<0.01$) and head shakes ($P<0.05$) in hot bladed trimmed laying hens compared to intact hens at week 20 of age and toe pecking at week 14 ($P<0.01$). These differences were seen in the chicks trimmed once (after birth) and in the hens that were re-trimmed at week 14 of age. There could no longer be differences found in week 60 of age, except from cage pecking ($P=0.05$) (Jongman et al., 2008). For this reason, it is suggested that the procedure of beak trimming does not cause long term pain in laying hens (Kuenzel, 2007; Jongman et al., 2008). However, the level of pain highly depends on the length of the beak that is removed. A beak of which is more than 50% removed, the amount of scar tissue increases and in turn laying hens will experience more difficulties with wound healing. Ultimately, it leads to abnormalities in

the beak like: excessive scar tissue, deformed beaks and neuroma formation (Fiks- van Niekerk & de Jong, 2007; Gentle & McKeegan, 2007, Kuenzel, 2007). The formation of neuromas is suggested to be a sign of chronic pain (Kuenzel, 2007; Jongman et al., 2008). Hester & Shea-Moore (2003) have concluded that neuromas do not form in laying hens that are beak trimmed on an age of less than 10 days. Furthermore, Kuenzel (2007) have found that neuromas will not form when 50% or less of the beak is removed. Freire et al. (2007) have showed similar results, neuromas did not form when 34% of the beak was trimmed. However, the risk of regrowth is significantly increased when less than 50% of the beak is removed (Cheng, 2006; Gentle & McKeegan, 2007; Kuenzel, 2007). According to Gentle & McKeegan (2007), this risk is even significantly increased ($P<0.0001$), it needs to be said that the exact length of the beak that was trimmed is unclear. Regrowth possibly leads to irregularities and deformations in the beaks like: splitting and bleeding of the beak, which is suggested to cause long term pain (Cheng, 2006; Kuenzel, 2007; Gentle & McKeegan, 2007). Additionally, cannibalism may not be effectively prevented in laying hens, resulting in a second beak trimming treatment of chickens (Fiks- van Niekerk & de Jong, 2007; Gentle & McKeegan, 2007).

Finally, Cheng (2006) have suggested that the procedure causes an open wound, which will lead to bleedings and in turn will increase the risk of infections (Cheng, 2006; Dennis & Cheng, 2012). However, there could not be find any other research that indicate a significant risk of infections.

5.3 Alternative for the procedure of beak trimming

A natural alternative for trimming the beaks of laying hens is beak blunting, which happens if abrasive materials are provided in the feed (EFSA, 2005; Pickett, 2008). However, limited studies are known that have looked into the feasibility of this method.

6. Economic impact of feather pecking behavior

The economic consequences of laying hens with trimmed beaks or intact beaks differ, which will both be explained. The procedure of beak trimming reduces the mortality rate and increases the feed conversion of laying hens, which will be beneficial for the revenues of farmers. It is important to mention that the body weights of beak-trimmed hens are reduced due to a lower feed intake until sexual maturity, but will be back to normal after they have passed this phase (FAWC, 2007). Another disadvantages are the costs for the treatment of beak trimming that need to be paid. Nonetheless, it is seen as a minor expenditure, since they are easily recovered due to a better plumage conditions and in turn no problems with their thermoregulation and a lower feed intake after sexual maturity (Hester & Shea-Moore, 2003; Fiks- van Niekerk & de Jong, 2007).

In contrast to beak-trimmed hens, intact beak laying hens do not have the costs for the beak-trimming procedure. However, more extreme costs are involved in having an intact beak. First of al, hens with intact beaks have significantly more plumage damage, which lead to a high feed conversion ratio (up to 40%) due to thermoregulatory issues (Tauson et al., 2004; Staack et al., 2007; Lambton et al., 2010). Feed is about 60-70% of the costs involved in producing eggs, which make these costs a major disadvantage for the farmer that raises hens with intact beaks (Hester & Shea-Moore, 2003). On top of this, the low energy level of laying hens with intact beaks make it more difficult for them to transform their energy into egg mass. This will have consequences for the egg production (Nicol et al., 2013). Moreover, they have a significant increased mortality risk and consequently higher production losses compared to beak-trimmed hens (Tauson et al., 2004). These disadvantages are in line with results of Craig (1992), who have proven a significant better egg production in beak-trimmed laying hens compared to hens with intact beaks. Finally, it is expected that the pharmaceutical costs

for diseased hens due to feather pecking behaviors will be higher in hens with intact beaks compared to trimmed beaks (FAWC, 2007; Nicol et al., 2013). Generally, it is expected that the economic impact of hens with intact beaks will be higher compared to hens with trimmed beaks, but it highly depends on an outbreak of severe feather pecking behavior and the severity of it (FAWC, 2007; Nicol et al., 2013).

7. Attitude of influencing stakeholders towards beak trimming of laying hens

Legislation is a frequently used method to set standards for the welfare of laying hens. However, attitudes of consumers, poultry producers and retailers highly affect such legal decisions. As a result, they are crucial for success in terms of acceptance and compliance of the legal actions (Sandilands & Hocking, 2012). They need to accept the raise of hens with intact beaks in order to successfully reduce the number of hens with trimmed beaks. The number of researches done on the attitude of these stakeholders is limited. Generally, consumers are expected to be unaware of the current situation of laying hens. Exceptions are seen in consumers that highly care for animal welfare (Sandilands & Hocking, 2012). Additionally, an individual poultry farmer does not have enough power to make a change towards a more animal friendly production count, which makes it important to joint forces with other farmers in some sort of association. Consequently, non-governmental organizations like animal welfare groups, trade associations and animal protection groups represent the interest of the high caring consumers, poultry farmers and the animals themselves (Sandilands & Hocking, 2012). Several of these organizations are known and will be discussed in the next paragraph.

8. Status of beak trimming in the European Union

8.1 Introduction of tail docking in the European Union

Beak trimming of laying hens is currently allowed in the European Union (European Commission, 1999). However, some countries have forbidden this procedure in their national legislation. Other countries have several active national non-legislative initiatives that make efforts to reduce the number of beak trimming procedures in laying hens, like in Austria and the Netherlands (Fiks-van Niekerk & De Jong, 2007); "Managing untrimmed flocks," 2014; Rondeel, n.d.). The national non-legislative initiatives are found by means of an online web search. It is expected that more initiatives do exist, especially related to the retail sector. As a result, the current status on beak trimming procedures is highly divers across the European Union (Fiks-van Niekerk & De Jong, 2007); "Managing untrimmed flocks," 2014; Rondeel, n.d.). The following subparagraphs will give an overview of the status in several member states, which is based on the availability of information.

8.1.1. Austria

National legislation of Austria allows the procedure of beak trimming on pullets that are less then ten days old. However, pullets that will be used for the domestic market are not trimmed, which is about 95-99% of the total production (Fiks-van Niekerk & De Jong, 2007)). Austrian assurance schemes play a major role in this, because they do not allow hens with trimmed beaks and they cover nearly the entire Austrian egg market (Fromwald, 2010; "Managing untrimmed flocks," 2014). This non-legislative ban is initiated by Kontrollstelle für Artgemässe Nutztierhaltung (KAN), which is an Austrian animal welfare certification scheme (Fromwald, 2010). Farmers have to pay a fine if they do trim the beaks of hens. This money is used as a financial compensation for farmers that raise hens with intact beaks and experience difficulties due to feather pecking behaviors. Furthermore, scientific research was carried out and guidelines are provided to farmers on how to best manage laying hens with intact beaks (Watson, 2011; "Managing untrimmed flocks," 2014). According to Knut Niebuhr (an

Austrian scientists), since the assurance schemes have introduced the ban on beak trimming, it took about 12 years to raise nearly only laying hens with intact beaks. Moreover, it did not lead to major problems with the performance and livability of the laying hens (as cited in "Managing untrimmed flocks," 2014).

Consequently, Austria is an example of the strong influence of animal welfare organizations on reducing a mutilation like beak trimming. Moreover, it shows the importance of giving farmers a confident feeling that it is possible to raise laying hens with intact beaks (Watson, 2011; "Managing untrimmed flocks," 2014). However, about 50% of the hens were already been raised with intact beaks before the assurance schemes raised their voice in 2000 (Watson, 2011). Furthermore, the egg production and the number of hens per farm is expected to be lower compared to countries like Germany and the Netherlands. This expectation is based upon the fact that Austria is a very small exporting country in terms of the worldwide export of poultry (1.0%) and eggs (0.21%) compared to Germany (25%; 7.4%) and the Netherlands (17%; 21%) (Simoes, n.d.-f,-g). These aspects have played a role in the success of the assurances schemes to reduce the number of beak trimming procedures in Austria (Watson, 2011; "Managing untrimmed flocks," 2014).

Not only is the KAN assurance scheme actively working on a reduction of beak trimming, but also Toni's Freilandeier has banned beak trimming of laying hens. This initiative uses eggs of free-range hens with intact beaks ("Toni's Freilandeier," 2015).

8.1.2. Belgium

National legislation does allow the procedure of beak trimming on laying hens only if evidence shows that intact beaks lead to serious welfare issues (Fiks- van Niekerk & de Jong, 2007). As a consequence, in practice nearly all hens are beak trimmed in Belgium (Fiks- van Niekerk & de Jong, 2007).

8.1.3. Denmark

National legislation allows beak trimming in the majority of the Danish poultry systems (cage, barn and free-range systems) (Niekerk et al., 2011). Beak trimming is forbidden in the organic poultry production, which has a market share of 18% (Larsen, 2014). According to Jørgen Nyberg Larsen, CEO of the Danish Poultry Council and of the Danish Egg Association, several actions have been taken to reduce the number of beak trimmed laying hens (Larsen, 2014). First of all, research projects on feather pecking behaviors have been and are still taking place (2013-2015). Secondly, a voluntary ban on beak trimming is agreed on by pig producers on beak trimming of cage hens (2013) and of barn and free-range hens (2014) (Larsen, 2014). It is important to mention that simple cage systems are no longer allowed in the European Union (Rodenburg et al., 2013). Enriched cages are most commonly used in Denmark (Larsen, 2014). The voluntary bans are successfully realized by means of selective breeding, litter materials and perches in poultry systems (Larsen, 2014). Additionally, the demand of free-range and organic eggs is increasing in Denmark (Larsen, 2014).

8.1.4. Finland and Sweden

The national legislations of Finland and Sweden have forbidden the procedure of beak trimming of laying hens (Fiks- van Niekerk & de Jong, 2007). As a consequence, national initiatives are not needed, because everybody is expected to comply with the general legislation. However, two Swedish labels Svenskt Sigill and KRAV (organic) exists, mainly to communicate to consumers that these products are of Swedish origin (KRAV, 2015; Svenskt Sigill, n.d.). Finally, it is interesting to mentioned that Sweden and Finland uses low numbers of brown breeds, which is a risk of cannibalistic behavior, and barn systems are frequently used in Sweden (Wageningen UR Livestock Research, 2010; Sandilands & Hocking, 2012).

8.1.5. France

The French national legislation does not have implemented more strict regulations in order to lower the number of beak trimming procedures compared to the European Union. No specific numbers are known, but it is suggested that nearly all of the laying hens have trimmed beaks in France (Fiks- van Niekerk & de Jong, 2007). However, several non-legislative initiatives (Nature&Progres and Label Rouge) make efforts to ban or reduce the number of beak trimmed laying hens (Nature&Progres, 2002; "Label Rouge," 2011).

8.1.6. Germany

Currently, the national legislation of Germany allows beak trimming of layinghens. The current number of beak trimming procedures is unknown in Germany, it is expected to be carried out by the majority of the laying hens (Fiks- van Niekerk & de Jong, 2007). However, several initiates and movements are seen towards a ban of this mutilation. A voluntary agreement is signed by the German minister of agriculture and the poultry sector to forbid the procedure of this mutilation on January 2016. On top of this, it will be forbidden to stock pullets with trimmed beaks from January 2017 onwards (Burkin, 2015; Clarke, 2015). Secondly, the Lower Saxony region in Germany will make it compulsory to stop beak trimming in 2016 (Deter, 2014; Linden, 2015). Currently, an initiative is active, a pilot, in this region that provide 250 farmers a premium, because they do not beak trim their laying hens (Linden, 2015). This stimulates egg farmers to behave in a more animal friendly way. Finally, several other initiatives exists that have taken efforts on reducing the number of beak trimming in Germany, for example the food labels Neuland, Bioland, "Was steht auf dem ei" and Tierschutzgepfruft ("KAT Guide for Laying Farms", 2013; "Bioland richtlinien," 2015; "Neuland," 2015; KAT, n.d).

8.1.7. Southern and Eastern Europe

Italy, Spain, Poland, Hungary and Czech Republic do not have any national regulation on beak trimming that is more strict than the legislation of the European Union (Fiks- van Niekerk & de Jong, 2007). Furthermore, the existence and number of non-legislative initiatives that forbid or work on reducing the procedure of beak trimming in these countries is unknown. For this reason, it is expected that these country, and other Eastern European countries, have high numbers of beak trimmed laying hens. These countries frequently used cages systems (Horne & Achterbosch 2008). However, these systems are no longer allowed (Rodenburg et al., 2013).

8.1.8. The Netherlands

In the Dutch conventional poultry production it is allowed to carry out beak trimming by means of the infrared-method on pullets younger than ten days (Dierenwelzijnsweb, 2013; de Haas et al., 2014). It is not allowed to beak trim hens in organic production, which is about 10% of the Dutch laying hens production ("Factsheet leghennen," 2015). Furthermore, the use of barn systems of laying hens is common (Horne & Achterbosch 2008; Wageningen UR Livestock Research, 2010). The national government and the poultry sector aims for a ban on beak trimming in the conventional production by 2018 (World Poultry, 2013; de Haas et al., 2014). Additionally, several Dutch non-legislative initiatives exit that aim the ban or reduce the number of beak trimming in laying hens, like: Rondeel and Beter Leven (3 star) ("Factsheet leghennen," 2015; Rondeel, n.d.). Finally, Dutch retailers, like Lidl, also work on a reduction of beak trimming in laying hens by introducing a label like: Beter Leven ("Lidl", 2015).

8.1.9. United Kingdom

Beak trimming is allowed on laying hens that are less than 10 days old, in order to prevent feather pecking and cannibalism in the United Kingdom. However, it is compulsory to use the infrared-method and experienced personnel (FAWC, 2007). The

British legislation does not allow the removal of more than one third of the beak and it is completely forbidden in organic production (EFSA, 2005; FAWC, 2007). Furthermore, the use of free-range systems is common in the United Kingdom (Horne & Achterbosch 2008; Wageningen UR Livestock Research, 2010). The former minister of agriculture, Jim Paince, has announced that the national government is willing to ban beak trimming in the conventional poultry production in the future, possibly in 2016 (Department for Environment, Food & Rural Affair, 2010; Watson, 2011). The Beak Trimming Action Group was asked to work on developing an action plan for a stop on beak trimming, recently they have pointed out that a stop in 2016 is too early (Department for Environment, Food & Rural Affair, 2010; "Government says No," 2015). Furthermore, several British initiatives make have already forbidden this mutilation from happening within their scheme, for example: Soil Association (organic) and RSPCA assured (Soil Association, 2009; RSPCA., n.d.-a; RSPCA., n.d.-b). Additionally, the Red tractor assured food standards has not, yet, forbidden this mutilation, but is carried out at a minimum level and a veterinarian need to approve the procedure ("Chicken standards", 2014). Finally, several retailers are actively working on introducing products of laying hens with intact beaks (e.g. Waitrose and Whole Foods market (organic) (Waitrose, n.d.; Whole Foods market., n.d.-a,-b).

8.2. Switzerland

Although, Switzerland is not part of the European Union, it is an interesting country to look at because they have banned beak trimming since 2001. For this reason, studying this country could give useful insights into how they succeeded in phasing out this mutilation. First of all, about 60% of the laying hens are white-feathered strains (F. Fröhlich, personal communication, May, 2008). Moreover, the majority has excess to outdoor areas and the indoor systems include distinct areas for specific functions (Häne et al., 2000; Jendral, 2005; F. Fröhlich, personal communication, May, 2008). The fourth characteristic of the Swiss poultry industry is that nearly all rearing pullets and laying hens have access to litter and perches (Huber-Eicher, 1999; Häne et al, 2000). These aspects are related to the major risk factors for feather pecking discussed paragraph 3, which suggest that Switzerland is able to raise hens with intact beaks with low numbers of feather pecking behaviors.

Appendix H Questionnaire: Surgical castration of male pigs

Table H-1. Results of surgical castration clustered in geographic regions

Geographic location			**Central Europe[1]**	**Northern Europe[2]**	**Mediterranean[3]**	**Scandinavia[4]**	**Eastern Europe[5]**
Total number			7	48	9	17	3
Significant reduction possible within 3-5 yrs (%)	Yes		66,65	61,63	75	48,6	0
	No		33,35	38,38	25	51,4	100
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	4,00	2,52	2,11	2,96	2,00
	Marketing initiatives by the pig sector	Mean*	4,63	4,45	4,21	4,15	2,25
	Marketing initiatives by the national retailers	Mean*	3,67	3,83	6,44	3,94	3,75
	Wholesale price increase by retailers	Mean*	3,42	5,38	4,81	4,44	4,50
	Actions set by non-governmental organizations	Mean*	6,67	5,80	6,81	5,47	8,50
	Subsidy programs of the national government to stimulate farmers	Mean*	4,71	5,26	3,52	4,57	4,75
	Educational programs for consumers	Mean*	6,42	6,37	6,23	6,43	6,50
	Educational programs for farmers	Mean*	6,04	6,08	5,36	6,49	6,00
	Influence of large multinational corporations	Mean*	6,59	6,24	6,58	6,99	8,50
	*Other**	Mean*	8,88	9,09	8,94	9,56	10,00
Country related obstacles	*Cultural aspects*	Mean**	3,00	1,60	1,44	2,18	3,00
	Restrictions imposed by specialty or regional products	Mean**	3,34	2,44	4,02	1,89	4,00
	Lack of consumer awareness	Mean**	3,92	3,32	3,00	3,88	3,75
	Lack of willingness to pay of consumers	Mean**	3,25	3,44	2,90	3,25	3,25
	Highly sensitive and low appreciation for boar taint	Mean**	4,25	3,43	3,73	3,69	4,75
	Lack of market	Mean**	4,84	3,45	2,25	3,46	5,00

	acceptance						
	Cooking habits	Mean**	4,17	2,95	2,36	2,29	4,50
	Lack of available land for pig production	Mean**	1,59	1,77	1,56	1,43	1,25
	Unsuitable weather conditions for pig production	Mean**	1,42	1,69	1,67	1,18	1,25
	Lack of acceptance in importing countries	Mean**	3,42	3,47	3,13	3,36	4,25
	Lack of political interest	Mean**	3,67	3,06	2,96	2,99	3,50
	*Other**	Mean**	2,67	2,27	1,47	2,22	4,50
Animal production related obstacles	*Feeding management*	Mean**	3,38	2,85	2,33	2,75	3,50
	Housing environment	Mean**	3,17	2,79	3,21	2,67	3,00
	Breed of pigs used	Mean**	3,46	3,29	3,08	2,72	2,50
	High stocking densities, low space allowance and or large group sizes	Mean**	3,17	3,38	3,58	2,96	3,50
	Group composition	Mean**	3,67	3,30	3,88	3,21	3,50
	Mixing of litters after weaning	Mean**	3,04	2,81	3,11	3,00	4,50
	Relatively outdated housing equipment	Mean**	2,75	2,63	2,90	2,67	2,00
	Insufficient or absence of enrichment materials	Mean**	3,29	3,14	3,50	2,89	3,50
	Poor hygiene	Mean**	2,84	2,74	3,21	3,07	2,50
	Frequent or unexpected changes	Mean**	2,59	2,66	3,19	2,74	3,50
	Unavailable and or insufficient detection methods	Mean**	3,79	3,51	3,48	3,56	4,00
	*Other**	Mean**	2,00	2,23	1,29	2,79	2,50

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1]Austria and France [2]Belgium, Germany, Netherlands and United Kingdom [3]Croatia, Italy, Portugal and Spain [4]Denmark, Finland and Sweden [5]Slovakia and Poland

*See tables H-2 till H-4 for explanation of the category "Other"

Table H-2. Results of surgical castration of the Central and Eastern European region

Geographic location			**Central Europe**		**Eastern European countries**	
Country			**Austria**	**France**	**Poland**	**Slovakia**
Total number			3	4	1	2
Significant reduction possible within 3-5 yrs (%)	Yes		33,30	100,00	0,00	0,00
	No		66,70	0,00	100,00	100,00
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	4,00	4,00	3,00	1,00
	Marketing initiatives by the pig sector	Mean*	5,00	4,25	2,00	2,50
	Marketing initiatives by the national retailers	Mean*	3,33	4,00	4,00	3,50
	Wholesale price increase by retailers	Mean*	3,33	3,50	1,00***	4,50
	Actions set by non-governmental organizations	Mean*	6,33	7,00	8,00	9,00
	Subsidy programs of the national government to stimulate farmers	Mean*	3,67	5,75	6,00	3,50
	Educational programs for consumer	Mean*	5,33	7,50	7,00	6,00
	Educational programs for farmer	Mean*	5,33	6,75	5,00	7,00
	Influence of large multinational corporations	Mean*	8,67	4,50	9,00	8,00
	Other[1]	Mean*	10,00	7,75*	10,00	10,00
Country related obstacles	*Cultural aspects*	Mean**	1,00	5,00	1,00	5,00
	Restrictions imposed by specialty or regional products	Mean**	2,67	4,00	4,00	4,00
	Lack of consumer awareness	Mean**	3,33	4,50	3,00	4,50
	Lack of willingness to pay of consumers	Mean**	4,00	2,50	4,00	2,50
	Highly sensitive and low appreciation for boar taint	Mean**	4,00	4,50	5,00	4,50
	Lack of market acceptance	Mean**	4,67	5,00	5,00	5,00
	Cooking habits	Mean**	3,33	5,00	4,00	5,00
	Lack of available land for pig production	Mean**	1,67	1,50	1,00	1,50
	Unsuitable weather conditions for pig production	Mean**	1,33	1,50	1,00	1,50
	Lack of acceptance in importing countries	Mean**	3,33	3,50	5,00	3,50
	Lack of political interest	Mean**	3,33	4,00	4,00	3,00
	Other[2]	Mean**	2,33*	3.00	5,00**	4,00***
Animal production related obstacles	*Feeding management*	Mean**	4,00	2,75	4,00	3,00
	Housing environment	Mean**	3,33	3,00	3,00	3,00
	Breed of pigs used	Mean**	3,67	3,25	4,00	1,00
	High stocking densities, low space allowance and	Mean**	3,33	3,00	4,00	3,00

	or large group sizes					
	Group composition	Mean**	4,33	3,00	4,00	3,00
	Mixing of litters after weaning	Mean**	3,33	2,75	4,00	5,00
	Relatively outdated housing equipment	Mean**	3,00	2,50	3,00	1,00
	Insufficient or absence of enrichment materials	Mean**	4,33	2,25	3,00	4,00
	Poor hygiene	Mean**	2,67	3,00	2,00	3,00
	Frequent or unexpected changes	Mean**	2,67	2,50	3,00	4,00
	Unavailable and or insufficient detection methods	Mean**	3,33	4,25	5,00	3,00
	Other[3]	Mean**	1,00	3,00	1,00	4,00*

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely
*** the same price for intact boars sold as fatteners to slaughterhouses as for gilts/castrates.
[1]*"better detection at the slaughterhouse [2]*"Products from non-castrated pigs are usually not accepted in abattoirs." **"lower price for intact boars sold as fatteners to slaughterhouses" ***" the use of hormonal castration" [3]*"hormonal castration"

Table H-3. Results of surgical castration of the Mediterranean countries

Geographic location			**Mediterranean countries**			
Country			**Croatia**	**Italy**	**Portugal**	**Spain**
Total number			1	4	1	3
Significant reduction possible within 3-5 yrs (%)	Yes		100,00	0,00	100,00	100,00
	No		0,00	100,00	0,00	0,00
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	1,00	3,75	2,00	1,67
	Marketing initiatives by the pig sector	Mean*	8,00	4,50	1,00	3,33
	Marketing initiatives by the national retailers	Mean*	9,00	4,75	7,00	5,00
	Wholesale price increase by retailers	Mean*	5,00	5,25	4,00	5,00
	Actions set by non-governmental organizations	Mean*	7,00	8,25	5,00	7,00
	Subsidy programs of the national government to stimulate farmers	Mean*	2,00	3,75	3,00	5,33
	Educational programs for consumer	Mean*	6,00	7,25	6,00	5,67
	Educational programs for farmers	Mean*	4,00	3,75	8,00	5,67
	Influence of large multinational corporations	Mean*	3,00	8,00	9,00	6,33
	Other[1]	Mean*	10,00	5,75*	10,00	10,00
Country related obstacles	*Cultural aspects*	Mean**	1,00	1,75	1,00	2,00
	Restrictions imposed by specialty or regional products	Mean**	2,00	4,75	5,00	4,33
	Lack of consumer awareness	Mean**	3,00	3,00	2,00	4,00
	Lack of willingness to pay of consumers	Mean**	2,00	3,25	2,00	4,33
	Highly sensitive and low appreciation for boar taint	Mean**	2,00	4,25	5,00	3,67
	Lack of market acceptance	Mean**	2,00	3,00	2,00	2,00
	Cooking habits	Mean**	1,00	3,75	2,00	2,67

	Lack of available land for pig production	Mean**	1,00	2,25	1,00	2,00
	Unsuitable weather conditions for pig production	Mean**	1,00	3,00	1,00	1,67
	Lack of acceptance in importing countries	Mean**	3,00	3,50	4,00	2,00
	Lack of political interest	Mean**	1,00	3,50	4,00	3,33
	Other	Mean**	5,00*	1,75**	1,00	1,67
Animal production related obstacles	*Feeding management*	Mean**	2,00	2,00	2,00	3,33
	Housing environment	Mean**	4,00	2,50	3,00	3,33
	Breed of pigs used	Mean**	2,00	3,00	4,00	3,33
	High stocking densities, low space allowance and or large group sizes	Mean**	5,00	3,00	2,00	4,33
	Group composition	Mean**	4,00	3,50	4,00	4,00
	Mixing of litters after weaning	Mean**	4,00	2,75	2,00	3,67
	Relatively outdated housing equipment	Mean**	3,00	2,25	4,00	2,33
	Insufficient or absence of enrichment materials	Mean**	4,00	3,00	3,00	4,00
	Poor hygiene	Mean**	4,00	2,50	3,00	3,33
	Frequent or unexpected changes	Mean**	4,00	2,75	3,00	3,00
	Unavailable and or insufficient detection methods	Mean**	3,00	3,25	4,00	3,67
	Other	Mean**	1,00	1,50	1,00	1,67

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1*]"For PDO productions is important to have really feasible alternatives" [2*]"it's cheaper not to do castration" [**]"quality of typical productions (DOP hams)"

Table H-4. Results of surgical castration of the Northern European and Scandinavian region

Geographic location			**Northern European countries**				**Scandinavian countries**		
Country			**Belgium**	**Germany**	**Nether-lands**	**United Kingdom**	**Denmark**	**Finland**	**Sweden**
Total number			5	13	20	10	8	3	6
Significant reduction possible within 3-5 yrs (%)	Yes		100,00	61,50	55,00	30,00	62,50	0,00	83,30
	No		0,00	38,50	45,00	70,00	37,50	100,00	16,70
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	1,80	3,23	3,25	1,80	3,88	4,00	1,00
	Marketing initiatives by the pig sector	Mean*	4,40	3,69	5,60	4,10	4,13	3,33	5,00
	Marketing initiatives by the national retailers	Mean*	3,40	3,77	3,65	4,50	4,00	3,33	4,50
	Wholesale price increase by retailers	Mean*	6,20	5,38	3,95	6,00	5,50	4,00	3,83
	Actions set by non-governmental organizations	Mean*	6,00	6,38	5,50	5,30	4,75	6,00	5,67
	Subsidy programs of the national government to stimulate farmers	Mean*	5,80	4,23	5,10	5,90	5,38	4,00	4,33
	Educational programs for consumer	Mean*	7,40	5,77	6,60	5,70	5,13	7,33	6,83
	Educational programs for farmers	Mean*	5,80	6,00	7,20	5,30	6,63	6,33	6,50
	Influence of large multinational corporations	Mean*	5,60	6,54	4,60	8,20	5,63	6,67	8,67

	Other[1]	Mean*	8,60	10,00	9,55*	8,20**	10,00	10,00	8,67***
Country related obstacles	*Cultural aspects*	Mean**	1,20	1,54	2,15	1,50	1,88	3,33	1,33
	Restrictions imposed by specialty or regional products	Mean**	1,80	2,69	3,25	2,00	2,00	2,00	1,67
	Lack of consumer awareness	Mean**	3,00	3,62	3,35	3,30	4,13	4,00	3,50
	Lack of willingness to pay of consumers	Mean**	3,80	3,92	3,55	2,50	3,75	3,33	2,67
	Highly sensitive and low appreciation for boar taint	Mean**	3,80	4,00	3,40	2,50	3,25	4,00	3,83
	Lack of market acceptance	Mean**	3,60	4,31	3,80	2,10	3,88	4,00	2,50
	Cooking habits	Mean**	3,40	3,54	2,55	2,30	2,88	2,00	2,00
	Lack of available land for pig production	Mean**	1,60	1,62	1,95	1,90	2,13	1,00	1,17
	Unsuitable weather conditions for pig production	Mean**	1,60	1,46	1,80	1,90	1,38	1,00	1,17
	Lack of acceptance in importing countries	Mean**	3,60	3,38	4,20	2,70	4,25	3,33	2,50
	Lack of political interest	Mean**	2,80	2,92	3,40	3,10	3,13	3,33	2,50
	Other[2]	Mean**	2,20	2,23*	2,55**	2,10***	2,00	3,00****	1,67
Animal production related obstacles	*Feeding management*	Mean**	2,40	3,38	3,10	2,50	3,25	2,67	2,33
	Housing environment	Mean**	2,00	3,31	3,15	2,70	3,00	2,67	2,33
	Breed of pigs used	Mean**	3,20	3,00	3,85	3,10	3,00	2,67	2,50
	High stocking densities, low space allowance and or large group sizes	Mean**	2,80	3,85	3,65	3,20	3,38	2,67	2,83
	Group composition	Mean**	2,80	3,46	3,55	3,40	3,13	3,00	3,50
	Mixing of litters after weaning	Mean**	2,60	2,69	3,05	2,90	3,50	2,67	2,83
	Relatively outdated housing equipment	Mean**	2,20	2,62	2,90	2,80	2,50	3,33	2,17
	Insufficient or absence of enrichment materials	Mean**	2,60	3,62	3,25	3,10	3,50	3,00	2,17
	Poor hygiene	Mean**	2,00	3,00	3,25	2,70	3,38	3,33	2,50
	Frequent or unexpected changes	Mean**	2,00	3,23	3,10	2,30	2,88	2,67	2,67
	Unavailable and or insufficient detection methods	Mean**	3,40	4,15	3,70	2,80	4,00	3,67	3,00
	Other[3]	Mean**	2,20	2,62*	2,30	1,80	2,88**	3,33***	2,17****

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1]*"grootste effect is druk vanuit afzetmarkt, dus vanuit Engeland en Duitsland. als daar castratie niet meer wordt geaccepteerd veranderd praktijk in NL meteen EU acceptance of male pigs should become the same as the acceptance for castrates" & "Het belangrijkste is dat de consument een hogere prijs gaat betalen voor ongecastreerd varkensvlees. Pas als dat gebeurd kunnen veehouders veranderingen doorvoeren. Nu verdienen de veehouders praktisch niets, dan is er ook geen ruimte voor innovatie" **"Pigs in UK are not castrated and I think farm assurance schemes played a role in that" ***"An agreement between all slaughterhouses not to accept pigs castrated without anesthesia (or castrated at all)" 2"*animal welfare problems in terms of agonistic and sexual behavior in boars" & "Lack of producers willingness to make a change (that will cost money)" **"veel mensen weten niet meer hoe men vlees moet bereiden. veel mensen kennen berengeur niet eens, worden er nooit mee geconfronteerd, dus van horen zeggen" ***"Castration is not widespread in UK production systems so there are no real obstacles in the UK" ****" Lack of experience with entire boar production and marketing/using products from entire boars" [3]*"Keeping sexes and groups separated during transportation and waiting for slaughtering" & "Transport and slaughter of entire males have to be adapted to decrease stress and aggression" & "costs of taint detection and loss of tainted meat" **"Systems and procedures to handle the more aggressive male pigs" & "the level of boar taint is too high in many farms" ***"high proportion of male finishers with boar taint" ****"It is possible to detect boar taint, but it is costly, and either the abattoir or the farmer must pay for the testing"

Table H-5. Housing management & Breed

Statements	Options	Central Europe		Eastern Europe		Mediterranean countries				Northern European countries					Scandinavian countries			Total (n)
		Austria	France	Poland	Slovakia	Croatia	Italy	Portugal	Spain	Belgium	Germany	Ireland	Nether-lands	United Kingdom	Denmark*	Finland	Sweden	
Total (n)		2	4	1	2	1	4	2	3	2	12	1	18	17	10	2	6	87
The most frequently used type of flooring in the housing system of slaughter pigs	Fully slatted floors	100,00	100,00	0,00	0,00	0,00	50,00	50,00	66,67	50,00	91,67	100,00	5,56	41,18	10,00	0,00	0,00	29
	Partly slatted floors	0,00	0,00	0,00	100,00	100,00	50,00	50,00	33,33	50,00	0,00	0,00	77,78	35,29	50,00	100,00	33,33	34
	Enriched flooring	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	5,56	23,53	10,00	0,00	33,33	3
	Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	10,00	0,00	0,00	8
	I do not know	0,00	0,00	100,00	0,00	0,00	0,00	0,00	0,00	0,00	8,33	0,00	11,11	0,00	20,00	0,00	33,33	13
Total (n)		3	4	1	2	1	4	1	3	5	13	0	20	10	8	3	6	84
The way male pigs are most frequently housed	Single-sex housing	0,00	0,00	0,00	0,00	0,00	50,00	100,00	33,33	20,00	53,85		15,00	10,00	12,50	0,00	0,00	17
	Mixed-sex housing	66,67	100,00	100,00	100,00	100,00	50,00	0,00	66,67	40,00	38,46		50,00	80,00	50,00	100,00	66,67	50
	I do not know	33,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	40,00	7,69		35,00	10,00	37,50	0,00	33,33	17
Total (n)		3	4	1	2	1	4	1	3	5	13	0	20	10	8	3	6	84
The most suitable alternative(s) for surgical pig castration	Immuno-castration	25,00	0,00	0,00	16,67	50,00	14,29	0,00	22,22	25,00	25,00		9,52	5,88	18,18	50,00	60,00	34
	Raising entire boars	0,00	11,11	33,30	0,00	50,00	0,00	0,00	22,22	8,33	4,17		4,76	23,53	4,55	0,00	0,00	13
	Raising entire boars and breeding for boar taint reduction	37,50	11,11	0,00	16,67	0,00	28,57	0,00	0,00	16,67	25,00		21,43	11,76	18,18	16,67	0,00	31
	Raising entire boars and more appropriate feeding and housing	12,50	22,22	33,30	16,67	0,00	0,00	0,00	11,11	8,33	29,17		19,05	11,76	13,64	16,67	0,00	28
	Raising entire boars and slaughtering at lower weights	0,00	11,11	0,00	33,33	0,00	14,29	50,00	0,00	16,67	12,50		16,67	29,41	9,09	0,00	10,00	25
	Raising entire boars and the use of (boar taint) detection methods	25,00	44,44	33,30	16,67	0,00	14,29	50,00	22,22	16,67	4,17		23,81	5,88	36,36	16,67	30,00	47
	I do not know	0,00	0,00	0,00	0,00	0,00	28,57	0,00	22,22	8,33	0,00		4,76	11,76	0,00	0,00	0,00	9

* A combination of fully, partly and concrete (1/3 of each)

Table H-6. Results surgical castration of the professions

Castration & Type of professions	Scientific researcher	Vet/Veterinary medicine	Policy officer /advisor	Farmer	Student	Employed in a slaughterhouse	NGOs	Others
Total (n)	47	11	7	1	6	1	7	4
Significant reduction possible within 3-5 yrs? (%)								
Yes	59,60	45,00	57,10	100,00	67,00	100,00	42,90	25,00
No	40,40	55,00	49,90	0,00	33,00	0,00	57,10	75,00
Factors with greatest chance of success in reducing tail docking	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*
Legislation approach by the national government	2.66	2.27	4.43	2.00	2.83	9.00	3.57	1.50
Marketing initiatives by the pig sector	4.40	5.18	4.71	4.00	5.17	3.00	2.86	4.50
Marketing initiatives by the national retailers	3.91	4.36	3.71	5.00	5.17	1.00	4.00	4.50
Wholesale price increase by retailers	4.83	3.00	5.86	6.00	5.00	8.00	4.29	6.00
Actions set by non-governmental organizations	6.36	6.09	5.14	3.00	5.67	5.00	5.86	5.25
Subsidy programs of the national government to stimulate farmers	4.57	4.73	5.29	7.00	5.17	6.00	5.71	5.50
Educational programs for consumers	6.57	6.73	5.71	1.00	5.00	7.00	6.57	5.50
Educational programs for farmers	6.38	6.55	5.00	8.00	5.17	4.00	5.86	7.75
Influence of large multinational corporations	6.36	6.09	5.14	9.00	5.83	2.00	8.86	6.75
Other	8.94	10.00	10.00	10.00	10.00	10.00	7.43	7.75
* Mean: 1, most successful to 10, least successful								
Country related obstacles	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*
Cultural aspects	1.74	2.09	2.00	1.00	1.50	1.00	1.57	3.00
Restrictions imposed by specialty or regional products	2.66	3.09	2.57	1.00	1.83	5.00	3.57	3.25
Lack of consumer awareness	3.40	3.73	3.86	5.00	3.83	3.00	3.29	3.25
Lack of willingness to pay of consumers	3.55	3.73	2.86	4.00	3.83	2.00	3.29	2.50
Highly sensitive and low appreciation for boar taint	3.64	3.82	2.71	3.00	3.50	3.00	4.29	3.50
Lack of market acceptance	3.51	3.27	3.14	1.00	3.17	4.00	4.43	3.50
Cooking habits	2.87	2.73	2.29	3.00	2.83	3.00	3.71	3.50
Lack of available land for pig production	1.66	1.91	1.29	4.00	2.00	1.00	1.71	2.50
Unsuitable weather conditions for pig production	1.55	1.91	1.29	1.00	1.83	1.00	1.71	2.25
Lack of acceptance in importing countries	3.51	3.55	3.57	1.00	3.67	4.00	4.00	2.50
Lack of political interest	3.15	3.45	2.57	4.00	3.67	4.00	3.00	2.75
Other	2.23	2.18	2.29	3.00	2.33	1.00	3.29	2.75
**Mean: 1 very unlikely to 5 very likely								
Animal production related obstacles	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*
Feeding management	2.55	3.55	2.71	4.00	2.83	5.00	3.71	4.00
Housing environment	2.53	3.64	3.00	1.00	3.67	4.00	3.57	3.75
Breed of pigs used	3.02	3.91	3.14	3.00	3.50	2.00	3.14	3.25
High stocking densities, low space allowance and or large group sizes	3.11	4.18	3.29	4.00	3.50	2.00	3.71	4.25
Group composition	3.34	3.82	3.00	4.00	3.17	4.00	4.00	3.25
Mixing of litters after weaning	2.96	3.27	2.86	4.00	2.67	3.00	3.00	3.75
Relatively outdated housing equipment	2.53	2.91	2.71	1.00	3.17	2.00	2.86	2.25
Insufficient or absence of enrichment materials	3.04	3.55	3.29	4.00	3.83	2.00	3.00	3.75
Poor hygiene	2.68	3.45	3.29	3.00	3.33	2.00	3.29	3.25
Frequent or unexpected changes	2.70	3.18	2.86	1.00	2.83	4.00	3.29	3.25
Unavailable and or insufficient detection methods	3.72	3.36	3.71	1.00	3.17	4.00	4.29	2.75
Other	2.32	2.09	1.71	3.00	2.17	1.00	2.86	2.75
**Mean: 1 very unlikely to 5 very likely								

Table H-7. Results surgical castration of the genders

Castration & gender		Female	Male
Total (n)		49	35
Significant reduction possible within 3-5 yrs (%)	Yes	53	60
	No	47	40
		Mean*	Mean*
Factors with greatest chance of success in reducing tail docking	Legislation approach by the national government	3.00	2.66
	Marketing initiatives by the pig sector	4.51	4.34
	Marketing initiatives by the national retailers	4.43	3.54
	Wholesale price increase by retailers	4.84	4.63
	Actions set by non-governmental organizations	5.88	6.23
	Subsidy programs of the national government to stimulate farmers	4.80	5.00
	Educational programs for consumers	6.04	6.66
	Educational programs for farmers	6.16	6.29
	Influence of large multinational corporations	6.92	5.66
	Other	8,43	10.00
* Mean value: 1, most successful, 10 least successful			
		Mean**	Mean**
Country related obstacles	Cultural aspects	1.84	1.80
	Restrictions imposed by specialty or regional products	2.63	2.94
	Lack of consumer awareness	3.59	3.40
	Lack of willingness to pay of consumers	3.53	3.34
	Highly sensitive and low appreciation for boar taint	3.63	3.57
	Lack of market acceptance	3.61	3.29
	Cooking habits	3.14	2.57
	Lack of available land for pig production	1.88	1.57
	Unsuitable weather conditions for pig production	1.78	1.43
	Lack of acceptance in importing countries	3.43	3.60
	Lack of political interest	3.16	3.17
	Other	2.31	2.40
Animal production related obstacles	Feeding management	2.98	2.86
	Housing environment	2.94	2.94
	Breed of pigs used	3.10	3.31
	High stocking densities, low space allowance and or large group sizes	3.39	3.40
	Group composition	3.47	3.37
	Mixing of litters after weaning	3.04	3.00
	Relatively outdated housing equipment	2.80	2.40
	Insufficient or absence of enrichment materials	3.37	3.00
	Poor hygiene	2.92	3.00
	Frequent or unexpected changes	2.78	2.97
	Unavailable and or insufficient detection methods	3.80	3.34
	Other	2.35	2.20
**Mean value: 1 very unlikely, 5 very likely			

Appendix I Questionnaire: Tail docking of pigs

Table I-1. Tail docking results of the clustering regions

Geographic location			Northern Europe[1]	Eastern Europe[2]	Mediterranean[3]	Central Europe[4]	Northern Scandinavia[5]
Total number			60	3	10	6	8
Significant reduction possible within 3-5 yrs (%)	Yes		47,50	25,00	64,50	50,00	
	No		52,50	75,00	35,50	50,00	
Factors with greatest chance of success in reducing tail docking	*Legislation approach by the national government*	Mean*	2,77	1,50	2,81	5,75	1,09
	Marketing initiatives by the pig sector	Mean*	4,30	3,75	4,54	4,38	4,75
	Marketing initiatives by the national retailers	Mean*	4,38	4,75	5,19	3,25	4,17
	Wholesale price increase by retailers	Mean*	3,99	2,75	4,13	1,88	5,59
	Actions set by non-governmental organizations	Mean*	6,90	9,00	6,71	5,88	4,34
	Subsidy programs of the national government to stimulate farmers	Mean*	4,09	3,75	3,77	4,63	6,84
	Educational programs for farmers	Mean*	5,65	4,50	3,94	4,50	5,17
	Educational programs for consumer	Mean*	7,12	7,00	7,54	7,00	6,09
	Influence of large multinational corporations	Mean*	6,14	8,00	6,38	7,75	7,75
	*Other**	Mean*	9,67	10,00	10,00	10,00	10,00
Country related obstacles	*Cultural aspects*	Mean**	1,33	1,25	1,48	1,38	
	Lack of consumer awareness	Mean**	3,39	3,00	3,19	3,88	
	Lack of willingness to pay of consumers	Mean**	3,78	4,00	3,15	4,25	
	Lack of available land for pig production	Mean**	2,28	1,00	2,61	2,38	
	Unsuitable weather conditions for pig production	Mean**	2,23	1,75	2,69	2,00	
	Lack of political interest	Mean**	3,10	4,75	3,75	3,00	
	*Other**	Mean**	3,04	4.00	1,54	2,25	

Animal production related obstacles	*Floor type of housing system*	Mean**	4,03	4,00	3,23	4,00
	Feeding management	Mean**	3,75	3,50	3,61	3,63
	Insufficient or absence of enrichment materials	Mean**	4,33	4,75	4,31	4,38
	Housing environment	Mean**	3,80	4,00	3,79	3,88
	Breed of pigs used	Mean**	3,09	2,00	2,73	2,38
	High stocking densities, low space allowance and or large group sizes	Mean**	4,44	5,00	4,23	4,00
	Mixing of litters after weaning	Mean**	3,66	4,25	3,71	3,88
	Frequent or unexpected changes	Mean**	3,50	4,25	3,50	3,38
	Poor hygiene	Mean**	3,13	3,75	3,65	2,88
	*Other**	Mean**	2,22	1,00	1,54	1,50

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely
[1]Belgium, Denmark, Germany, Ireland, Netherlands and United Kingdom [2]Poland and Slovakia [3]Croatia, Italy, Portugal and Spain[4]Austria and France [5]Finland and Sweden
*See table (I-2 till I-4) for explanation of the category "Other"

Table I-2. Tail docking results of the Northern European region

Geographic location			**Northern European countries**					
Country			**Belgium**	**Denmark**	**Germany**	**Ireland**	**Netherlands**	**United Kingdom**
Total number			2	10	12	1	18	17
Significant reduction possible within 3-5 yrs (%)	Yes		50,00	40,00	75,00	0,00	61,00	59,00
	No		50,00	60,00	25,00	100,00	39,00	41,00
Factors with greatest chance of success in reducing tail docking	*Legislation approach by the national government*	Mean*	1,00	3,90	3,67	1,00	3,39	3,65
	Marketing initiatives by the pig sector	Mean*	2,50	4,60	3,33	5,00	5,17	5,18
	Marketing initiatives by the national retailers	Mean*	5,50	4,80	4,25	4,00	4,22	3,53
	Wholesale price increase by retailers	Mean*	4,50	4,00	4,33	3,00	3,94	4,18
	Actions set by non-governmental organizations	Mean*	8,00	5,70	6,25	9,00	5,89	6,53

	Subsidy programs of the national government to stimulate farmers	Mean*	5,00	5,00	3,67	2,00	4,83	4,06
	Educational programs for farmers	Mean*	5,00	5,00	6,08	6,00	5,83	6,00
	Educational programs for consumer	Mean*	9,00	5,80	7,33	7,00	7,28	6,29
	Influence of large multinational corporations	Mean*	4,50	7,10	6,17	8,00	4,94	6,12
	Other[1]	Mean*	10,00	9,10	9,92*	10,00	9,50**	9,47***
Country related obstacles	*Cultural aspects*	Mean**	1,00	1,50	1,08	1,00	1,78	1,59
	Lack of consumer awareness	Mean**	2,00	3,70	3,33	4,00	3,22	4,06
	Lack of willingness to pay of consumers	Mean**	3,00	3,80	3,92	4,00	4,11	3,82
	Lack of available land for pig production	Mean**	1,00	1,60	1,42	5,00	2,61	2,06
	Unsuitable weather conditions for pig production	Mean**	1,00	1,50	1,33	5,00	2,28	2,24
	Lack of political interest	Mean**	2,50	3,40	2,50	3,00	3,56	3,65
	Other[2]	Mean**	3,00*	3,10**	2,75***	4,00****	2,67*****	2,71******
Animal production related obstacles	*Floor type of housing system*	Mean**	4,00	3,80	3,58	5,00	4,11	3,71
	Feeding management	Mean**	4,50	3,60	4,00	3,00	4,06	3,35
	Insufficient or absence of enrichment materials	Mean**	4,50	4,50	4,08	4,00	4,44	4,47
	Housing environment	Mean**	4,00	4,00	3,67	3,00	4,06	4,06
	Breed of pigs used	Mean**	4,50	2,60	2,67	2,00	3,50	3,24
	High stocking densities, low space allowance and or large group sizes	Mean**	4,50	4,40	4,00	5,00	4,44	4,29
	Mixing of litters after weaning	Mean**	3,50	3,30	3,33	5,00	3,44	3,41
	Frequent or unexpected changes	Mean**	4,00	3,20	3,33	3,00	3,83	3,65
	Poor hygiene	Mean**	3,50	3,50	3,08	2,00	3,22	3,47
	Other[3]	Mean**	2,00	2,60*	2,42**	1,00	2,56***	2,76****

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely
1*"there is no ranking (except consumer education which I rank last), all of these are needed simultaneously" **"Market incentives for farmers to produce pigs with intact tails e.g. slaughterhouse payments partly based on the number of intact tails" & "als exporterende landen geen vlees meer afnemen van varkens die ge taildockt zijn" ***"Tighter assessment of legislation compliance by farm assurance schemes (this has made a difference in environmental enrichment legislation enforcement). This would also require a change in attitude/ understanding of the legislation by pig vets which we achieved through a webtool" 2*"too much tial biting in the conventional practices" ***"A large export of pig meat" & "Lack of available systems and procedures to reduce the need of tail docking" ***"Focusing on quantity and exports instead of quality and internal markets of the pig sector Federalism might hinder quick changes" & "current housing systems are hardly appropriate for keeping pigs with intact tails no long-term assurance of higher prices" ****"Lack of awareness that it's possible to rear long tailed pigs, by farmers" *****"Lack of interest/ability of pigs famers/pig industry in developing new systems for slaughter pigs due to very low market prices" & "risk sharing in the supply chain" & "Awareness among the pig farmers" & "Import from other countries makes it impossible to compete" &"People need to let inform them more what is in all the food" ******"Lack of initiative (funds for changing housing, more security that their products will be bought for a reasonable price) for farmers to try this more challenging way of farming" & "industry reluctance to change established practice" 3*"too many pigs in the barns is very likely to be an argument that farmers will go on tail docking because otherwise they fear tail biting" **"early weaning, transportation,esp. when combined with changing group composition, chemical use and mode of production in feed production, no straw- low fibre content of feed" & "Fresh-water supply" & "early weaning, all of the mentioned factors already in husbandry of breeding sows" ****"Lack of enforcement of existing legislation" & "varkenshouders hebben geen weet meer van staartbijten door de gangbare praktijk van staart'knippen'. daardoor denkt men dat het nodig is zonder dat men daadwerkelijk weet of het in hun bedrijf voorkomt" *****"A sudden decrease in enrichment of the environment, for example, suddenly removing straw" & "lack of a suitable environment and not enough or lack of manipulable materials".

Table I-3. Tail docking results of the Eastern European and Mediterranean regions

Geographic location			**Eastern European countries**		**Mediterranean countries**			
Country			**Slovakia**	**Poland**	**Croatia**	**Italy**	**Portugal**	**Spain**
Total number			2	1	1	4	2	3
Significant reduction possible within 3-5 yrs (%)	Yes		50,00	0,00	100,00	75,00	50,00	33,00
	No		50,00	100,00	0,00	25,00	50,00	67,00
Factors with greatest chance of success in reducing tail docking	*Legislation approach by the national government*	Mean*	1,00	2,00	1,00	3,25	5,00	2,00
	Marketing initiatives by the pig sector	Mean*	2,50	5,00	8,00	4,50	2,00	3,67
	Marketing initiatives by the national retailers	Mean*	3,50	6,00	5,00	5,25	5,50	5,00
	Wholesale price increase by retailers	Mean*	4,50	1,00	3,00	4,50	5,00	4,00
	Actions set by non-governmental organizations	Mean*	9,00	9,00	6,00	7,50	6,00	7,33
	Subsidy programs of the national government to stimulate farmers	Mean*	3,50	4,00	2,00	3,25	3,50	6,33
	Educational programs for farmers	Mean*	6,00	3,00	7,00	2,75	3,00	3,00
	Educational programs for consumer	Mean*	7,00	7,00	9,00	6,50	8,00	6,67
	Influence of large multinational corporations	Mean*	8,00	8,00	4,00	7,50	7,00	7,00
	Other	Mean*	10,00	10,00	10,00	10,00	10,00	10,00
Country related	*Cultural aspects*	Mean**	1,50	1,00	1,00	1,25	2,00	1,67

obstacles	*Lack of consumer awareness*	Mean**	2,00	4,00	2,00	3,25	3,50	4,00
	Lack of willingness to pay of consumers	Mean**	3,00	5,00	1,00	3,25	4,00	4,33
	Lack of available land for pig production	Mean**	1,00	1,00	1,00	2,75	3,00	3,67
	Unsuitable weather conditions for pig production	Mean**	2,50	1,00	4,00	2,25	1,50	3,00
	Lack of political interest	Mean**	4,50	5,00	4,00	3,50	3,50	4,00
	Other[1]	Mean**	4,00*	4,00**	1,00	1,50	2,00	1,67
Animal production related obstacles	*Floor type of housing system*	Mean**	4,00	4,00	2,00	3,25	4,00	3,67
	Feeding management	Mean**	4,00	3,00	4,00	3,25	2,50	4,67
	Insufficient or absence of enrichment materials	Mean**	4,50	5,00	4,00	4,25	4,00	5,00
	Housing environment	Mean**	4,00	4,00	4,00	3,50	4,00	3,67
	Breed of pigs used	Mean**	2,00	2,00	1,00	3,75	3,50	2,67
	High stocking densities, low space allowance and or large group sizes	Mean**	5,00	5,00	4,00	4,25	4,00	4,67
	Mixing of litters after weaning	Mean**	4,50	4,00	4,00	3,50	4,00	3,33
	Frequent or unexpected changes	Mean**	4,50	4,00	4,00	3,50	3,50	3,00
	Poor hygiene	Mean**	3,50	4,00	4,00	3,25	4,00	3,33
	Other[2]	Mean**	3,50*	1,00	1,00	1,50	2,00	1,67

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1]*"economical aspects" **"standard procedure, breeders are used to do it because it reduces aggressive behavior" [2]*"mineral feed"

Table I-4. Tail docking results Central and Northern Scandinavian regions

Geographic location			**Central Europe**		**Northern Scandinavian countries**	
Country			**Austria**	**France**	**Finland**	**Sweden**
Total number			2	4	2	6
Significant reduction possible within 3-5 yrs (%)	Yes		50,00	50,00		
	No		50,00	50,00		
Factors with greatest chance of success in reducing tail docking	*Legislation approach by the national government*	Mean*	8,00	3,50	1,00	1,17
	Marketing initiatives by the pig sector	Mean*	4,00	4,75	5,50	4,00
	Marketing initiatives by the national retailers	Mean*	3,00	3,50	4,50	3,83
	Wholesale price increase by retailers	Mean*	1,50	2,25	7,00	4,17
	Actions set by non-governmental organizations	Mean*	5,00	6,75	3,00	5,67
	Subsidy programs of the national government to stimulate farmers	Mean*	5,00	4,25	8,00	5,67
	Educational programs for farmers	Mean*	3,50	5,50	4,00	6,33
	Educational programs for consumer	Mean*	6,00	8,00	5,00	7,17
	Influence of large multinational corporations	Mean*	9,00	6,50	7,00	8,50
	Other[1]	Mean*	10,00	10,00	10,00	8,50*
Country related obstacles	*Cultural aspects*	Mean**	1,00	1,75		
	Lack of consumer awareness	Mean**	4,00	3,75		
	Lack of willingness to pay of consumers	Mean**	4,50	4,00		
	Lack of available land for pig production	Mean**	2,00	2,75		
	Unsuitable weather conditions for pig production	Mean**	1,50	2,50		
	Lack of political interest	Mean**	2,50	3,50		
	Other[2]	Mean**	1,00	3,50*		
Animal production related obstacles	*Floor type of housing system*	Mean**	4,00	4,00		
	Feeding management	Mean**	3,50	3,75		
	Insufficient or absence of enrichment materials	Mean**	4,00	4,75		
	Housing environment	Mean**	3,50	4,25		
	Breed of pigs used	Mean**	2,50	2,25		
	High stocking densities, low space allowance and or large group sizes	Mean**	4,00	4,00		
	Mixing of litters after weaning	Mean**	4,00	3,75		
	Frequent or unexpected changes	Mean**	3,50	3,25		
	Poor hygiene	Mean**	3,00	2,75		
	Other	Mean**	1,00	2,00		

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1*]"Tail docking is already prohibited." 2*slatted floor" 3*

Table I-5. Results tail docking of the professions

Tail docking & type of profession	Scientific researcher	Vet/Veterinary medicine	Policy officer /advisor	Farmer	Student	Employed in a slaughterhouse	NGO	Others
Total (n)	45	14	7	1	6	1	8	5
Significant reduction possible within 3-5 yrs? (%)								
Yes	53,30	57,00	42,90	100,00	83,00	100,00	37,50	80,00
No	46,70	43,00	57,10	0,00	17,00	0,00	62,50	20,00
Factors with greatest chance of success in reducing tail docking	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*
Legislation approach by the national government	2.73	3.50	4.71	4.00	2.67	8.00	3.88	3.60
Marketing initiatives by the pig sector	4.49	5.36	4.29	6.00	4.33	1.00	4.00	3.60
Marketing initiatives by the national retailers	4.31	4.50	3.43	1.00	4.33	5.00	4.25	4.00
Wholesale price increase by retailers	4.00	4.14	3.43	5.00	5.33	2.00	4.13	3.20
Actions set by non-governmental organizations	6.27	6.14	6.14	3.00	6.50	7.00	6.13	7.80
Subsidy programs of the national government to stimulate farmers	4.60	4.07	4.43	7.00	4.00	6.00	4.25	5.00
Educational programs for farmers	4.98	5.86	7.14	8.00	5.67	3.00	4.88	5.80
Educational programs for consumers	7.16	6.79	7.29	2.00	6.33	9.00	6.00	6.60
Influence of large multinational corporations	6.69	5.93	5.43	9.00	5.83	4.00	7.50	5.40
Other	9.78	8.71	8.71	10.00	10.00	10.00	10.00	10.00
* Mean: 1, most successful to 10, least successful								
Country related obstacles	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**
Cultural aspects	1.36	1.71	1.29	2.00	1.50	1.00	1.75	2.20
Lack of consumer awareness	3.24	3.57	3.00	5.00	3.67	3.00	4.00	3.80
Lack of willingness to pay of consumers	3.67	3.71	3.71	2.00	4.50	4.00	4.13	3.40
Lack of available land for pig production	2.07	3.00	1.29	1.00	1.83	1.00	2.00	1.80
Unsuitable weather conditions for pig production	2.02	2.21	3.00	1.00	1.67	1.00	1.88	1.60
Lack of political interest	3.16	3.71	2.57	5.00	3.33	1.00	3.38	4.20
Other	2.71	2.29	1.57	3.00	2.50	1.00	3.13	3.40
**Mean: 1 very unlikely to 5 very likely								
Animal production related obstacles	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**
Floor type of housing system	3.67	4.00	3.57	1.00	3.67	1.00	3.50	3.80
Feeding management	3.51	3.64	3.43	1.00	4.33	4.00	3.75	3.20
Insufficient or absence of enrichment materials	4.09	4.21	4.14	5.00	4.50	4.00	4.13	4.60
Housing environment	3.51	4.00	4.00	5.00	4.00	4.00	4.13	3.40
Breed of pigs used	2.89	3.00	3.14	1.00	3.17	3.00	2.88	3.00
High stocking densities, low space allowance and or large group sizes	4.02	4.29	4.29	5.00	4.33	2.00	4.00	4.60
Mixing of litters after weaning	3.49	3.36	3.14	1.00	3.17	3.00	3.63	3.20
Frequent or unexpected changes	3.20	3.57	4.14	1.00	3.83	5.00	3.75	4.00
Poor hygiene	3.02	3.29	3.57	3.00	3.67	3.00	3.50	3.40
Other	2.39	2.36	1.29	3.00	2.00	1.00	2.75	3.00
**Mean: 1 very unlikely to 5 very likely								

Table I-6. Tail docking results of the genders

Tail docking & gender		Female	Male
Total (n)		52	35
Significant reduction possible within 3-5 yrs (%)	Yes	59,6	51
	No	40,4	49
		Mean*	Mean*
Factors with greatest chance of success in reducing tail docking	Legislation approach by the national government	3.35	3.09
	Marketing initiatives by the pig sector	4.54	4.40
	Marketing initiatives by the national retailers	4.31	4.09
	Wholesale price increase by retailers	3.81	4.34
	Actions set by non-governmental organizations	6.33	6.26
	Subsidy programs of the national government to stimulate farmers	4.08	5.11
	Educational programs for farmers	5.56	5.14
	Educational programs for consumers	6.81	6.97
	Influence of large multinational corporations	6.60	6.11
	Other	9.00	9.49
* Mean value: 1, most successful, 10 least successful			
		Mean**	Mean**
Country related obstacles	Cultural aspects	1.50	1.51
	Lack of consumer awareness	3.62	3.14
	Lack of willingness to pay of consumers	3.83	3.63
	Lack of available land for pig production	2.10	2.09
	Unsuitable weather conditions for pig production	1.90	2.26
	Lack of political interest	3.31	3.26
	Other	2.79	2.31
Animal production related obstacles	Floor type of housing system	3.88	3.29
	Feeding management	3.63	3.46
	Insufficient or absence of enrichment materials	4.35	3.94
	Housing environment	3.67	3.83
	Breed of pigs used	3.02	2.80
	High stocking densities, low space allowance and or large group sizes	4.17	4.06
	Mixing of litters after weaning	3.54	3.14
	Frequent or unexpected changes	3.42	3.54
	Poor hygiene	3.25	3.17
	Other	2.31	2.31
**Mean value: 1 very unlikely, 5 very likely			

Appendix J Questionnaire: Beak trimming of laying hens

Table J-1. Beak trimming results of the cluster regions

Geographic cluster or country			**Northern Europe[1]**	**Mediterranean[2]**	**Central Europe[3]**	**Eastern Europe[4]**	**Austria**	**Denmark**	**Finland**	**Sweden**
Total number			50	4	3	1	1	7	1	6
Significant reduction possible within 3-5 yrs (%)	Yes		68,93	33,33	0,00	0,00				
	No		31,08	66,67	100,00	100,00				
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	3,27	1,33	3,67	1,00	8,00	3,29	1,00	2,00
	Marketing initiatives by the poultry sector	Mean*	5,34	3,50	5,00	3,00	1,00	2,57	6,00	4,14
	Marketing initiatives by the national retailers	Mean*	3,44	4,17	4,00	4,00	2,00	3,86	7,00	3,83
	Actions set by non-governmental organizations	Mean*	5,57	7,00	7,00	7,00	3,00	4,29	2,00	4,83
	Subsidy programs of the national government to stimulate farmers	Mean*	4,40	5,67	3,00	2,00	7,00	5,14	8,00	4,83
	Educational programs for consumer	Mean*	6,69	6,50	6,00	9,00	6,00	5,86	3,00	6,67
	Educational programs for farmers	Mean*	5,84	4,67	6,00	6,00	4,00	5,14	4,00	5,33
	Wholesale price increase by retailers	Mean*	4,73	6,50	7,33	5,00	5,00	6,57	9,00	6,67
	Influence of large multinational corporations	Mean*	6,16	5,67	3,00	8,00	9,00	8,29	5,00	8,00
	*Other**	Mean*	9,57	10,00	10,00	10,00	10,00	10,00	10,00	8,67*
Country related obstacles	*Cultural aspects*	Mean**	1,59	2,17	1,33	1,00				
	Lack of consumer awareness	Mean**	3,19	3,67	4,33	3,00				
	Lack of willingness to pay of consumers	Mean**	3,58	4,33	4,00	4,00				
	Lack of available land for poultry production	Mean**	2,24	3,17	1,67	1,00				
	Unsuitable weather conditions for poultry production	Mean**	2,08	3,00	1,67	1,00				

	Lack of political interest	Mean**	2,84	4,33	3,33	4,00	
	*Other**	Mean**	3,00	1,33	4,00	5,00	
Animal production related obstacles	*Housing systems*	Mean**	3,81	4,50	4,33	3,00	
	Feeding management	Mean**	3,58	3,33	3,67	5,00	
	Housing environment	Mean**	3,70	3,33	4,00	5,00	
	Breed of laying hens used	Mean**	3,70	2,67	4,00	4,00	
	High stocking densities and large group sizes	Mean**	3,92	4,50	4,00	5,00	
	Insufficient or absence of litter materials	Mean**	3,78	4,17	4,00	5,00	
	Frequent or unexpected changes	Mean**	3,60	2,33	4,00	4,00	
	Poor hygiene	Mean**	2,66	2,67	3,33	5,00	
	*Other**	Mean**	2,79	1,33	1,67	4,00	

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely
[1]Belgium, Germany, Netherlands and United Kingdom [2]France [3]Italy, Portugal and Spain [4]Slovakia
*See table J-2 till J-4 for explanation of the category "Other"

Table J-2. Beak trimming results of the Northern European region

Geographic location			***Northern European Countries***			
Country			**Belgium**	**Germany**	**Netherlands**	**United Kingdom**
Total number			5	7	17	21
Significant reduction possible within 3-5 yrs (%)	Yes		60,00	85,70	82,40	47,60
	No		40,00	14,30	17,60	52,40
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	4,20	2,29	2,35	4,24
	Marketing initiatives by the poultry sector	Mean*	5,60	5,14	5,82	4,81
	Marketing initiatives by the national retailers	Mean*	4,00	1,71	4,06	4,00
	Actions set by non-governmental organizations	Mean*	5,40	5,43	5,76	5,67
	Subsidy programs of the national government to stimulate farmers	Mean*	4,40	5,00	3,94	4,24
	Educational programs for consumer	Mean*	6,80	6,86	6,76	6,33
	Educational programs for farmers	Mean*	5,60	5,86	6,59	5,29
	Wholesale price increase by retailers	Mean*	4,20	5,57	4,82	4,33
	Influence of large multinational corporations	Mean*	4,80	7,14	5,35	7,33
	Other[1]	Mean*	10,00	10,00	9,53*	8,76**
Country related obstacles	*Cultural aspects*	Mean**	1,60	1,00	2,00	1,76
	Lack of consumer awareness	Mean**	3,00	3,29	3,18	3,29
	Lack of willingness to pay of consumers	Mean**	3,20	3,57	3,82	3,71
	Lack of available land for poultry production	Mean**	2,60	1,57	2,65	2,14
	Unsuitable weather conditions for poultry production	Mean**	2,20	1,57	2,29	2,24
	Lack of political interest	Mean**	2,20	2,86	3,12	3,19
	Other[2]	Mean**	4,00*	2,57**	2,53***	2,90****

Animal production related obstacles	*Housing systems*	Mean**	3,60	3,71	3,94	4,00
	Feeding management	Mean**	3,60	3,86	3,35	3,52
	Housing environment	Mean**	3,80	3,86	3,53	3,62
	Breed of laying hens used	Mean**	3,20	3,86	3,53	4,19
	High stocking densities and large group sizes	Mean**	3,80	3,86	4,12	3,90
	Insufficient or absence of litter materials	Mean**	3,60	4,00	3,82	3,71
	Frequent or unexpected changes	Mean**	3,60	3,43	3,59	3,76
	Poor hygiene	Mean**	2,80	3,43	0,97	3,43
	Other[3]	Mean**	3,20*	3,14**	2,37***	2,43****

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely

[1]*"Market driven demand for eggs from hens with intact beaks" & "veel export van eieren dus druk van export landen" **"Knowledge transfer from scientific research and practical experience on management interventions to reduce the likelihood that hens will peck and cause injurious pecking" & "These are all marketing /political/ legal actions. We need actions that better enable you to keep birds untrimmed. Better breeds, better management policies, not political initiatives. Only being able to keep birds with good welfare should be the reason to change the production system" [2]*the extra costs and investments that need to be made by the farmers" **"current housing and management conditions lack of long-term assurance of higher prices" & "Factors that could counteract the approach for a ban. E.g. paying for amount of eggs instead of the weight. Thus, farmers will not adapt due to selling prices" ***"Lack of want for the farmers to change" & "Lack of integration within the poultry production chain that prevents farmers that raise chickens to feel responsible for the problem of pecking laying hens" & "Lack of market demand for eggs from hens with intact beaks" ****"Perceived financial consequences in enforcing beak trimming" & "producer fear of cannibalism affecting there flocks, which is both financially damaging" & "Welfare impacts on hens from injurious pecking" & "Attitude problem in the industry. Beak trimming does not stops feather pecking. It just reduces the damage caused by a feather pecking outbreak. Until industry start tackling the underlying causes of feather pecking" [3]*"All are actually likely of very likely, however there are enough cases in which no feather pecking occurred with intact beaks in all sort of housing systems, feeds, management procedures, etc. The hens need proper rearing period and good management and distraction during the laying cycle management" **"all of these during rearing lack of welfare monitoring during rearing and laying period insufficient matching of rearing and laying conditions" & "absence of raw material (straw, Luzern, silage ect.) Sand, grit stones" ***"Quality and level of light (absence of UV, spectrum, etc) & "Rearing system" ****"Rearing" & "Most free range producers have converted from caged systems. There mind set is intensive production"

Table J-3. Beak trimming results of the Central&Mediterranean & Eastern European regions

Geographic location			**Central Europe**	**Mediterranean countries**			**Eastern Europe**
Country			**France**	**Italy**	**Portugal**	**Spain**	**Slovakia**
Total number			3	2	1	1	1
Significant reduction possible within 3-5 yrs (%)	Yes		0,00	0,00	100,00	0,00	100,00
	No		100,00	100,00	0,00	100,00	0,00
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	3,67	1,00	1,00	2,00	1,00
	Marketing initiatives by the poultry sector	Mean*	5,00	5,50	2,00	3,00	3,00
	Marketing initiatives by the national retailers	Mean*	4,00	5,50	3,00	4,00	4,00
	Actions set by non-governmental organizations	Mean*	7,00	8,00	5,00	8,00	7,00
	Subsidy programs of the national government to stimulate farmers	Mean*	3,00	2,00	6,00	9,00	2,00
	Educational programs for consumer	Mean*	6,00	5,50	8,00	6,00	9,00
	Educational programs for farmers	Mean*	6,00	3,00	4,00	7,00	6,00
	Wholesale price increase by retailers	Mean*	7,33	5,50	9,00	5,00	5,00
	Influence of large multinational corporations	Mean*	3,00	9,00	7,00	1,00	8,00
	Other	Mean*	10,00	10,00	10,00	10,00	10,00
Country related obstacles	*Cultural aspects*	Mean**	1,33	1,50	1,00	4,00	1,00
	Lack of consumer awareness	Mean**	4,33	4,00	3,00	4,00	3,00
	Lack of willingness to pay of consumers	Mean**	4,00	4,00	4,00	5,00	4,00
	Lack of available land for poultry production	Mean**	1,67	2,50	2,00	5,00	1,00
	Unsuitable weather conditions for poultry production	Mean**	1,67	2,00	2,00	5,00	1,00
	Lack of political interest	Mean**	3,33	4,00	4,00	5,00	4,00
	Other[1]	Mean**	4,00*	2,00	1,00	1,00	5,00**
	Housing systems	Mean**	4,33	3,50	5,00	5,00	3,00

Animal production related obstacles	*Feeding management*	Mean**	3,67	4,00	1,00	5,00	5,00
	Housing environment	Mean**	4,00	3,00	2,00	5,00	5,00
	Breed of laying hens used	Mean**	4,00	4,00	1,00	3,00	4,00
	High stocking densities and large group sizes	Mean**	4,00	3,50	5,00	5,00	5,00
	Insufficient or absence of litter materials	Mean**	4,00	3,50	4,00	5,00	5,00
	Frequent or unexpected changes	Mean**	4,00	3,00	2,00	2,00	4,00
	Poor hygiene	Mean**	3,33	3,00	3,00	2,00	5,00
	Other[2]	Mean**	1,67	2,00	1,00	1,00	4,00*

* Mean: 1, most successful to 10, least successful **Mean: 1 very unlikely to 5 very likely
[1]*"lack of farmer awareness about the other possibilities without beak trimming" & "Lack of scientific data showing that it is possible to do without any damaging consequences for birds and farmers" **"Economy" [2]*"lightening, mineral feed"

Table J-4. Beak trimming results of countries that have already forbidden the procedure

Geographic location			**Central and Northern European**		**Scandinavian countries**	
Country			**Austria**	**Denmark**	**Finland**	**Sweden**
Total number			1	7	1	6
Factors with greatest chance of success in reducing beak trimming	*Legislation approach by the national government*	Mean*	8,00	3,29	1,00	2,00
	Marketing initiatives by the poultry sector	Mean*	1,00	2,57	6,00	4,14
	Marketing initiatives by the national retailers	Mean*	2,00	3,86	7,00	3,83
	Actions set by non-governmental organizations	Mean*	3,00	4,29	2,00	4,83
	Subsidy programs of the national government to stimulate farmers	Mean*	7,00	5,14	8,00	4,83
	Educational programs for consumer	Mean*	6,00	5,86	3,00	6,67
	Educational programs for farmers	Mean*	4,00	5,14	4,00	5,33
	Wholesale price increase by retailers	Mean*	5,00	6,57	9,00	6,67
	Influence of large multinational corporations	Mean*	9,00	8,29	5,00	8,00
	Other	Mean*	10,00	10,00	10,00	8,67*

* Mean: 1, most successful to 10, least successful
* "We do not beak trim"

Table J-5. Results Housing management and breed relating to laying hens

Statements	Options	Central Europe		Eastern Europe	Mediterranean countries			Northern European countries					Scandinavian countries		Total (n)
		Austria	France	Slovakia	Italy	Portugal	Spain	Belgium	Denmark	Germany	Netherlands	United Kingdom	Finland	Sweden	
Total (n)		1	3	1	2*	1	1	5*	7*	7*	17*	21*	1	6*	73
The most frequently used housing system of laying hens	Conventional cage systems	0,00	0,00	0,00	0,00	0,00	100,00	10,00	0,00	0,00	5,00	2,56	0,00	0,00	4
	Furnished cage system	0,00	100,00	100,00	67,00	100,00	0,00	40,00	38,46	0,00	0,00	28,21	100,00	11,11	29
	Aviary systems	100,00	0,00	0,00	0,00	0,00	0,00	20,00	15,38	55,56	40,00	10,26	0,00	22,22	24
	Free-range systems	0,00	0,00	0,00	0,00	0,00	0,00	10,00	23,08	22,22	15,00	43,59	0,00	44,44	27
	Barn systems	0,00	0,00	0,00	33,00	0,00	0,00	20,00	15,38	22,22	20,00	12,82	0,00	22,22	17
	I do not know	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,69	0,00	20,00	2,56	0,00	0,00	6
The most frequently used breed of laying hens	Brown breeds	100,00	67,00	100,00	100,00	100,00	100,00	40,00	28,57	28,57	58,82	100,00	0,00	0,00	44
	White breeds	0,00	0,00	0,00	0,00	0,00	1,00	20,00	42,86	42,86	17,65	0,00	100,00	83,33	17
	I do not know	0,00	33,00	0,00	0,00	0,00	0,00	40,00	28,57	28,57	23,53	0,00	0,00	16,67	12

*Respondents have filled out the question more than once.

Table J-6. Results of beak trimming of the professions

Beak trimming & type of professions	Scientific researcher	Vet/Veterinary medicine	Policy officer /advisor	Farmer	Students	Employed in a slaughterhouse	NGOs	Others
Total (N)	37	12	5	5	6	1	3	4
Significant reduction possible within 3-5 yrs? (%)								
Yes	64,90	67,00	60,00	20,00	83,00	100,00	67,00	75,00
No	35,10	33,00	40,00	80,00	17,00	0,00	33,00	25,00
Factors with greatest chance of success in reducing beak trimming	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*	Mean*
Legislation approach by the national government	2.73	2.58	5.80	4.40	4.00	1.00	2.67	2.75
Marketing initiatives by the poultry sector	5.05	5.17	4.60	2.20	5.67	6.00	1.33	5.25
Marketing initiatives by the national retailers	3.51	4.33	5.80	2.80	4.50	5.00	2.33	3.50
Actions set by non-governmental organizations	5.65	5.33	4.00	6.00	5.67	9.00	5.33	5.25
Subsidy programs of the national government to stimulate farmers	4.59	4.58	4.00	6.00	3.17	4.00	5.00	2.50
Educational programs for consumer	6.57	6.50	6.40	7.80	3.67	7.00	7.33	7.25
Educational programs for farmers	5.43	6.67	3.40	4.40	4.33	8.00	7.67	8.00
Wholesale price increase by retailers	5.24	5.25	4.20	6.00	6.83	2.00	5.33	4.50
Influence of large multinational corporations	6.65	6.00	6.80	7.20	7.17	3.00	8.00	6.00
Other	9.57	8.58	10.00	8.20	10.00	10.00	10.00	10.00
* Mean: 1, most successful to 10, least successful								
Country related obstacles	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**
Cultural aspects	1.43	2.00	2.20	2.00	1.17	1.00	2.33	2.25
Lack of consumer awareness	3.43	2.83	2.40	2.60	4.00	2.00	4.00	3.50
Lack of willingness to pay of consumers	3.41	3.50	3.80	3.40	4.00	5.00	2.67	3.50
Lack of available land for poultry production	1.86	2.83	2.20	3.20	2.33	1.00	2.00	2.25
Unsuitable weather conditions for poultry production	1.78	2.67	2.40	1.60	2.33	1.00	2.00	2.25
Lack of political interest	3.08	3.08	3.00	3.20	3.33	2.00	3.33	3.25
Other	2.84	2.33	3.00	2.40	2.50	4.00	3.00	3.50
**Mean: 1 very unlikely to 5 very likely								
Animal production related obstacles	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**	Mean**
Housing systems	3.54	3.67	3.40	3.40	4.50	4.00	3.67	4.50
Feeding management	3.59	3.08	3.40	3.00	3.67	3.00	3.67	3.25
Housing environment	3.38	3.58	3.40	3.40	4.00	4.00	3.33	4.00
Breed of laying hens used	3.65	3.33	3.80	3.60	3.17	4.00	4.00	4.00
High stocking densities and large group sizes	3.81	3.92	3.00	3.40	4.33	4.00	3.67	4.25
Insufficient or absence of litter materials	3.76	3.75	2.60	3.40	4.00	4.00	4.00	4.00
Frequent or unexpected changes	3.46	3.17	3.00	4.00	3.67	4.00	3.67	4.00
Poor hygiene	3.14	2.50	3.00	3.00	4.33	4.00	3.33	3.50
Other	2.59	2.17	1.80	2.20	2.50	5.00	3.67	2.75
**Mean: 1 very unlikely to 5 very likely								

Tabel J-7. Results of beak trimming and the genders

Beak trimming & gender		Female	Male
Total number (n)		41	32
Significant reduction possible within 3-5 yrs (%)	Yes	75,6	50,0
	No	24,4	50,0
		Mean*	Mean*
Factors with greatest chance of success in reducing beak trimming	Legislation approach by the national government	2.93	3.34
	Marketing initiatives by the poultry sector	5.00	4.47
	Marketing initiatives by the national retailers	3.93	3.66
	Actions set by non-governmental organizations	5.27	5.84
	Subsidy programs of the national government to stimulate farmers	4.07	4.88
	Educational programs for consumer	6.46	6.47
	Educational programs for farmers	5.76	5.41
	Wholesale price increase by retailers	5.27	5.28
	Influence of large multinational corporations	6.71	6.47
	Other	9.61	9.19
* Mean value: 1, most successful, 10 least successful			
		Mean**	Mean**
Country related obstacles	Cultural aspects	1.66	1.69
	Lack of consumer awareness	3.46	3.00
	Lack of willingness to pay of consumers	3.46	3.53
	Lack of available land for poultry production	2.05	2.38
	Unsuitable weather conditions for poultry production	2.00	2.06
	Lack of political interest	3.07	3.16
	Other	2.80	2.72
Animal production related obstacles	Housing systems	3.66	3.72
	Feeding management	3.51	3.34
	Housing environment	3.54	3.47
	Breed of laying hens used	3.56	3.66
	High stocking densities and large group sizes	3.93	3.66
	Insufficient or absence of litter materials	3.71	3.69
	Frequent or unexpected changes	3.49	3.47
	Poor hygiene	3.27	3.00
	Other	2.44	2.63
**Mean value: 1 very unlikely, 5 very likely			