Production diseases and farm animal welfare:

What do the public think?

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Abstract

The intensification of animal production has been associated with an increased incidence of production diseases, which can negatively impact upon farm animal welfare (FAW). While there is considerable research focused on public attitudes towards improved FAW, it is not clear whether this relates specifically to a reduction in diseases related to animal production systems. This research therefore seeks to establish public attitudes towards FAW with a specific focus on production diseases, and whether the incidence of diseases and interventions associated with these represent a barrier to their increased use.

Systematic review methodology combined with evidence synthesis was applied to integrate existing knowledge regarding consumer willingness-to-pay (WTP) for, and attitudes, towards FAW with a specific focus on the reduced incidence of animal production diseases. Four databases were searched and screened and identified 54 studies evaluating WTP and 80 studies investigating attitudes. Meta-regression based on random effects meta-analysis explored heterogeneity in WTP whilst a thematic analysis was used to explore attitudes towards FAW.

An evidence-gap was highlighted in relation to attitudes towards and WTP for production diseases associated with the intensification of production, with only 7% of WTP and 26% of attitudes studies investigating aspects in relation to this, primarily in relation to antibiotic use. This evidence gap was used to inform a European survey (n=2,330) exploring risk-benefits associated with and acceptability of production diseases and associated interventions in intensive pig and poultry production systems.

Several risks and benefits of both the systems and the interventions were identified, relating to both human and animal health concerns, with the most preferred interventions being those that were perceived as being more natural. Whilst legislation will ensure that these interventions will deliver safe food the results highlight the need for effective communication of the risks and benefits of the management practices within these systems.

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List of abbreviations

AIC	Akaike information criterion
AMR	Antimicrobial resistance
BIC	Bayesian information criterion
BSE	*Bovine Spongiform encephalopathy*
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
EC	European Commission
EFA	Exploratory factor analysis
ELM	Elaboration likelihood model
EU	European Union
FAW	Farm animal welfare
GM	Genetically modified
GRADE	Grading of Recommendations Assessment, Development and Evaluation framework
I^2	Heterogeneity
ISO	International Organisation for Standardization
KMO	Kaiser-Meyer-Olkin Test for Sampling Adequacy
MI	Modification indices
MSEM	Multigroup structural equation modelling
PEO	Perceived ethical obligation
PICO	Population/ patient, intervention, control/ comparator, outcome
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RMSEA	Root means squared error of approximation
SD	Standard deviation
SDGs	Sustainable development goals
SEM	Structural equation modelling
SRMR	Standardised root mean squared residual
TPB	Theory of Planned Behaviour
TLI	Tucker lewis index
WFP	Welfare friendly products
WTO	World Trade Organization
WTP	Willingness-to-pay

Publications arising from the research

- Clark, B., Stewart, G.B., Panzone, L.A. and Frewer, L.J. (2014) 'A protocol for a systematic review into consumers' attitudes, beliefs and perceived ethical obligations towards farm animal welfare'. *PeerJ PrePrints* 2:e676v1 http://dx.doi.org/10.7287/peerj.preprints.676v1
- Clark, B., Stewart, G.S., Panzone, L.A. and Frewer, L.J. (2014) 'A protocol for a meta-analysis of consumers' and citizens willingness-to-pay for farm animal welfare and disease prevention'. *PeerJ PrePrints* 2:e675v1 http://dx.doi.org/10.7287/peerj.preprints.675v1
- Clark, B., Stewart, G.B., Panzone, L.A., Kyriazakis, I. and Frewer, L.J. (2016) 'A systematic review of public attitudes, perceptions and behaviours towards production diseases associated with farm animal welfare'. *Journal of Agricultural and Environmental Ethics*, 29(3), pp.455-478.
- Clark, B., Stewart, G.B., Panzone, L.A., Kyriazakis, I. and Frewer, L.J. (2017) 'Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies'. *Food Policy*, *68*, pp.112-127.
- Clark, B., Frewer, L.J., Panzone, L.A. and Stewart, G.B. (2017) 'The Need for Formal Evidence Synthesis in Food Policy: A Case Study of Willingness-to-Pay'. *Animals*, 7(3), p.23.

Chapter 1. Introduction

1.1 Introduction

To meet the need for increased demand for foods originating from animals, sustainable intensification of animal production systems is increasing in some parts of the world, predominantly in more developed countries, such as Western Europe and North America, and several emerging economies (Bruinsma, 2003; High Level Panel of Experts on Food Security and Nutrition, 2016). Whilst the intensification of animal production offers a means to help meet this demand, it also poses several points for consideration, in particular, societal concerns over farm animal welfare (FAW) (Austin *et al,* 2005), as well as having negative environmental impacts in relation to resource usage and emissions (Steinfeld, 2004; Garnett, 2013), the former of which is a growing public concern (Harper and Henson, 2001; European Commission, 2016). Intensive production systems are also potentially more susceptible to production diseases, which can have negative impacts on FAW as well as economic feasibility at the farm level. These in turn, may raise societal concerns in relation to both animal health and animal welfare. Production diseases are particularly prevalent within intensive animal production systems (Stenfield, 2004). Public concerns may be associated with the increased incidence of animal production diseases, with concerns raised previously in relation to epidemic diseases such as avian influenza and *Bovine spongiform encephalopathy* (BSE; Scudamore, 2007; Rowe *et al,* 2008). Public concerns may also relate to the interventions used to prevent or treat these, and may represent a barrier to public acceptance of intensive animal production systems increased use, with public perceptions of the risk and benefits, and potential ethical issues associated with these, and ultimately their acceptance and long-term use (Frewer *et al,* 2004; Fischer and Frewer, 2009).

In this chapter, the rationale for the research is presented in relation to growing public concern over the risks associated with food production. The research will then be introduced in the context of food security, the sustainable intensification of animal production for human food consumption, growing public concern over FAW, and the role of production diseases within this. The research gaps in relation to consumer attitudes, production diseases and associated interventions are then introduced, and the need for research to address these gaps are highlighted. The aims of the

research are then presented before finally an overview of the rest of the thesis is given.

1.2 Background

The Sustainable Development Goals (SDG's) are concerned with the harmonisation of economic growth, social inclusion and environmental protection for the wellbeing of both individuals and society (United Nations, no date), whilst ensuring that the planet can meet current generational needs, without compromising those of future generations (Tilman *et al,* 2002). Food and nutrition security is thought to have implications for all 17 of the SDG's, via the implementation of sustainable agricultural development (High Level Panel of Experts on Food Security and Nutrition, 2016). No system can be considered as being sustainable if a substantial proportion of the population, voice concerns over it, or find it unacceptable (Broom, 2010).

Lusk and Perugini (2016) describe food as one of the key concerns in society, with several stakeholders, including the public becoming increasingly concerned over how the food they consume is produced, including the raw ingredients used and the technologies and processes involved in its manufacture (Frewer and Salter, 2002; Zingg *et al*, 2013). Because of this growing concern, the public are becoming increasingly aware and demanding of higher standards of both production and the final products (Grunert, 2005), and expect food to be safe and free from contaminants, toxic substances, additives, pesticide and veterinary medicine residues including antibiotics (Scudamore, 2007).

The process of food production and consumption is potentially associated with several sociological, cultural, health, ethical and environmental consequences, which may directly or indirectly influence several aspects including public and/ or environmental health and food security (High Level Panel of Experts on Food Security and Nutrition, 2016). This includes the type of food production system used (High Level Panel of Experts on Food Security and Nutrition, 2016). The public are becoming increasingly concerned over the risks surrounding food in particular (Frewer, 2000), especially considering recent food scares such as dioxins (Verbeke *et al,* 1999) and the contamination of food (Kher *et al,* 2013). The means of production is also being questioned critically, and can influence perceptions of risks and benefits associated with food (Frewer *et al*, 1998; Siegrist, 2008), including the technologies used in the processing and packaging of the final products. Previous

research has demonstrated that technological innovations, including those found within the agri-food domain, can be met with societal resistance in the form of negative attitudes, as has been the case with genetically modified (GM) crops (Frewer *et al*, 2013), and nanotechnology (Giles *et al,* 2015), both of which have highlighted the role risk perception can play in the formation of attitudes (Fife-Schaw and Rowe, 1996).

Understanding attitudes and perceptions towards a given hazard is also an important part of establishing the motivation and rationale behind individuals' behaviours (Frewer *et al,* 2004), and how they may potentially respond to the hazard in question. It is therefore necessary to understand how individuals evaluate potential or apparent risks associated with specific foodstuffs (Fischer and Frewer, 2009), as the public's perceptions of these are likely to play a significant role in attitude formation regarding food risks (Grunert, 2005), and the acceptability of the foodstuff in question (Frewer *et al,* 2004). This is especially importand as every hazard, including food related hazards, has its own unique pattern of psychologically determined characteristics that are related to the risk characteristics associated with it (Slovic, 1992; Miles *et al*, 1999).

Animal production has let to concerns over recent decades, with food scares including BSE (Frewer and Salter*,* 2002), foot and mouth disease (Poortinga *et al,* 2004), the 'horsegate' scandal (Tse *et al,*2016), and the production systems used, all leading to a rise in public concern. The recent growth in intensive animal production systems has fuelled concerns surrounding these in relation to product quality and safety, as well as in relation to FAW. The intensification of production is associated with a change towards more confined animal production systems, whereby animals are confined and raised within fewer production units, with a large increase in the number of animals within these units (Fraser, 2005). Animals within these systems are generally raised in large numbers, in specialised indoor environments that offer a higher degree of environmental control.

Despite growing public concerns over the use of these systems, the use of intensive animal production systems is set to increase, with the intensification of production thought to play an integral role in establishing and maintaining food security for a growing world population. However, these systems are not without their limitations, with the intensification of production also associated with an increase in the

susceptibility or severity of production diseases (Stenfield, 2004; Food and Agriculture Organization of the United Nations, 2011a).

Production diseases usually originate from a complex interaction of microorganisms, (such as bacteria) which are present on farms, the animals' own genetics, and the environment in which the animal is reared. This potentially represents an increase risk as a consequence of the characteristics of housing, feed and management practices used, and their interactions. For example, large farms with continuous production and higher stocking densities create more opportunities for the exchange of interflora linked to porcine respiratory disease complex (Bochev, 2007). They differ from epidemic diseases (such as foot and mouth disease or avian influenza), which are caused by new infections from outside the farm (Perry *et al,* 2013), and which may have origins in the natural environment. Production diseases compromise the health and welfare of the animals effected, generating inefficiencies which negatively impact on profitability, environmental footprint, and product quality, in addition to having potential implications for food safety, and antimicrobial resistance (AMR) through the need to treat affected animals with antibiotics, and the potential for antrimicrobial resistant bacteria to enter the food chain (Fevre *et al,* 2006; Perry *et al,* 2013; Food Standards Agency, 2016).

Several proactive and reactive intervention measures have been developed to address the increased rise and scale of production diseases within intensive animal production systems, with reactive measures being used to treat the diseases once detected and the proactive measures being used to prevent them in the first instance. However, these may or may not be acceptable to society, including consumers of the animal based products and wider members of the public who may not necessarily consume animal based products. Some members of society may not want to consume the ultimate end products of these systems, for example, vegetarians, vegans, or those concerned about the risk of disease transfer (Harper and Henson, 2001; Hall and Sandilands, 2007), but none-the-less, still have an interest in how they are managed and the experience of the animals within these systems. This potential disparity in opinions and attitudes between consumers of animal based products and wider citizens or members of the public, is acknowledged in the wider FAW literature (Harper and Henson, 2001; Grunert, 2006). Citizens, including vegetarians and vegans, may not purchase animal products regardless of the production systems and welfare standards with which they are associated, yet still

have an interest in the issues surrounding the implementation of and production of these products (Grunert, 2006). These differences are potentially important when developing FAW legislation and policies, which need to align with the preferences and priorities of all societal stakeholders concerned (Blandford *et al,* 2002; Spooner *et al,* 2014), therefore, production practices used need to be acceptable to citizens, whilst also ensuring that the market meets the demands and needs of consumers.

There is a considerable body of research that has focused on consumer attitudes for improved FAW (see *inter alia* Harper and Henson, 2001; Bennett *et al,* 2012), including the examination of willingness-to-pay (WTP) which can be used as a proxy for attitude (Ryan and Spash, 2011). However, it is not clear whether this relates specifically to interventions aimed at reducing production diseases originating in intensive animal production systems, or simply just interventions aimed at introducing higher animal welfare standards in general. As intensive animal production systems are already a contentious subject in the minds of the public (Harper and Henson, 2001), identifying and understanding public attitudes and concerns, including their perceptions of risks and benefits, in relation to intensive farming practices and those surrounding production diseases is important, and will ensure that the processes and interventions align with the values, needs and expectations of society (Asveld *et al*, 2015). Conducting research to establish attitudes and perceptions is therefore an essential part of understanding of how the public view and make decisions in relation to intensive animal production systems, including in relation to how they determine what is and is not acceptable in relation to products and regulations. Failure to meet the expectations of society will result in consumer/ citizen protest. Therefore addressing societal expectations, and ensuring that acceptable regulatory and production practices are in place, monitored and communicated, resulting in acceptable animal products being available.

Communication, and risk communication in particular, is also important for consumer protection (Verbeke*,* 2008), enabling consumers to make informed choices (Miles *et al,* 1999; van Dijk *et al,* 2011), and for maintaining and increasing societal trust for those organisations and institutions involved in the production and risk management process (Poortinga and Pidgeon, 2005), with trust only likely to be improved by understanding and addressing any underlying concerns the public have in relation to that issue (Poortinga and Pidgeon, 2005). The identification of and acknowledgement of public perceptions and attitudes of food related risks should therefore be taken into

consideration so that communications can be tailored accordingly (de Jonge *et al,* 2008). This should also enable any public scepticism in relation to certain issues to be addressed (Frewer and Salter, 2002) and will ultimately act to foster and improve public trust and confidence in stakeholders along the supply chain, and in the safety of food (Frewer *et al,* 2004).

1.3 Research aims and objectives

The overall aim of the research presented in this thesis is to explore public attitudes towards FAW within intensive production systems. As part of this, people's attitudes towards interventions targeted at both preventing and reducing these will be considered, to identify barriers and facilitators to the increased use of such systems. Several research objectives and associated research questions will be used to achieve this as outlined in table 1.1 below.

Research objective	Research questions
Chapter 3: To integrate the existing body of research focused on public attitudes towards FAW in intensive animal production systems, and to assess gaps in knowledge.	• Are the public concerned over FAW in intensive animal production systems? • To what extent does the existing consumer literature relate to production diseases? • Do socio-demographic and socio-economic factors affect attitudes and beliefs in relation to FAW • Do different aspects of welfare affect attitudes and beliefs in relation to FAW • Are citizens more concerned than consumers in relation to farm animal welfare?
Chapters 4 and 5: To determine public willingness-to-pay for improved farm animal welfare.	• What the public are willing-to-pay for FAW? • To what extent does the existing willing-to-pay literature relate to interventions targeted at production diseases? • Does WTP vary by animal type? • Does WTP vary by socio-demographic or socio-economic characteristics? • Is there a difference in WTP between citizens and consumers? • Does publication bias affect the results of the meta-analysis?
Chapter 6: To establish European public attitudes towards production diseases.	• How concerned are the European public around intensive animal production systems? • the European public in relation to production diseases? • What are the risks and benefits of intensive animal production systems as perceived by the public? • How acceptable to the public are interventions to treat production diseases?
Chapter 7: To make methodological recommendations for future research based on the research conducted.	• What are the limitations of the research methods used in relation to the research conducted? • Are current research methods appropriate for assessing public attitudes? • What best practice recommendations can be taken away from the research conducted? • What are the benefits of mixed-methods systematic review?
Chapter 7: To make evidence based recommendations for both producers and policy makers in relation to animal based production systems.	• What are the barriers to the growth of intensive animal production systems? • What are the facilitators to public acceptance of intensive animal production systems? • What are the barriers to interventions used to treat production diseases? • What are the facilitators to interventions to treat production systems? • What are the policy and legislative implications of the research? • What are the communication implications of the research?

Table 1.1 Research objectives and questions for the thesis

1.4 Research approach

Before designing and undertaking empirical research there is a need to establish what is known about the topic in question from existing literature, and importantly what is not, so that the primary research can be conducted to address any

knowledge gaps (Cooper and Hedges, 1994; Gough *et al,* 2012). This research will therefore undertake a systematic review of the available literature prior to the collection of primary research data. The assessment of what the public thinks of FAW will be explored using two approaches; first, the social-psychological literature which examines public attitudes towards FAW in intensive animal production systems will be considered and analysed using systematic review methodology (Campbell Collaboration, 2014) to establish the extent to which it relates to production diseases. Secondly, the consumer economics literature will be considered in order to examine consumer WTP (Breidert *et al*, 2006) for higher than minimum FAW standards, and to again establish the extent to which this relates to production diseases. The assessment of potential bias is an important part of policy development, and this includes publication bias and the implications this has for interpretation of systematic review outputs (Miguel *et al,* 2014). This will be explored in the WTP literature only, as the inherent nature of the analysis means that publication bias cannot be assessed in a qualitative review as it is not possible to perform the statistical methods required to detect publication bias in a qualitative data set (Lewin *et al,* 2015). A largescale consumer survey will then be used to address the research gaps identified in the two reviews, and to assess the acceptability and preferences towards several proposed interventions designed to both prevent and treat production diseases in intensive animal systems. The survey will also be informed by the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and risk-benefit theory to enable evidence-based conclusions to be drawn and recommendations to be made.

Finally, a summary of the policy implications identified though the research will be summarised and discussed, and the implications and recommendations focused on the needs of several different stakeholders will be identified and presented. Several methodological considerations and recommendations, identified as a result of the research methods used in the thesis, will also be outlined, as well as further recommendations for future research.

1.5 Thesis outline

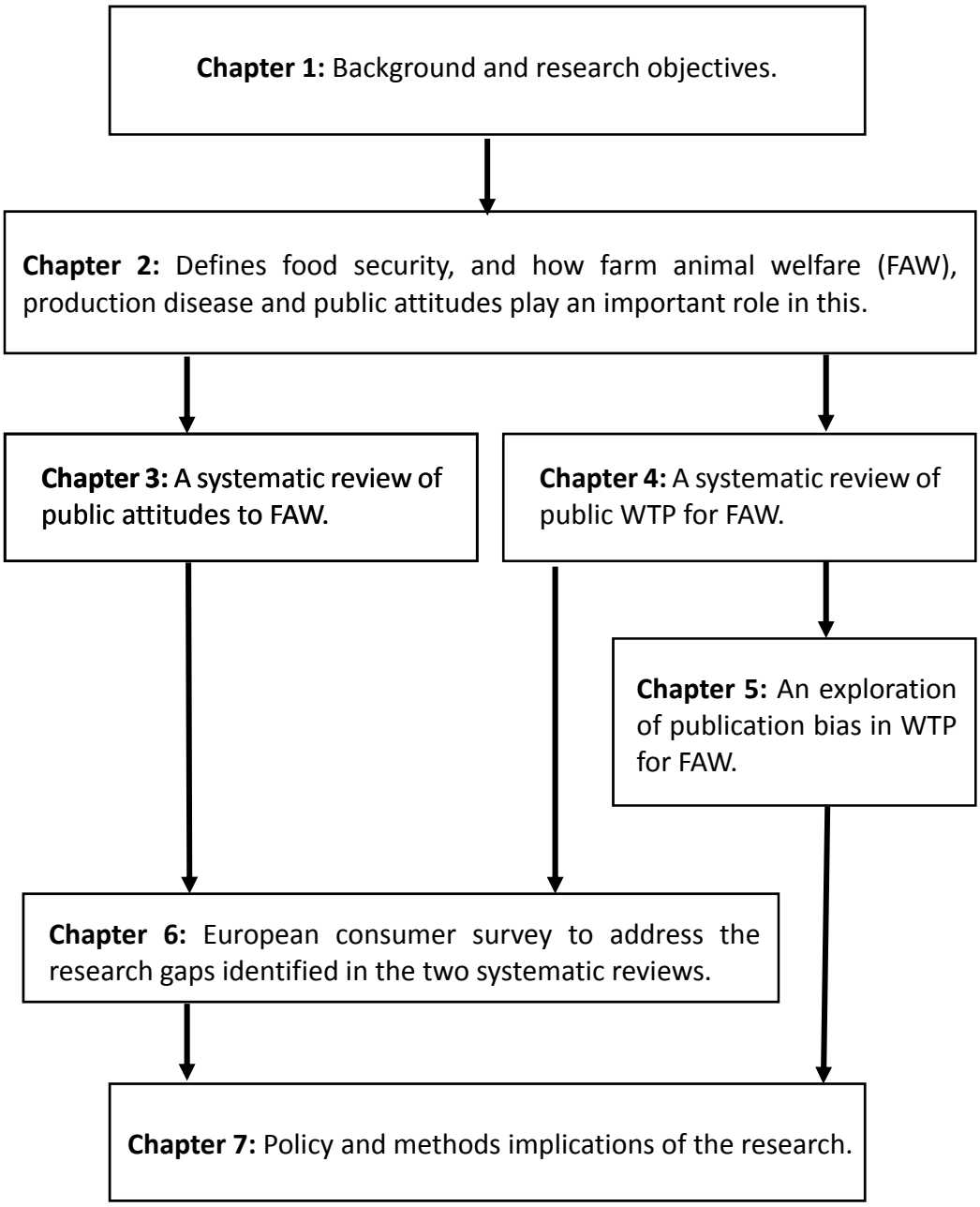


Figure 1.1 An overview of the thesis

An overview of the thesis can be found in figure 1.1. Following on from the introduction, chapter 2 further details the rationale for the research, including the rise of intensive animal production systems and production diseases, before detailing the importance of considering public attitudes towards these issues, and the distinction between citizens and consumers. Chapters 3 and 4 outline the two systematic reviews used to address public attitudes towards FAW. First, chapter 3 details the growing public concern and the uses qualitative evidence-synthesis to explore public

attitudes to FAW, before chapter 4 outlines the method of meta-analysis, before utilising this quantitative evidence synthesis to again explore public attitudes towards FAW, in the for willingness-to-pay for FAW. Chapter 5 then discusses the issue and implications of publication bias identified in the quantitative review, and the implications this has for the interpretation of the results. Chapter 6 details the theoretical underpinning to the consumer survey in relation to the TPB and risk-benefit analysis, before describing and presenting the results of a European consumer survey to address the research gaps identified in the two systematic reviews. Finally, chapter 7 will draw together and summarise the conclusions from the preceding 5 chapters, including the wider policy, theoretical and methodological implications of the results.

1.6 Summary

Increased consumer demand for animal products has led to a rise in intensive animal production systems, with the sustainable intensification thought to have an important role in ensuring future food security. At the same time, intensive production systems are coming under increased public scrutiny, with the public additionally becoming increasingly concerned over several potential risks in relation to the food they eat. Production diseases are one potential risk to animals and humans, and are particularly prevalent in intensive production systems, with their presence, and interventions associated with them, in fact being a barrier to their increased use. To ensure the acceptability of animal production systems going forward, and maintain public trust in stakeholders across the food chain, public perceptions of these systems, production diseases and any associated interventions needs to be established. This research seeks to address this, looking to establish public attitudes towards these, production diseases within these, and the interventions utilised to both prevent and treat them.

Chapter 2 will further expand upon the ideas presented in this chapter, detailing the growth in intensive production systems, the rise in intensive production systems and the implications these have on FAW, and the need to consider public perceptions within these.

Chapter 2. Literature review

2.1 Introduction

Chapter 1 outlined the rationale for this research, and briefly introduced the context in which the research objectives and questions listed in section 1.3 sit. This chapter will first demonstrate the importance of animal production systems in the context of food security, including the increased demands for animal derived foods. The rise of intensive animal production systems and production diseases within such systems will then be explored. The topic of FAW will then be introduced, along with the implications for welfare as a result of the rise in production diseases. Finally, the importance of public perceptions of production diseases and their associated interventions will be examined, including the need to establish and make sense of public attitudes to FAW.

2.2 Food security and intensive animal production

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (Food and Agriculture Organization of the United Nations, 1996). Considering this definition, four dimensions of food security can be said to exist (Food and Agriculture Organization of the United Nations, 2008a); physical availability, economic and physical access to food, food utilization and the stability of these over time, with all four needing to occur simultaneously for food security to be achieved and sustained (World Food Programme, 2016). These four dimensions encompass factors such as food production, trade, dietary diversity, feeding practices, income, and market prices, all of which affect the ability of individuals to be food secure, in the sense that they are regularly consuming enough food to meet energy and nutritional requirements for an active and healthy lifestyle (World Food Programme, 2016).

Although progress has been made on the Millennium Development Goals, around one in nine people are still malnourished globally (Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development and World Food Programme, 2016) and so are not food secure, with the vast majority being in developing regions. At the same time, a further 39% and 13% of adults overweight and obese respectively (World Health Organization, 2016). This dual burden of under

and over nutrition, is occurring whilst the global population is increasing, with estimates purporting a rise from the 7.3 billion in 2015 to 9.7 billion in 2050 (United Nations, 2015). Therefore, achieving global food security is a pressing challenge. The United Nations introduced the SDG's (United Nations, no date) in January 2016, to build on the success of the Millennium Development Goals, and these are concerned with the harmonisation of economic growth, social inclusion and environmental protection for the wellbeing of both individuals and society (United Nations, no date), whilst ensuring that the planet can meet current generational needs, without compromising those of future generations (Tilman *et al,* 2002). Food and nutrition security is thought to have implications for all 17 of the SDG's, via the implementation of sustainable agricultural development, and improvements to the economy (High Level Panel of Experts on Food Security and Nutrition, 2016), with goal number two specifically focusing on eradicating global food insecurity. Increases in output from both agricultural and animal production systems needed to meet increased demand (World Health Organization, 2009), and need to be achieved in a sustainable manner as possible.

A number of factors are thought to contribute towards food insecurity (United Nations,no date) including increased demands for Westernised diets in regions where traditional production has relied less on foods derived from animals (Godfray *et al,* 2010). This increases resource pressures such as space, water and energy (Godfray *et al,* 2010), including through increased animal production, to enable the increased demands for animal based products to be met. Together with concerns over the long-term sustainability and resilience of food production systems, this has culminated in the desire for the sustainable intensification of both agricultural and animal production, to enable the growth and changing pressures in demand to be met, in an increasingly sustainable and environmentally friendly manner, to ensure food security, and achievement of the SDG's.

The drivers and factors contributing to food security require involvement from actors involved in production, supply and distribution and access to food to ensure that food security is achieved. Livestock production in particular, has both positive and negative both direct and indirect effects on food security as summarised in table 2.1 (Compassion in World Farming and World Society for the Protection of Animals, 2012). Intensive animal production systems offer a means of raising large volumes of animals for food production, in a more resource and time efficient manner than

conventional animal farming systems. The scale and control offered by these systems contributes towards more stable food supplies and prices, while in addition offering a means for production to keep up with the growing global demand for animal based products. It should be noted that the consumption of animal based products can contribute towards improved diet and nutritional status, with those in lower income countries benefiting from increased meat and animal product consumption (Steinfeld and Gerber, 2010), as a result of higher protein and micronutrient intakes, such as iron, zinc and vitamin A (World Health Organization, 2009). However, most developed countries now have intakes that surpass nutritional needs and requirements (Sans and Combris, 2015), with an increase in animal product consumption corresponding to an increase in the amount of saturated fat consumed (World Health Organization, 2009), and associated with several non-communicable diseases (World Health Organization, 2009), and some cancers (Bouvard *et al,* 2015). However, despite these health concerns, animal product consumption in most of the regions is forecast to remain stable, or decrease only slightly (Vranken *et al,* 2014)

	Direct role	Indirect role
Positive	- Source of food (energy, protein and nutrients)	- Source of energy (draft power, manure for fuel and biogas)
	- Source of income and employment - Status for the farmer	- Source of fertilizer or soil conditioner - Means of weed control
	- Store of wealth and a buffer against crop failure	- Increasing animal production saves foreign exchange
	- Broadened resource base (recycling household or industrial wastes and utilisation of marginal lands and crop residues)	- Manure, leather, bones and other products for building, clothes and tools
		- Social and cultural significance -Provide investment and savings
Negative	-Competition with humans for crops and agricultural land	- Associated with animal welfare issues
	-Use of fish that could feed humans directly - Higher resource use compared to crops	- High environmental impact - May displace the consumption of balanced, healthy plant-based foods
	- Increased risk of certain diseases due to high consumption of livestock products	-Measures to reduce disease spread from intensive farming may disproportionally impact on small-scale farmers
	- Human health threats from zoonotic diseases, food safety and incorrect use of antibiotics	-Intensification may displace small-scale farmers from the market

Table 2.1 The roles of livestock in food security (Adapted from Compassion in World Farming and World Society for the Protection of Animals (2012)).

2.3 The rise of intensive production systems

Although globally heterogeneity in dietary intakes exists (Kearney, 2010), mostly due to cultural difference (de Boer *et al,* 2006), worldwide consumption of animal products is increasing as highlighted in figure 2.1 (Alexandratos and Bruinsma, 2012; Allievi *et al,* 2015). Developed regions, such as Western Europe already have a high consumption of animal protein (Food and Agriculture Organization of the United Nations, 2016), with consumption levels static, or decreasing slightly, albeit from a high consumption level (Vranken *et al,* 2014; Sans and Combris, 2015). However, developing nations such as India and China are demanding increasingly larger quantities due to increased disposable incomes (Tilman *et al,* 2002), growing population numbers (Wathes, 2013), urbanisation, improved infrastructure (Kearney, 2010) and changing tastes. This consumer driven demand for animal based products has been termed the *livestock revolution* (Delgado *et al,* 1999; Delgado, 2003; Steinfeld and Gerber, 2010), which reflects a move away from more indigenous and staple product consumption (World Health Organization, 2009), towards more Westernised diets (Pingali, 2007), characterised by higher meat and grain intakes (Popkin, 2006). This "*nutrition transition*", of changing demand and supply (Popkin, 2006), is leading to globally increasing demands for protein, especially products of animal origin (Pingali, 2007; Allievi *et al,* 2015). This is reflected in estimates of animal product production, which are predicted to increases to between 376-455 million tonnes in 2030 (Alexandratos and Bruinsma, 2012), compared to the 218 million tonnes produced between 1997-1999 (World Health Organization, 2009).

As the regions with increasing animal product consumption, such as Africa and Asia, are those where the largest population growth is predicted to occur (United Nations, 2015), this *nutrition transition* and accompanying changes in food consumption patterns, has implications for global food supply, markets and trade (Kearney, 2010), with traditional, more extensive farming approaches not thought to be able to keep up with demand.

As land limitations inhibit the expansion of extensive production systems in most regions (Steinfeld, 2004), the intensification of animal production systems has occurred, with a shift from the production of ruminents, such as cattle, towards monogastric species such as pigs and chickens (Fraser, 2005; Steinfeld and Gerber, 2010). These animals are easier and more straightforward to rear in more confined

production systems due to their short reproduction cycles, high feed conversion ratios (High Level Panel of Experts on Food Security and Nutrition, 2016), and grain based diets (Steinfeld and Gerber, 2010). Thus, their production has increased sharpest over the past few decades (Alexandratos and Bruinsma, 2012), and it is now estimated that 81.5% chickens and 38.2% pigs are kept in intensive production systems (High Level Panel of Experts on Food Security and Nutrition, 2016).

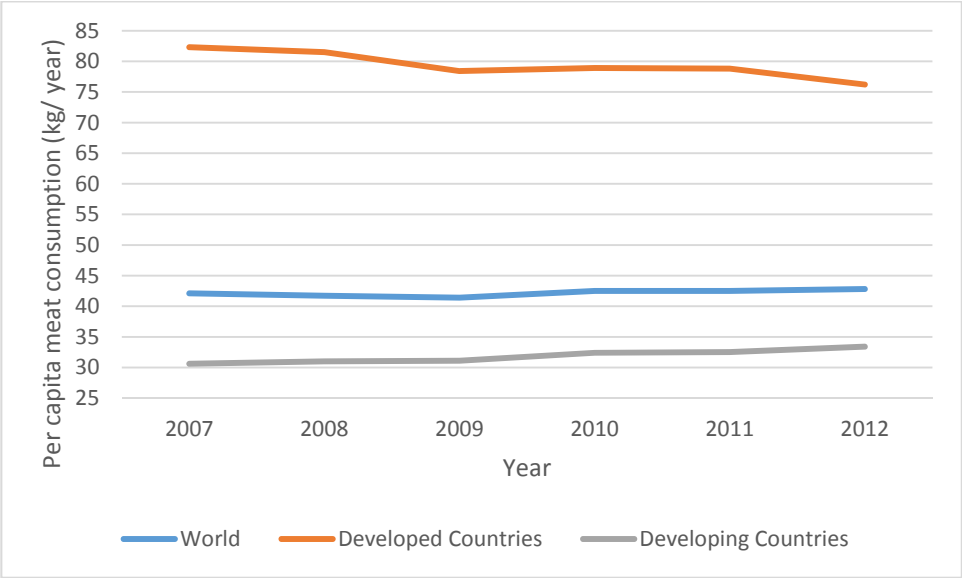


Figure 2.1 Meat consumption trends (Adapted from Food and Agriculture Organization of the United Nations, 2008b, 2009, 2010, 2011b, 2012, 2013)

The intensification of production is associated with a change towards more confined animal production systems with fewer production units, and a large increase in the number of animals within these (Fraser, 2005). Animals within these systems are generally raised in large numbers, in specialised indoor environments that offer more environmental control. Intensive production systems seek to optimise production efficiency, maximize productivity and profitability (Vanhonacker and Verbeke, 2014), and this is usually achieved through changes to housing conditions and with the appearance of increased mechanisation and decreased use of space. Given this rise in intensification of agricultural practices, the average amount of land needed to feed a person in 2005 is now two thirds of what it was in 1963 (Kastner *et al,* 2012). In developed countries, such as within Western Europe, farm animal production has

increased considerably over the past decade to cope with increased demand (Fraser, 2008a).

Animal production poses several challenges in relation to the sustainability of food production, including its disproportionate contribution to the environmental cost of agriculture (Leip *et al,* 2010; Kastner *et al,* 2012; Garnett, 2013), through resource use including water, soil, air and biodiversity (Steinfeld, 2004), the environmental impacts of its waste (Tilman *et al,* 2002), not to mention the increasing amounts of grain being fed to animals (Bruinsma, 2003). In addition, the efficiency gains through intensification may result in animal rights and welfare concerns (Austin *et al,* 2005; World Bank, 2011), with Broom (2010, p.83) stating that *"no system or procedure is sustainable if a substantial proportion of people find aspects of it now, or of its consequences in the future, morally unacceptable."* Stakeholder perceptions of animal production systems, including those of the public, therefore need to be taken into consideration, with these systems being unsustainable if it is perceived that they pose an unacceptable cost to FAW (Farm Animal Welfare Committee, 2016).

As animal product production and consumption continues to increase across much of the world, the ethical component is likely to become an inherently important component of sustainable intensive agriculture (Garnett, 2013; Vinnari and Vinnari, 2014; Allievi *et al,* 2015), and it is important to consider both the ethical and scientific challenges associated with this whilst ensuring the quality of lives experienced by the animals (Croney and Anthony*,* 2014). For example, large farms with continuous production and higher stocking densities create more opportunities for the exchange of interflora linked to porcine respiratory disease complex (Bochev, 2007), which may negatively impact upon the health and welfare of the animal, yet offer a more sustainable means of production. Food policy is therefore highly complex in addressing the issue of food security including the management of animal welfare and the sustainability of these systems, and the interrelationships between these issues. An integrated approach is therefore required for food policy to ensure that a range of objectives are achieved (Compassion in World Farming, 2014), including the maintenance of FAW.

2.4 Farm animal welfare

2.4.1 What is farm animal welfare?

Animal welfare is an integral part of animal production globally (Pinar, 2006) although there are several different perspectives on how FAW is defined in this context. Broom (1991) defines welfare as the "*state of living of an animal in relation to its environment*", and so can therefore be established by the assessment of how well an animal can cope within the environment in which it lives (Blandford *et al,* 2002). The Farm Animal Welfare Council *(*2009a, p.iii) puts forward a more affective definition, describing animal welfare as "*the need for animals to have a life worth living, with a growing number enjoying a good life*". This emphasises the subjectivity of FAW, with a "*good life*" meaning different things to different stakeholders and individuals (Broom, 2014). Although several scientific measures are available to provide a more objective welfare assessment (Broom, 2014), what constitutes as good welfare is ultimately a question of what people consider acceptable and unacceptable in relation to how animals are treated. This subjectivity becomes even more apparent when the perspectives both within and between different stakeholder groups need to be taken into consideration (Lusk and Norwood, 2011), and is reflective of it being a combination of multifaceted issues, such as scientific, ethical, economic, socio-cultural, religious and political dimensions (Moynagh, 2001; World Organisation for Animal Health, 2016).

Intensive animal production systems are not always viewed favourably by the public, with discussion centred around whether they are ethically or morally acceptable (see *inter alia* Regan, 1987; Pluhar, 2010; Loughnan *et al,* 2014). Although for some, the keeping of animals is a decidedly anthropocentric concept, most people perceive themselves as having some form of moral obligation towards other animal species (Broom, 2014). Intensive production systems juxtapose the suffering caused to sentient beings, i.e. farm animals, with the benefits gained to humans (Singer, 1975, 1990 version; Regan, 2004), which from a utilitarian perspective would result in intensive production systems as being perceived as unacceptable. Therefore, acting to improve FAW would involve some form of altruistic act whereby an individual would experience some form of loss, e.g. financial or non-consumption, to ensure the welfare of production animals (Broom, 2006), and reflect their intrinsic worth, beyond their utilitarian value to humans (Spooner *et al,* 2014).

Whilst highly subjective, anthropocentric and utilitarian based attitudes are based on considerations of animal sentience, and whether farm animals have both the capacity and ability to suffer (Bentham, 1789), both physically and emotionally (Singer, 1975; 1990 version). A sentient being is considered one that has the capacity to both have and experience several feelings, including the ability to have awareness, and evaluate its own and others actions and their consequences (Broom, 2006). They also have some preference autonomy, in that they can act in line with their beliefs and desires and their wellbeing incorporates the extent to which they can act in accordance with these (Regan, 2004). Thus, farm animals can feel and demonstrate emotions, and they can feel pain (Farm Animal Welfare Council, 2009a).

Although it is one of the more controversial aspects of the application of science to FAW (Farm Animal Welfare Committee, 2012), there is increasing recognition of farm animals as sentient beings (Broom, 2014), and it is this recognition that has facilitated the development of animal protection in recent years (Broom, 2014), with public concern wholly or in part associated with the affective states of animals (Broom, 2014). Subsequently, legislation and policy is underpinned by several ethical judgements as to how farm animals should be treated (Broom, 2014; Johansson-Stenman, 2006), which can be considered as an "*ethical framework for how animal production systems should be developed*" (Moynagh, 2001, p.108).

A balanced welfare assessment system therefore must satisfy several different stakeholders including consumers, the public, industry, policy and scientific stakeholders (Welfare Quality, no date), who may also happen to have different definitions as to what constitutes good welfare (Miele *et al,* 2011). The term animal welfare is now used as a scientific concept describing a potentially measurable quality of a living animal at a given time (Broom, 2006). Ethical considerations are, in part, used to establish the relevance of the more objective science underpinning decision making (Broom, 2014), meaning both scientific and ethical perspectives are often the focus. (Buller, 2010). These more objective scientifically-based measures provide a means of establishing, measuring and monitoring animals to ensure that their health and welfare is maintained at or above acceptable minimum standards in all production systems. In addition, they provide a means of documenting evidence to support compliance with, or surpassing of, minimum welfare standards.

In most countries, minimum FAW standards are based upon the five freedoms of animal welfare (table 2.2) published in the Brambell Report (1965), and these are

commonly referred to when describing the rights of animals when under human control (World Organisation for Animal Health, 2016). These core principles have been focused into a set of objectively measured, species specific, animal-based outcome measures and indicators (Broom, 2014), for example as demonstrated within the Welfare Quality Project (table 2.3; Welfare Quality, no date). As for the Five Freedoms, these measures provide a holistic overview of welfare, incorporating physiological and behavioural measures of welfare, disease, injury, movement and growth (Broom, 2014), with there being some debate as to whether the criteria currently used fully considers the concept of animal wellbeing, with "*the question is not just, "do they suffer?" nor, "are their needs met?" but rather, "do they have a life worth living?""* (Farm Animal Welfare Committee, 2010, p.4). It is this latter point which most discussion surrounding the subjectivity, and intensive animal production is based, with the consideration of what constitutes as good welfare related to whether animals have a life worth living. What constitutes as good welfare is beyond the scope of this thesis and readers are directed to Broom (2014) for a more in-depth discussion.

Freedom	Description
1. Freedom from hunger or thirst	by ready access to fresh water and a diet to maintain full health and vigour
2. Freedom from discomfort	by providing an appropriate environment including shelter and a comfortable resting area
3. Freedom from pain, injury or disease	by prevention or rapid diagnosis and treatment
4. Freedom to express (most) normal behaviour	by providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from fear and distress	by ensuring conditions and treatment which avoid mental suffering

Table 2.2 The five freedoms of animal welfare (Adapted from Farm Animal Welfare Council (2009b))

Although underpinned by the Five Freedoms, there is no universally agreed set of criteria for assessing FAW, with there being several different welfare schemes, assurance programmes and laws available that outline minimum welfare and production standards (Broom, 2014). These schemes can vary within and between markets, both nationally and internationally (Pluhar, 2010). Although there are no global standards from which to assess welfare against FAW, and animal health standards in particular, are encouraged by the World Organisation for Animal Health

(World Organisation for Animal Health, 2016), who work in close partnership with the World Trade Organisation (WTO) (World Trade Organization, 2017), and these are guidelines used for counties with no minimum FAW standards (High Level Panel of Experts on Food Security and Nutrition, 2016).

Principles	Welfare Criteria
Good Feeding	1. Absence of prolonged hunger
	2. Absence of prolonged thirst
Good Housing	3. Comfort around resting
	4. Thermal comfort
	5. Ease of movement
Good Health	6. Absence of injuries
	7. Absence of disease
	8. Absence of pain induced by management procedures
Appropriate Behaviour	9. Expression of social behaviours
	10. Expression of other behaviours
	11. Good human-animal relationship
	12. Positive emotional state

Table 2.3 The Welfare Quality items (Adapted from Blokhuis et al (2010))

Within the European Union (2012), the strategy in relation to FAW lays the foundation for improving welfare standards, ensuring that they are applied and enforced according to 'Council directive 98/58/EC' (1998), which lays down the minimum standards for all farmed animals, with there being a number of additional pieces of legislation for different species such as 'Council directive 2008/120/EC' (2008) for pigs, 'Council directive 2007/43/CE' (2007) for broilers and 'Council directive 1999/74/EC' (1999) for layers, and for different stages of production. For example, 'Council regulation (EC) No. 1/2005' (2004) on transportation and 'Council regulation (EC) N° 1099/2009' (2009) on slaughter. These directives recognise that animals are sentient beings, working on the guiding principle that *"everyone is responsible"* ensuring and emphasising the need for guidance to be revised in light of scientific advancements, and also the acknowledgement of the importance of the identification and incorporation of public concerns and perspectives.

Welfare Concerns	Welfare Advantages
Animals prevented from expressing natural behaviours and denied access to natural surfaces	New facilities designed to align with specific welfare requirements
With large numbers, subtle indicators of an individual's ill health or distress may be missed	Large facilities staffed by specialist veterinarians, nutritionists and stockmen to meet the specific needs of individuals and the herd
If a disease enters a herd or flock, it can spread rapidly	Protection from inclement weather. Reduces piglet mortality and nutritional stress for dairy cows
Reduced longevity of sows and cows due to the drive to increase production at the expense of fertility	Biosecurity can be enhanced by reducing exposure to, and from, wildlife

Table 2.4 Advantages and disadvantages of intensive production systems in relation to farm animal welfare (Adapted from Wathes et al (2013) adapted from Parlimentary Office for Science and Technology (2012))

These directives, as well as World Organisation for Animal Health standards, highlight the importance of animal health as a central component of FAW (World Organisation for Animal Health, 2016), with the absence of disease and freedom from injury being important parts of animal wellbeing. Table 2.4 highlights that the intensification of animal production presents both advantages, such as biosecurity and better surveillance of disease (Fraser, 2005; Perry *et al,* 2013), as well as concerns in relation to animal health (Farm Animal Welfare Committee, 2012; Parliamentary Office of Science and Technology, 2012; Wathes *et al,* 2013), including production diseases.

2.4.2 Farm animal welfare and production diseases

Production diseases have implications for both the health and welfare of farm animals (Bengtsson and Greko, 2014), in addition to generating inefficiencies which negatively impact upon profitability (PROHEALTH, 2016; no date), including reduced growth and feeding efficiency (Bengtsson and Greko, 2014). Production diseases originate from a complex, multifactorial interaction of bacteria, animal genetics and the environment in which the animal is reared, including the type of housing, feed and management practices used (PROHEALTH, no date). From a production disease perspective, several factors should be considered as part of good welfare practices, including health, productivity, physiology and ethology (Moynagh, 2001). They differ from epidemic diseases (such as foot and mouth disease or avian influenza) which are caused by new infections from outside the farm, and there has

been much greater control and management of these in recent decades (Perry *et al,* 2013).

Although present in all types of animal production systems, the susceptibility or severity increases in intensive production systems (Stenfield, 2004) due to the inherent nature of the systems themselves. It is worth noting that many of the organisms involved are part of the normal flora and so are not susceptible to eradication. The intensification of production, and the environments created within these systems, therefore has implications for the level of infectious challenge (Bengtsson and Greko, 2014), and disease dynamics (Perry *et al,* 2013) incorporating the host, the environment, and the infectious agent, also known as the epidemiological triad (Broom, 2014; Farm Animal Welfare Committee, 2012).

As well as the characteristics of the animals themselves (i.e. the host), stress factors, such as those associated with the animal production environment, along with poor animal welfare can increase an animal's susceptibility to disease by weakening the animals' immune response (Nørrung and Buncic, 2008; Farm Animal Welfare Committee, 2012). Examples include increased stocking density, which can provide an increased build up and opportunity for horizontal transmission of pathogens (Collins and Wall, 2004), compared to outdoor and more extensive animal production systems (Nørrung and Buncic, 2008). All types of animal production system present their own challenges (High Level Panel of Experts on Food Security and Nutrition, 2016), and it is worth noting that production diseases and compromised welfare are not just constrained to intensive production systems and are also prevalent in outdoor, organic and free-range systems depending on the type of livestock and the operation (Collins and Wall, 2004; Wathes *et al,* 2013), and animals kept outdoors are actually more at risk of certain diseases (Perry *et al,*2013), such as foot pad dermatitis (Pagazaurtundua and Warriss, 2007). Rather it is the type, severity, and transmission of these which is distinctive to intensive production systems along with the welfare implications of treating and managing these. For example, the large herd and flock sizes within intensive production systems facilitates the exchange and potential evolution of pathogens within these systems (Saenz *et al,* 2006), with the potential of zoonotic diseases increasing with intensification and the scale or production and subsequent increased demand for meat (Fevre *et al,* 2006; Food and Agriculture Organization of the United Nations, 2011a; Gebreyes *et al,* 2014)

The severity and impact of production disease will vary from one production unit to another, with both the reactive treatments and proactive measures to protect against disease potentially proving costly. Common diseases include respiratory and gastrointestinal disease, locomotor and reproductive conditions (Niemi *et al,* 2015; Jones *et al,* 2016), all of which can have considerable economic losses resulting from mortality and resource inefficiencies such as increased labour and feed, treatment costs and reduced volume or quality of product (meat, milk or eggs) produced (Jones *et al,* 2016). Conversely, both the efficiency of production, and the profitability of the production system can be improved by improving the health status of the animals (Farm Animal Welfare Committee, 2016). Estimates as to the financial impact of production diseases in relation to pigs and poultry are highlighted in table 2.5 and figures 2.2 and 2.3 respectively, and can be as high as €30 and €40 per fattened pig, which could have severe economic consequences for the primary producer.

Production disease	Cost per pig
Mastitis/ MMA**	€9.40
Premature replacement**	€7.00
Parasites	€7.00
Actinobacillus pleuropneumoniae	€6.40*
Mortality	€5.00*
Porcine respiratory disease complex	€4.20*

*Respiratory diseases and mortality costs are per pig in an affected herd
**The cost of mastitis/ MMA (mastitis-metritis-agalactia) and premature replacement have been converted from € per sow to € per fattening pig originating from an affected sow.

Table 2.5 Cost of production diseases per pig (Adapted from PROHEALTH (2015))

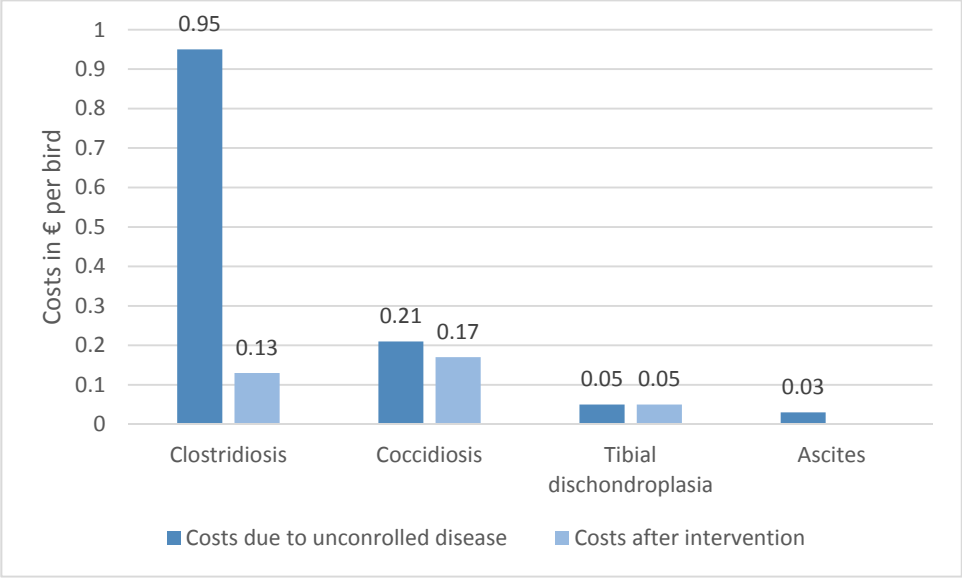


Figure 2.2 Costs of production diseases in broiler chickens (Adapted from PROHEALTH (2016))

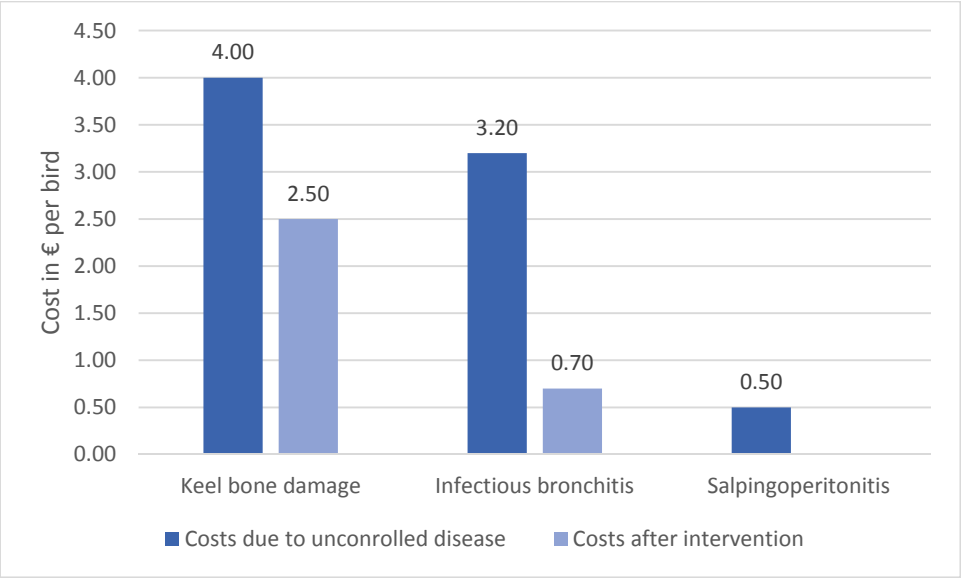


Figure 2.3 Costs of production diseases in layer hens (Adapted from PROHEALTH (2016))

The scale and number of intensive animal production systems is likely to increase. Given the known impacts production diseases have upon animal welfare, efficiency and profits, several different interventions and treatments are being used or developed. These include changes in management and husbandry, hygiene, housing practices, biosecurity measures, in addition to dietary supplements, antibiotics, vaccinations, probiotics and genetic selection of animals (Collins and Wall, 2004; Jones *et al,* 2016). Some of these are relatively simple, whereas others are quite complex. Controversies may also be associated with some applications, for example in association with welfare implications, food safety and novelty concerns, and the inappropriate or unnecessary use of antibiotics in the prevention, rather than treatment of animal diseases (High Level Panel of Experts on Food Security and Nutrition, 2016). For example, the emergence of AMR organisms is becoming an increasingly salient topic in the minds of several different stakeholders within the agri-food as well as public health sectors, including the public, thanks to widespread concern over AMR and the associated implications for public health (van Boeckel *et al,* 2015), such as ineffective treatment for infections and even death (Food Standards Agency, 2016). Agricultural use has been identified as compromising the efficacy of most antimicrobials (Silbergeld *et al,* 2008), with pig farming in particular, identified as one sector where the use of antimicrobials is contributing towards AMR (Rushton *et al*, 2014). Current research would suggest that most antimicrobials are used for animals rather than in humans (Robinson *et al,* 2016), with the total amount

of antimicrobials used worldwide in animal production systems expected to rise to 105,596 (±3,605) tons in 2030 if current trends continue (van Boeckel *et al,* 2015). This is an increase of 67% on the 63,151 (±1,560) tons used in 2010 (van Boeckel *et al,* 2015), and is primarily a result of increasing animal numbers and a shift towards intensive farming practices whereby they are used as one means of maintaining productivity.

Within the European Union, public concern over the sub-therapeutic use of antibiotics has resulted in more stringent controls over the use of antimicrobials i.e. 'Council regulation (EC) No.1831/2003/EC' (2003), compared to other regions such as the United States, where antimicrobials usage is more commonplace (Steinfeld, 2004; Lusk *et al,* 2006). As the public are an important stakeholder group, establishing public perceptions of proactive and reactive interventions is important. This is particularly significant as animal health and welfare standards, and improvements to these in particular, are increasingly being demanded by the public (Broom, 2014). As the ultimate end users of animal based products, there is a need to assess potential concerns in relation to additional proactive and reactive measures against production diseases, especially in light of existing concerns, such as antimicrobial resistance, and FAW standards.

2.5 The importance of public perceptions

The public represent an important user of the food-chain, and can drive demand for specific food products (Jensen, 2006). Failure to take into account societal attitudes and concerns is thought to threaten the legitimacy of the associated regulatory frameworks and regulatory agencies (Frewer *et al,* 2004). Consequently, their concerns and preferences should be taken into consideration in relation to animal production systems and how FAW is monitored, so that effective and acceptable legislative regulations can be implemented (Bennett *et a*l, 2002a).

Consumer attitudes are an important determinant of consumer decision-making and behavioural intentions, as well as actual behaviours. An attitude can be described as the tendency to evaluate an entity or object with a certain degree of favour or disfavour (Eagly and Chaiken, 1993). Numerous studies have demonstrated that attitude is a reliable predictor of intention in relation to food choice, including predicting behavioural intention in relation to behaviours such as healthy eating, organic food consumption, adoption of personalised nutrition or consumption of

animal derived foods produced using higher FAW (Brouwer *et al,* 2015; Arvola *et al,* 2008; Nocella *et al,* 2012; Poínhois *et al,* 2015). It is therefore important to study attitudes concerning a specific behaviour or product, in order to gain a better understanding of and individuals' behavioural intentions regarding subsequent consumption decisions.

Whilst there is a considerable body of research focused on consumer attitudes and WTP for improved FAW (see, *inter alia* Harper and Henson, 2001), the existing body of literature may be more applicable to interventions aimed at introducing higher FAW standards in general, rather than understanding consumer perceptions of FAW within intensive animal production systems. In addition, as the assessment of animal production systems depends on the alternatives production systems available at the time, the assessment of intensive systems and their acceptability, may change as time progresses (Bennett *et al,* 2012). Thus, what was acceptable previously or is acceptable at the present time may become unacceptable in the future (Brambell Report, 1965) i.e. the sustainability and acceptability of an animal production system needs to be considered over space and time (Broom, 2014). As a result, it is important to assess how public attitudes to FAW related to animal production diseases have changed over time, in order to establish potential criteria that may facilitate or hinder the adoption of interventions.

At the same time as the demand for animal derived products is increasing, consumers and/ or citizens are becoming increasingly concerned about several different aspects within the agri-food domain, including the quality and safety of raw ingredients and the technologies and processes involved in its manufacture (Frewer and Salter, 2002; Zingg *et al,* 2013). Several of these concerns relate to animal production including FAW (Harper and Henson, 2001), the environment and food safety (Grunert, 2005). Previous research has demonstrated that innovations, can be met with societal resistance, as has been the case with GM crops (Frewer *et al*, 2013), and vaccination (Zingg and Siegrist, 2012). Intensive animal production systems are already a contentious subject in the minds of the public, yet little is known about the proactive and reactive intervention measures that have been developed to address the rise of production diseases within intensive animal production systems. These interventions may or may not be acceptable to society, including consumers of the animal based products and wider members of the public (i.e. citizens), who whilst not wanting to consume ultimate end products of these

systems, still have an interest in how they are managed and the experience of the animals within these.

This potential disparity in opinions and attitudes between citizens and consumers is acknowledged in the wider FAW literature (Harper and Henson, 2001; Grunert, 2006). This corpus of knowledge suggests that both citizens and consumers tend to express favourable attitudes towards higher FAW production systems, and concerns over more modern or intensive production systems (Blandford *et al*, 2002). However, consumers can express these attitudes through the purchasing of animal based products from higher welfare systems (such as free range), whereas citizens, including vegetarians and vegans, may not purchase animal products regardless of the welfare standards with which they are associated, yet still have an interest in the issues surrounding the implementation of and production of these products (Grunert, 2006).

An individual's concerns over FAW and animal production can give rise to legislative initiatives and widespread regulation changes (Spooner *et al,* 2014). Citizens can participate in political processes to change and even prevent certain management practices (Grunert, 2006). An example is provided by citizen lobbying to instigate the Californian Proposition 2 vote to outlaw battery cages in egg production (Lusk, 2010). This is also an important mechanism for people who do not buy animal products to express views via discussions with government and other stakeholders to maintain and improve policy and legislative standards at an acceptable level (Kjærnes and Lavik, 2007).

Despite the levels of concern reported by the public (Lusk *et al,* 2007; European Commission, 2016), research indicates that attitudes towards FAW do not always translate into purchase decisions (Harper and Henson, 2001; Toma *et al,* 2011), as indicated in the discrepancy between reported willingness-to-pay and existing sales and market share information (Baltzar, 2004; Grunert, 2006). This attitude-behaviour gap may be explained by the potential discrepancy between an individual's dual role as both a citizen and as a consumer (te Velde *et al,* 2002; Grunert, 2006; Boogaard *et al*, 2011), with individuals behaving differently, and having different concerns, in different contexts.

Individuals may express preferences for higher welfare systems when questioned (Johansson- Stenman, 2006; Vanhonacker *et al,* 2007). In other words, when directly

questioned, they may report high levels of FAW concern and consequently demonstrate a potentially inflated WTP, or levels of WTP which do not correspond to market shares. In reality, consumers may not be as logical in their choices as we are led to believe (Lusk, 2014). Although individuals appear to be concerned about FAW in the context of food production (European Commission, 2007), attitudes towards FAW and higher welfare production systems could be weak (Grunert, 2006) or insufficiently activated (Verbeke, 2009), with attitude activation theory suggesting that attitudes are only activated automatically if they are of sufficient strength (Fazio *et al,* 1986). Therefore, if only weak attitudes to FAW are held, they will not be activated in a purchase situation. In addition, most individuals are also not aware of the situational factors which influence their decision whilst shopping. Consequently, FAW concerns may not necessarily be utilised in consumer decision making (Blandford, *et al,* 2002), or arise spontaneously when purchase decisions are made (Harper and Henson, 2001). Individuals may also encounter a number of conscious and/ or subconscious barriers that could prevent them from acting in accordance to their ethical beliefs (Schröder and McEachern, 2004), and as a result they may end up purchasing animal based products produced using production methods that, if they were prompted to think about them, could cause them concern with regard to FAW (Stampfli *et al*., 2010).

These differences are potentially important when developing FAW legislation and policies, which need to align with the preferences and priorities of all societal stakeholders concerned, and need to take into consideration the various ways that individuals can change their behaviour e.g. such as avoiding or purchasing certain products, or their political behaviours (Blandford *et al,* 2002). Therefore, there is a need to ensure and that everyone has the right to express their choices. In other words, production practices used need to be acceptable to citizens, whilst also ensuring that the market meets the demands and needs of consumers, maintaining appropriate and acceptable levels of pricing (Ingenbleek *et al,* 2012).

Despite their concerns over FAW and modern animal production systems, the public may have very little or no understanding of the technicalities of modern farming practices (Harper and Henson, 2001), and are unfamiliar with several topics or norms associated with FAW (te Velde *et al,* 2002; Lassen *et al,* 2006). This unfamiliarity and lack of knowledge may create misunderstandings, and it is important to address these. Identifying and understanding public attitudes and concerns, including their

perceptions of risks and benefits in relation to intensive farming practices including those surrounding production diseases is important, and will ensure that the processes and interventions align with the values, needs and expectations of society (Asveld *et al*, 2015). Conducting research to understand attitudes and perceptions, and how these change in relation to external events and cultural shifts, is therefore an essential part of addressing societal expectations, and ensuring that acceptable regulatory and production practices are in, The available literature on perceptions and attitudes towards FAW will therefore be reviewed to map consensus or heterogeneity in views towards current and potential animal production systems, and the extent to which these views and concerns relate to production diseases.

2.6 Summary

This chapter introduced the concept of food security and the rise of intensive animal production systems, and the implications that these systems have on both FAW and on production diseases. It highlighted the importance of establishing and taking into consideration societal concern for FAW and animal health, especially in relation to public attitudes towards production diseases, and potential interventions used to address these. In light of this it is important to establish public attitudes to FAW and specifically production diseases, which is explored in the following chapter.

Chapter 3. Attitudes towards farm animal welfare

3.1 Introduction

The conclusions of chapter 2 identified a need to map consumer and/ or citizen attitudes towards FAW to establish whether there is any consensus or heterogeneity regarding these with respect towards FAW within intensive animal production systems, the extent to which perceptions of, and attitudes towards, FAW, relate to production diseases, and whether systematic demographic and socio-cultural differences exist in attitudes and perceptions across different population groups. The overall objective of the research presented here is to synthesise the existing literature in relation to FAW, and explore the findings to meet the aforementioned research gaps. To meet this objective, systematic review methodology was applied to identify studies relevant to the research objectives. This chapter describes state of the art methodological approaches to conducting a systematic review. The scope of the review is then defined, with boundaries defined within the context of public concern over FAW and animal production. The chapter then describes in detail the review methodology applied before finally presenting and discussing the findings, including the key conclusions and research gaps identified regarding attitudes towards, and perceptions of, FAW in animal production systems.

3.2 Background

3.2.1 Systematic reviews

As the volume of research literature increases, the challenge of assessing and presenting the totality of evidence in relation to a given topic also grows (Solesbury, 2001; Petticrew and Roberts, 2008; Organisation for Economic Co-operation and Development, 2016). Traditionally within the social science domain, narrative reviews have been conducted (EPPI-Centre, 2016) to collate evidence on a given topic and provide an overview to interested stakeholders. Whilst this more traditional approach to conducting a literature review offers an insight into the research consensus (or lack of) on a topic, its ad-hoc approach means it is often prone to bias and does not necessarily involve the totality of evidence on a given topic (Torgerson 2003), or the exploration of the weight of evidence and heterogeneity within the data (Koricheva *et al*, 2013).

Systematic review methodology offers a more strategic approach to summarising the literature, and "*seeks to collate all evidence that fits pre-specified eligibility criteria to address a specific research question"* (Higgins and Green, 2011). A systematic review seeks to apply scientific principles to the literature search process and reviewing of the evidence compared to the more traditional approach (Pettigrew and Roberts, 2008). This is achieved by utilising a more formalised and systematic approach to identifying evidence in relation to a given topic, by using explicit, pre-specified methods (Campbell Collaboration, 2014), including grey literature, which can often be overlooked. This level of detail, and transparency over the review process (table 3.1), would enable the review to be replicated, thus allowing for the appropriateness of the methods used to be judged by others, including those using the information. In addition, it provides an increased level of robustness, and reduces bias associated with the review process (Pullin and Stewart, 2006), and help to understand uncertainty and highlights evidence gaps (Pettigrew and Roberts, 2008). This transparent and systematic approach enables a large amount of data to be reviewed, assessed, critiqued and presented in an easily accessible format (Higgins and Green, 2011).

Criteria	Example
Transparent	Clearly written and readily available research questions and objectives.
Explicit	Understandable and clearly stated details of the review including; objectives and methods, techniques for data extraction, quality appraisal and data synthesis.
Stepwise	Follows several pre-defined steps, which would allow another researcher to repeat the review.
Accountable	Answerable, responsible and justified.
Useable	The findings of the review need to be useable, and so involvement of stakeholders interested in the research should be encouraged.

Table 3.1 Research synthesis criteria (Adapted from EPPI-Centre (2009) and Gough* et al *(2012))

Unlike a traditional review, a systematic review is normally followed by either a quantitative (meta-analysis) or a qualitative (e.g. narrative) data integration approach, or evidence synthesis approach. Meta-analysis is used to assess the effectiveness of a given factor or intervention, and is known for its ability to assess the validity of findings and the presence of bias in a given topic (Higgins and Green, 2011), whereas qualitative evidence synthesis is more concerned with the interpretation of

results rather than aggregation (Harden, 2010), and can provide insights into the rigour and transferability of research results to a given setting. These synthesised outcomes of the review process can help to reduce vast volumes of information into more manageable amounts (Campbell Collaboration, 2014), making review results more accessible to a wider range of interested stakeholders.

Evidence synthesis is at the heart of the shift towards evidence-based practice and policy and the need to make better use of research findings (Sandelowski *et al*, 2006), and are especially useful when a more overall picture is needed to direct future research efforts. This is especially important to those who may use the output of research reviews to help in their decision making, and this could be a variety of different stakeholders (Pettigrew and Roberts, 2008), including decision makers and policy makers. These stakeholders are becoming increasingly interested in evidenced-based decision making and practice (Pettigrew and Roberts, 2008; Gough *et al,* 2012), and may have little time or experience in dealing with scientific literature (Gough *et al,* 2012). The role and value of systematic review and evidence synthesis methodology, and the need to be able to robustly and rigorously present research findings, therefore has a role to play in the shaping of future research and policy (Suri and Clarke, 2009), and looks set to gain increased usage in social science (Organisation for Economic Co-operation and Development, 2016). Consequently, there is an increased need for applying systematic reviews across all scientific domains, including within social science.

In light of the rigorous standards which need to be applied to both meta-analysis and systematic review, a number of databases and protocol guidance handbooks have been developed to ensure that research undertaken conforms to a required standard which is both rigorous and transparent, thereby enabling the analysis to be repeated if needed (Koricheva *et al*, 2013). This rigorous approach originated in the health and medical sciences in association with the Cochrane Collaboration, with later the Campbell Collaboration (education and social care, employment and crime and justice), Centre for Reviews and Dissemination (health and social sciences) and the EPPI-Centre (education, social policy, health promotion and public health) being established to provide guidance on best practice in their respective disciplines, and importantly, also providing a forum for discussion for researchers on methodological matters.

Systematic review is regarded as the "*gold standard*" for research in an ever-diverse array of disciplines, including environmental sciences (Lortie, 2014), medicine (Higgins and Green, 2011), and social interventions (Campbell Collaboration, 2014) to name a few. Despite the widespread use in these disciplines, evidence based methods have more infrequently been used in other areas of social science such as consumer science, and systematic reviews have only begun to receive attention over the past decade, with the existing reviews within the discipline utilising different aspects of best practice.

Due to the variability in study design and methods used within social science, it has been suggested that there is a lack of definitive guidelines, transparency and rigour in reviews, with guidelines such as those provide by the Cochrane Library not being applicable to non-intervention consumer studies. This is reflected by the EPPI-Centre (2016) which state that "*The methods used in systematic reviews have traditionally given more attention to research reporting evaluations of interventions, than to other kinds of research. Ways of locating, reviewing and synthesising non-intervention research are thus an important challenge."* There is a need to ensure that systematic review, and subsequent evidence synthesis methods within the discipline meet the same rigorous standards as applied elsewhere, more specifically aspects such as transparent, structured protocols need to be addressed to ensure that reliable results are obtained. The review process outlined in section 3.3 therefore seeks to follow best practice from existing reviews conducted within social science and other disciplines where more definitive guidelines exist, to demonstrate best practice, transparency and rigour in the systematic review process.

3.2.2 Rise of the concerned consumer

FAW is also of interest from the perspective of *ethical consumerism,* with intensive animal production systems under increased scrutiny from the public who appear to be highly concerned about FAW (Harper and Henson, 2001). From a European perspective Eurobarometer surveys have frequently shown the majority of European citizens to be concerned over animal production systems and animal wellbeing within these, with 94% of Europeans considering the protection of the welfare of farm animals as important (European Commission, 2016). It is also a topic of importance to the European public, receiving an average rating of 7.8/ 10, with the majority

(80%) rating it is an important[1] (European Commission, 2007). In addition, numerous studies have highlighted public concern in relation to a number of different farming practices such as castration (Heid and Hamm, 2013), transport (Miele *et al,* 2011), slaughter (Vanhonacker *et al,* 2010) and the type of animal housing systems used (Tonsor *et al,* 2009; de Jonge and van Trijp, 2013), which has contributed in a number of regulation changes or production aspects to be banned altogether (Harvey and Hubbard, 2013a), such as battery cages for hens 'Council directive 1999/74/EC' (1999) in Europe and Proposition 2 in the USA (Malone and Lusk, 2016).

For some individuals, concerns over FAW are based on concerns for their own wellbeing, rather than the wellbeing of the animals involved in production i.e. a human rather than an animal perspective. Indeed, it could be said this forms a "warm glow" effect a so-called form of impure altruism (Johansson-Stenman, 2006), whereby human concerns make humans feel good, but do not in themselves improve the welfare conditions of the animals under consideration (Lusk and Norwood, 2011). Public concerns over food safety also contribute to this. As described in chapter 2, the public are concerned over the risks surrounding food (Frewer, 2000; Frewer *et al,* 2016) following recent food scares and high levels of media coverage surrounding these (Tonsor and Olynk, 2011; Vanhonacker and Verbeke, 2014; Miele *et al,* 2011). Links between FAW and human health have been established (Pinar, 2006), particularly from a consumer perspective (Hall and Sandilands, 2007; Bennett *et al,* 2012), with consumers now wanting to have FAW reassurances in relation to the food they eat (World Bank, 2011).

There is also the realisation that what is bad for the animal is potentially bad for the consumer (Hall and Sandilands, 2007), such as animal health and wellbeing, including disease. As a result, consumers are becoming increasingly aware of how their food is being produced, and subsequently are demanding higher product standards (Scudamore, 2007) and more process related product characteristics such as organic, and welfare friendly (Grunert *et al,* 2004). These credence quality characteristics, serve as guarantees, or indicators of, product safety and quality in the mind of consumers (Zingg *et al,* 2013), and this includes FAW (Grunert *et al*, 2004). In addition, they are demonstrating an increased interest in how the food they

[1] 80% gave the importance of FAW a score of greater than 6 on a 10 point Likert scale, where 1 was not at all important and 10 was very important.

eat is produced (Grunert, 2005), resulting in an increased consumer demand for greater transparency in production.

The available evidence does not suggest that more intensive systems lead to unsafe, or less safe food products, than more extensive, or free-range systems (Norwood and Lusk, 2013), with outdoor reared animals having the potential to be exposed to more pathogens than those in intensive systems (Collins and Wall, 2004). However, there is some indication that animal health (and subsequently welfare) is linked to the production of safe food, and subsequently human health (Norwood and Lusk, 2013; Collins and Wall, 2004), with the spread of certain food-borne pathogens linked to intensive production systems, including *Escherichia coli, Listeria monocytogenes*, and *Campylobacter jejuni* (Perry *et al,* 2013).

The public are concerned about routine antibiotic and growth hormone use in animals used to produce food (Miele *et al,* 2011), and through concerns over diseased animals being included into the food chain, usually because of disease epidemics. This has been emphasised by recent (and not so recent) high profile food scares such as BSE (Grunert, 2004) and to a lesser extent foot and mouth disease (Breakwell, 2003; Scudamore, 2007), and more recently, avian influenza (Rowe *et al,* 2008). The literature focuses more on disease epidemics rather than on production diseases that are inherent to intensive production systems. This reflects the difficulty in gaining public perceptions, with perceptions in relation to disease only assessed after the occurrence of an epidemic outbreak, usually with the specific disease hits the headlines (Scudamore, 2007), rather than being assessed in relation to production diseases.

In terms of intensive production systems, and interventions and preventative measures to treat production diseases which arise within these, European veterinary legislation has minimum requirements in terms of quality, efficacy and safety (Scudamore, 2007) in relation to ensuring both animal and human health. The public are concerned about interventions and preventative measures both used and proposed including vaccinations against epidemics (Zingg and Siegrist, 2012), prophylactic antibiotic use (Vanhonacker *et al,* 2010; Miele *et al,* 2011) and probiotics (van Wezemael *et al,* 2011), with only just over a third (37.6%) accepting the addition of protective bacteria to feed of beef cattle (Wezemael *et al,* 2011) and almost a quarter finding this unacceptable (24.1%, with the rest being neutral).

It would therefore appear that the public are concerned in relation to animal production, health and welfare, including potential interventions used within these systems. However, the extent to which this relates to production diseases and their mitigation and reduction strategies is unknown. Given the rise in intensive animal production systems, and the impact production diseases have within these, it seems pertinent to explore this gap and assess attitudes towards and the acceptability of these.

3.2.3 Review objectives

There has, to date, been no systematic review of public attitudes towards FAW. In particular, it is not clear to what extent the literature on perceptions of, and attitudes towards, FAW is related to production diseases and associated mitigation and/ or management strategies. To enable this to be done, it is important to gain an understanding of the underpinning ethical assumptions (Lassen *et al,* 2006), including the moral, cultural or sociological factors that form the basis of public concern, in order to develop acceptable animal production systems in line with consumer priorities, and to facilitate effective communication about these.

In light of the above, this review seeks to establish; 1) the public's attitudes towards FAW; and 2) what are the public's attitudes towards interventions to improve FAW through reduction in the incidence of production diseases. Heterogeneity within the data will be explored in relation to several secondary objectives, specifically to determine whether; 3) socio-demographic factors affect attitudes and beliefs in relation to FAW; 4) socio-economic factors affect attitudes and beliefs in relation to FAW; 5) different aspects of welfare affect attitudes and beliefs in relation to FAW, and 6) citizens are more concerned than consumers in relation to FAW.

3.3 Methods

3.3.1 Literature search

A protocol for the review was published online prior to its commencement to provide transparency and to enable feedback from other researchers (Clark *et al,* 2014a; Appendix A). Four different databases were searched; Scopus, ISI Web of Knowledge, AgEcon Search and Google Scholar, with the latter two enabling the identification of relevant grey literature. Databases were searched using a combination of different search terms (table 3.2), with combinations specific to each database. Only studies from the past 20 years (1995 onwards) were included.

Search strings were trialled and refined in a multistep process, with the face validity of each search addressed by checking search results for key authors identified through an initial search. Animal specific search terms were not used as they frequently returned studies that originated in the natural rather than the social sciences. A copy of the trial and final search terms are included in Appendix B. Key authors in the field were also contacted for additional sources of grey literature or any unpublished works. Returned studies were exported into an Endnote library (Thomson Reuters, 2011), and duplicates were removed. Studies were then excluded in a two-stage sifting process in relation to a set of predetermined inclusion criteria as described below. Reference lists of included studies were screened to identify any further relevant studies.

Type of Study and Outcome	Attitude*OR perception* OR belief* OR valu* OR intention*OR behave*OR purchas*OR ethic*OR pref*OR moral*OR consumer
AND	
Animal Species	farm animal OR production animal
AND	
Animal Welfare	Animal welfare OR health OR disease OR welfare OR production disease

Table 3.2 Keywords considered for the searches

Qualitative and quantitative studies which measured consumer attitudes, preferences, perceptions, beliefs and perceived ethical obligation towards FAW were included. Although WTP studies can be used as a proxy for attitudes (Ryan and Spash, 2011), these were included in a separate review to enable a quantitative analysis of the results. All studies included sampled members of the public. All farm animal types, animal based products and aspects of welfare were considered eligible for inclusion, with welfare measures being those described to participants as altering the lives in animals in some way, either specifically (e.g. tail docking) or more generally, (e.g. use of outdoor production systems). Welfare measures in relation to production diseases targeted the reduction or control of diseases. Antibiotic use was considered as a proxy for interventions to reduce production diseases (Hughes and Heritage, 2002), rather than as a growth promoter unless specifically specified. Only studies which were written in English were included. If two or more studies reported duplicate populations, the study presenting the most information for analysis was retained. Duplicate studies were not coded, but were checked to ensure that no extra

details or covariates were missed and that their findings concurred with results of the review. An overview of the search process is presented in the PRISMA[2] flow diagram (Figure 3.1; Moher *et al* 2009), including the number of studies excluded at each stage. References to studies excluded at the full text stage and a list of all studies included in the review can be found in Appendix C.

3.3.2 Data extraction and analysis

As quantitative and qualitative data were included in the analysis, and a large variety of measures and scales were used to measure consumer attitudes, meta-analysis was not possible. A narrative analysis was therefore conducted following the Economic and Social Research Council narrative synthesis guidelines (Popay *et al*, 2006). Papers included were first read and a summary table created to provide an overview of the different studies (Appendix D). This provided a mechanism for the researcher to become familiar with the data before coding, and provided an initial idea of the codes and subsequent themes to be used. This formed the basis of the thematic coding approach taken (Braun and Clarke, 2006; Thomas and Harden, 2008). Data was then analysed using QSR Nvivo 10 (QSR International Ltd, 2012). A computer based coding approach was used due to the large number of studies included in the analysis. The researcher retained an active role in making conceptual and interpretative decisions in relation to the data analysis (Weitzman, 2000).

Coding of the papers deviates from that stated in the protocol (Clark *et al,* 2014a; Appendix A), with the qualitative and quantitative data being analysed in a single, as opposed to separate streams. The TPB was not used in analysis, due to the returned data not fitting within the framework, with the free-coding retaining much more information from the data. Free-coding also enabled a data driven approach and greater researcher reflexivity. Although some individual studies did demonstrate elements of the TPB, these specifically incorporated the TPB into their methodologies. Deviating from the protocol may induce bias into the review. However, this is unlikely due to the comprehensiveness of the search terms used, and the nature and level of transparency in the analysis, resulting in maximum data inclusion.

[2] PRISMA stands for the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, and is an evidence-based set of items used to established the minimum reporting standards in systematic reviews and meta-analyses (Moher *et al,* 2009).

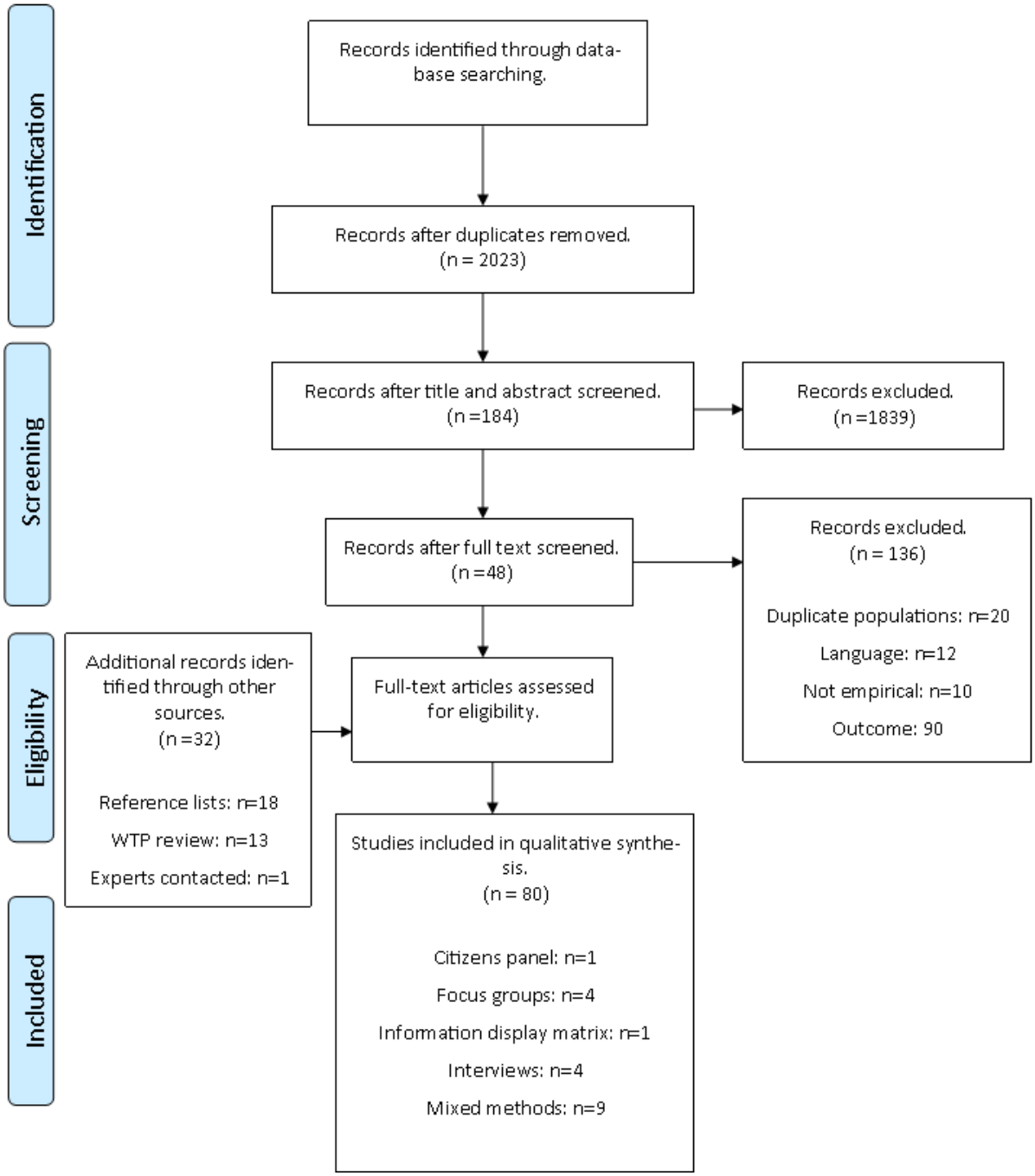


Figure 3.1 A PRISMA flow diagram of the search process

Following the researcher familiarising themselves with the studies in the data base, open-coding was initially used to extract data from studies, with codes also being generated in relation to all objectives mentioned in section 3.2.3. The initial coding framework was then refined after half of the studies were coded to provide a more representative framework. This involved rearranging different codes or breaking them down into multiple separate codes to create more detail. Codes were renamed to make them more informative and reflective of the content they included. The remaining studies were then coded based on the new framework. These final codes were then grouped into themes (table 3.3), based on the primary researchers' conceptual insight, and were discussed and refined with the rest of the research team.

3.3.3 Critical appraisal

Studies were critically appraised to assess bias and validity. A critical appraisal document was developed to enable appraisal of the diverse nature of studies included in the review. A separate tool was developed for qualitative and quantitative studies due to the inherent differences in the nature of the methods (Bryman, 2012) and both can be found in Appendix E. The tool was developed by consulting several existing guidelines and recommendations and provided a document relevant to a non-healthcare context. The tool considered construct validity, internal and external validity, and the reliability of the studies included in the analysis (Yin, 2009) in the form of seven different criteria commonly used to assess study quality; study aims, study design, recruitment of participants, data collection, data analysis, ethical considerations of the study and the discussion of findings, with the role of the researcher in relation to data collection and analysis being assessed in qualitative studies providing an eighth category. Each category was assigned a risk of bias score based in a 5-point scale, ranging from very high to very low according to the criteria in each section. The overall study quality was then judged based on the quality of each of the criteria. For mixed methods studies, critical appraisal was conducted for each separate method. A summary of the critical appraisal assessment for all included studies can be found in Appendix F.

No studies were excluded based on the critical appraisal, with the findings being taken into account during the analysis when assessing the overall strength of evidence as part the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) analysis (Meader *et al,* 2014). The GRADE framework

was also used to provide an overview of the strength of evidence and was again adapted to enable the inclusion of qualitative research (Stewart *et al,* 2015). An overall assessment based on the results of each of the five was then made. A summary of the GRADE assessment results can be found in Appendix G.

- **Risk of bias** – addressed through critical appraisal of each study using the risk of bias tool, and was graded as a high, moderate or low risk of bias.
- **Inconsistency** – traditionally done though forest plots and I^2 (heterogeneity) values. This was evaluated from the summary of evidence table for overall variation, and during data analysis to establish how much variation there was in each theme. This was assessed as high, moderate, or low, with a higher risk of bias associated with a higher variation.
- **Indirectness** – was established by examining whether studies were focused on addressing the PICO (population, intervention, control, outcome) elements of the research question, such as whether the population were members of the public and whether FAW was the sole focus of the research. This was assessed as high, moderate or low.
- **Imprecision** – due to the qualitative nature of the analysis 95% confidence intervals (CI) were not available, therefore this was determined from several factors. For qualitative studies, this included examination of how confident the authors were of their findings and also assessing study generalizability. For quantitative studies, this was assessed through examining the generalizability of the findings, whether any potential confounding factors were explicitly mentioned and the sample size. Imprecision was assessed as high, moderate or low.
- **Publication bias** – this is traditionally assessed through funnel plots but due to the thematic analysis used this was not possible. Differences in outcomes between published and unpublished studies were therefore examined, and the risk of bias assessed as either strongly suspected or undetected depending on whether differences were present or not.

3.4 Results

3.4.1 Overview

80 studies were included for analysis and most studies included were quantitative (n=62). Of these, 43 were surveys, 17 were WTP studies, one was based on modelling existing data and another was an information display matrix. Of the nine

qualitative studies, there were four focus groups, four interviews and one citizen's panel. The remaining nine studies applied mixed methods, with 5 containing both qualitative and quantitative methods, three containing multiple qualitative methods and one containing multiple quantitative methods.

Most studies were conducted in Europe (n=59), with Northern and Western European countries most commonly represented. Of the remaining studies, 14 were conducted in North America, two in South America, two in Australasia, two in Asia, one in Africa, and one across multiple regions. Nearly half of studies (n=33) did not focus on specific animal types. Of those that did, pigs were most commonly included (n=17), followed by multiple named animal types (n=8), broiler chickens (n=8), and layer hens (n=6), with fish, lamb, beef and dairy cows being the only other animal types studied.

The majority of studies were peer reviewed journal articles (n=65). The remaining 15 were conference papers, project reports, theses and working papers. Critical appraisal revealed that studies were of mixed quality and therefore a mixed risk of bias. Generally, quantitative studies were rated as less risk of bias than qualitative studies, with only one qualitative study having low risk of bias. All qualitative studies had an appropriate research design and presented and discussed the results adequately. Most studies also had a clear statement of aims. Information regarding participant recruitment, and how data was collected and analysed was not always as clear or indeed reported. Justification of the sample size, whether the data collection addressed the research issue, whether data analysis was sufficiently rigorous and acknowledgment of limitations were generally least frequently or badly reported. No qualitative studies discussed obtaining ethical approval or the role of the researcher in data collection or analysis.

Most of the quantitative studies provided clear statements of study aims. When this was not the case it was due to elements being unclear. Most quantitative studies had an appropriate research design, although few provided a justification of the methods used. Details surrounding participant recruitment were unclear, in particular in relation to the justification of the sample size and reporting the response rate. The majority of studies provided sufficient information concerning data collection, analysis and reporting of findings. However, information regarding the reliability and validity of the instrument, prevention of selective use of data and study limitations were less frequently reported. Findings were not always adequately discussed, or discussed in

relation to the original research aims and objectives. Again, ethical considerations associated with the study design were rarely considered, being mentioned in nine of the 62 studies. Risk of bias and reporting standards for mixed methods studies were much the same as for the qualitative and quantitative studies. Data analysis and the discussion of findings were assigned a higher risk of bias, mostly for the qualitative studies. This could be due to space limitations of journals, resulting in insufficient space for enough detail about multiple methods.

The GRADE assessment (outlined in section 3.3.3) indicated a moderate strength (or quality) of evidence, suggesting that results of the review should be interpreted with caution. Publication bias was not detected, as there appeared to be no differences in results between peer reviewed and non-peer reviewed studies. Indirectness was low, with most studies involving participants drawn from the public, and designed specifically to examine perceptions of, and attitudes towards FAW. Imprecision was high, with few studies acknowledging cofounding factors which may influence their results in particular. Finally, there was a moderate risk of bias because of inconsistency across some themes, but consistent findings across others. Table 3.3 provides an overview of the themes included in the review, and the subthemes they were derived from. Supporting quotes for each theme can be found in Appendix H.

Theme	Subtheme
Concept of Welfare	Definition Welfare Naturalness Humane Treatment (inc. production diseases)
Attitudes Towards Welfare	Overall Animal Type Population Characteristics
Role and Orientation	Citizens vs. Consumer Role Anthropocentric vs. Zooncentric Concerns
Behaviour	Consumption Patterns Willingness to Pay
Barriers and Facilitators	Barriers to Consumption Facilitators of Consumption
Mediators	Trust Responsibility Knowledge

Table 3.3 A summary of themes from included studies (n=80)

3.4.2 Concept of welfare

Definition of welfare

Although what was thought to constitute as good FAW varied, humane treatment and naturalness were central to acceptability. There was also a growing recognition of FAW beyond health and housing, taking into account 'off the farm aspects' such as transport and slaughter, and the psychological aspects of welfare including the animals' natural behaviours and instincts, with the latter being more of a moral consideration and so more contested by the public. This suggests that both consumers and citizens utilise a holistic view of welfare and health, although these may not always be equal in terms of the weight given to each. Study participants acknowledged that what was bad for the animals' welfare and health ultimately had negative consequences for consumers too, particularly in relation to the control of disease, and negativity regarding the use of antibiotics in intensive production systems, with all linked to human health concerns. In relation to health and treatment, there was evidence that both consumers and citizens acknowledge that antibiotic use cannot totally be avoided, with concerns primarily relating to their overuse.

Naturalness

Naturalness was central to attitudes and concerns in relation to both the animals' behaviours and living conditions. It was thought to be important for animals' physical and psychological wellbeing, with the hampering of natural behaviours perceived as having a negative impact on the animals' overall health. "Naturalness" was defined as providing enough space and associated freedom to allow the animals to behave according to their natural instincts, and included them having access outdoors and to un-adulterated feed, as exemplified in the following quote.

"Frequent references were made to animals "just being outside", "having their feet on turf, not just concrete", "grazing out" and "being able to get outside and breathe fresh air and feel daylight". Most regarded natural living as being consistent with animals' natural predispositions …"

Spooner *et al* (2014)

Modern, intensive systems were therefore typically viewed as unnatural as they breached one or more of these criteria. Conversely, more traditional, extensive and outdoor systems were viewed as more natural and as producing higher quality products. Despite overriding preferences for naturalness, there was some benefits associated with modern production systems such as improved hygiene.

Humane treatment

Perceptions and attitudes of study participants indicated that the animals' health and basic physiological needs were linked to various factors including access to natural light, cleanliness and sufficient space (avoidance of overcrowding). Unsurprisingly, considering how central naturalness was in determining welfare, efforts to protect health at the expense of naturalness were not supported. Linked to this was the control and absence of disease. No studies focused specifically on production diseases, although the results of 21 studies included reference to antibiotic use. Concerns surrounding disease were linked to cramped conditions leading to higher disease prevalence, and the preventative and overuse of antibiotics. Treatment of disease and injury was important, and the use of antibiotics in this context was considered acceptable. Addition of antibiotics to animal feed was viewed as unnatural and inappropriate, along with other additives such as growth hormones. Feed in general was considered an important element of animal nutrition and health.

Together with animal feed, "on the farm", housing conditions were the most frequently studied aspect of welfare. These were most commonly discussed in relation to the amount of space animals had, the cleanliness of the housing conditions, and the naturalness of the environment, for example, whether animals had outdoor access. Access to sufficient food and water was also considered important. Intensive systems, such as barns, were considered too cramped. Outdoor access and lower stocking densities were preferred. Study participants tended to express the view that alternatives to current practices were needed, in particular in relation to the use of battery cages in poultry, and gestation crates and castration without anaesthetic in pigs, which were considered inhumane. Good husbandry practices were also mentioned with concerns raised in relation to neglect and mistreatment, as highlighted in the below quote. Good husbandry was thought to include regular animal contact and careful handling, and it was recognised that this is more difficult in the industrialised context modern farming occupies.

"Firstly, focus group participants believed that low intensity farming systems could provide better animal welfare than high intensity industrialised systems that rely on confined housing. This was due to concerns about space, freedom, the difficulty of farmers fulfilling their roles as animal carers in 'industrial' contexts"

Miele *et al* (2011)

Concerns over animal transport and slaughter conditions were raised (and often associated). Slaughter conditions were deemed important, primarily in relation to ensuring a quick and pain-free death to minimise suffering. Conditions during transport, such as access to food and water and the length of transportation were also thought important, and study participants indicated that the duration needed to be as short as possible. Both factors varied in importance. Concerns were not always raised spontaneously during qualitative studies.

The consideration of psychological wellbeing of animals was thought to represent an important part of humane treatment, although there were more diverse views on this. The majority believed that animals had the capability to suffer psychologically and emotionally. The animals' integrity and ability to express natural behaviours was perceived as an essential part of achieving psychological wellbeing, which was central to animals being able to live a natural life. This was also associated with housing conditions, especially animals' ability to interact with other animals, space restrictions and freedom to move around housing areas.

3.4.3 Attitudes towards welfare

Overall

Although positive and negative attitudes towards modern farming systems were identified, study participants were also concerned about current FAW standards. Participants viewed modern production systems as' bad, cruel, and unnatural', which generated a high level of concern. Industrial efficiency was viewed negatively and invariably led to more traditional, smaller and lower intensity farms being preferred. In quantitative studies, the majority of participants reported being concerned about FAW, with the proportion ranging between 46-86% (Bennett and Blaney, 2003; McKendree *et al*, 2014), more commonly towards the higher end of this range. Those who viewed contemporary farming practices more positively were more appreciative of modern production, citing benefits such as more sanitary conditions, greater efficiency and improved welfare. However, these attitudes were normally associated with concerns in relation to contemporary practices, with increased efficiency and productivity believed to occur at the expense of welfare, as illustrated below.

"In the present study, people also experienced dilemmas. On the one hand, respondents strongly emphasised the importance of animals' naturalness in pig production, referring to as little human interference as possible. As such, pig production reflects 'naturality' referring to "farming's interactions with nature, animals and the soil but also through its dependence on nature" (Boogaard et al., 2010a:

p. 34). But on the other hand, respondents appreciated certain aspects of modernity – such as hygienic farming practices, efficiency and high production – because these make pork affordable and represent technological innovations able to contribute to animal welfare, e.g. climate control and sprinkler systems"

Boogaard *et al* (2011)

Although negative attitudes toward modern production were raised overall, the level of negativity of these attitudes varied between animal types. Layer hens and broiler chickens were generally viewed as farmed in the worst conditions when considering FAW, and conditions for dairy cows were generally viewed more positively. Farming conditions for pigs varied across studies, and were generally considered to need less improvement compared to chickens.

Socio-demographic characteristics

Attitudes and concerns towards FAW appeared to vary in relation to several socio-demographic characteristics, such as age, gender, education, income and whether individuals lived in a rural location. The importance of welfare tended to decrease with age, with younger participants being more likely to have greater awareness of welfare issues, be less convinced about the FAW and have more animal, as opposed to human centred attitudes. Older respondents were more accepting of current standards in some studies. Women were generally more concerned, and had more negative views towards modern farming. Segmentation analysis studies frequently indicated a higher proportion of women in the "more concerned" or "welfare conscious" groups.

Those with a higher education were likely to be more aware of FAW issues and tended to be more concerned about modern farming conditions, as well as reporting greater familiarity with farming practices and a greater number of farm visits, although this was only investigated in a few studies. Greater concern was reported by those with both lower and higher incomes. Those in professional positions demonstrated greater concern although this was thought to be related to participants' higher levels of self-reported knowledge and greater education.

Welfare issues were reported as being more important for those living in urban areas, although rural respondents also reported concerns. Knowledge of FAW was greater for those living in rural locations, and having some connection to agriculture. Living in a rural location was associated with less concern about FAW and being more accepting of modern farming.

Several other characteristics were investigated less frequently across studies. Pet ownership was linked to more negative views of modern farming, greater concern for FAW, and was motivated by more ethical, (as opposed to human health) concerns. Religious and political beliefs were also associated with varying degrees of concern for FAW, with evangelicalism, more frequent church attendance and a stronger religiosity associated with less FAW concern. Those left and centre of the political spectrum were likely to have greater concern compared to those on the right. The trend for households with children was mixed, with evidence for both greater and reduced concern for FAW. Finally, vegetarians were much more critical of welfare practices, voiced greater concern about FAW compared to meat eaters, and were more homogenous in their responses.

3.4.4 Role and orientation

Consumer vs. citizens' role

Consumers and citizens voiced FAW concerns. An individuals' role as a consumer was associated with guilt, with one participant following a farm visit stating;

"*Is this the price to pay for having meat as cheap as possible?*"

Boogaard *et al* (2011)

The need for a clear conscience was also expressed, and aside from purchasing welfare friendly products (WFP), several coping strategies were identified to enable guilt-free consumption. Disconnecting the product from the animal it originated from was one strategy, meaning consumers did not have to think about the production processes involved. Another dissociation strategy was convincing themselves that the control of welfare is out of their hands, thereby removing their responsibility. Some consumers also mentioned that they would rather not think about certain aspects of production, including those portrayed in the media, and some consumers simply did not want to know from where their meat came.

Anthropocentric vs. zoocentric concerns

Negative attitudes and associated FAW concerns were motivated by either zoocentric (animal) or anthropocentric (human) concerns. A concerned group of individuals, including consumers, exist who tend to view welfare issues from an animal perspective, believing that animals have emotions and can feel pain, with intensive production systems therefore evoking feelings of guilt. They perceive

animals to possess more than a utilitarian value to humans and believe the quality of the animals' lives to be important.

Conversely, some individuals' FAW concerns were motivated by their own wellbeing. They seemed to lack an affinity with animals, viewing them as inferior to humans, and having a lower sentience. Although they acknowledged that modern production systems are inhumane, and that they were likely to be causing cruelty by eating meat, they questioned the use of anthropomorphism when discussing welfare, as emphasied below.

"*they won't know any different*"

Schröder and McEachern (2004)

"*it is a (human) right to eat animals*"

Harper and Henson (2001)

This human centred view may also offer another form of dissonance, by viewing animals as objects rather than sentient beings. This human centred approach is also observable in the additional consumer benefits associated with higher welfare systems (see section 3.4.6). When discussing specific aspects of FAW these often had a human motivation, such as the reduction of the risk of disease transfer and veterinary residues.

3.4.5 Behaviour

Across all studies, between 14-51% of study participants reported intending to, or already having, decreased their consumption of animal products (Ellis *et al,* 2009; McKendree *et a*l, 2014). The restriction of certain meat types was more common than others, with pork and beef consumption most likely to decrease, and chicken consumption most likely to increase, although this may well be due to health and safety concerns, not just welfare considerations. Pro-welfare behaviour and the level of concern associated with animal production were also associated with consumption practices, with those with greater concern consuming animal products less frequently, purchasing WFP more frequently, and indicating a greater use of welfare related labels. This shows a higher level of involvement is associated with greater levels of pro-welfare behaviour.

Welfare as a motivator for purchase was strongest in women, which is unsurprising considering the greater concern they have surrounding animal production. In terms of

the type of WFP consumed, free-range eggs were most frequently purchased and were commonly purchased by those with varying levels of concern. The association between changing consumption practices and socio-demographic characteristics was less apparent, although more upper to middle class consumers were more likely to consume WFP, with a higher income associated with an increased WTP, decreased price sensitivity or no difference in consumption. It would also seem that younger individuals were more likely not to eat meat due to ethical, rather than health concerns.

3.4.6 Barriers to, and facilitators of, consumption

Barriers to consumption

Most participants agreed FAW was important, with those rating it more highly most likely to say that improvements are needed. However, the rated importance of FAW did not always translate into purchasing behaviour. In some focus group discussions, FAW was not mentioned when food attributes were initially discussed, with a number of other attributes assigned a greater importance when purchasing animal products, with most purchase decisions normally involving the evaluation of multiple attributes. Prioritised attributes included quality, freshness, origin, sensory characteristics such as taste, value for money, food safety and human health. A number of barriers were identified by participants in several studies as summarised below.

"High welfare products were generally thought be less widely available ("…the problem for consuming more is the limited availability (G1)…"), carry a higher price and trustworthiness of the label/claim to be questionable"

Vanhonacker *et al* (2010)

Many consumers believed the availability of WFP to be limited, and that it was too time consuming to locate them. The lack of availability prevents those who are concerned from purchasing their preferred products, resulting in them buying lower welfare alternatives, and the frustration caused by this was apparent. Concerns were also raised over contexts where individuals have little control, such as in restaurants. Cost was also as a barrier, with WFP perceived as too expensive to purchase, especially in large quantities, with price premiums thought to take away consumer responsibility for FAW. Welfare was also described as being out of consumer control.

Despite wanting assurances and guarantees about WFP, and citing the availability and ease of identification as barriers to purchase, labels to indicate WFP were not

universally supported. Those critical of labels claimed they presented an information overload. Doubts were also raised as to their credibility and reliability, with only 34% of participants in one study reporting being somewhat trusting of information presented (Makdisi and Marggraf, 2011). Labels were also viewed as confusing, especially in terms of being able to identify farming systems. Lack of available information appears more of a problem for those actively trying to seek it. However, consumers indicated that labels could play a positive role in communication and are an opportunity that needs improving. Labelling was identified as the preferred method for the identification of WFP in manty studies, providing additional reassurance to consumers about FAW standards. In relation to existing labelling schemes, women, those with higher education and those in the Scandinavian countries appear best at understanding existing labels, and this corresponds to the greater FAW concern and knowledge in these groups.

Facilitators of consumption

WFP were repeatedly associated with, and used as, an indicator of other product attributes as illustrated in the below quote, especially quality and additional consumer benefits such as safety, resulting in products having value beyond that of better FAW. Consumers who associated higher welfare with these additional attributes were also WTP more for FAW.

"Finally, focus group participants' understandings of what counts as good animal welfare were far less circumscribed than scientific understandings and participants inextricably linked issues of animal welfare with issues of environmental sustainability, food quality/taste and human health"

Miele *et al* (2011)

Human health and safety were commonly mentioned benefits of higher welfare systems, with the two likely to be linked. 50-78% of respondents thought that WFP were healthier (Moran and McVittie, 2008; Bennett *et a*l, 2012). In relation to product safety, improved living conditions and the reduced use of antibiotics were thought to contribute to this. Both overall and sensory quality, such as taste, were associated with improved FAW, with more involved consumers more convinced of this relationship. Questions were raised as to the quality of meat originating from intensive production systems and WFP were seen as a means of guaranteeing superior quality products. WFP were also associated with organic production, which evoked less welfare concerns than more intensive systems. More FAW orientated systems were believed to have less of an environmental impact for several reasons

including; reduced use of chemicals, greater sustainability and protection of the soil, water and air.

3.4.7 Mediators

Trust and responsibility

Trust was an important factor, raised in relation to labelling and those who bear responsibility for ensuring acceptable welfare standards. Implementing a credible inspection system was an important component in establishing and maintaining acceptable welfare standards. This entailed ensuring independent bodies were used for accreditation, which would also provide a basis for labelling schemes to avoid the current scepticism and distrust surrounding existing labels, as illustrated below.

"A third source was related to a general distrust in the beef production chain. This distrust was either related to the production system, the actors and/or the sources of information. Intermediaries, slaughterhouses, meat processing industries and beef packaging companies were generally considered not to be reliable actors or trustworthy sources of information"

Vanhonacker *et al* (2010)

The amount of trust conferred on different stakeholders varied along the food-chain, with actors such as retailers generally less trusted than farmers, although the perceived trustworthiness of farmers and also the government differed between countries, with consumers in Northern European countries trusting these stakeholders more than consumers in Southern Europe. If organisations were perceived as more knowledgeable about, and not engaged in, animal production, they were more trusted.

Responsibility for ensuring acceptable FAW standards was not thought to be associated with one actor. The most trusted stakeholders, and the stakeholders perceived to be the most responsible were not always the same. Some consumers thought responsibility had been removed from them by the government, or due to increased prices making WFP unaffordable and frequently ranked themselves as amongst the least responsible. Some acknowledged their responsibility, believing society to be the start of a chain of influence of concern. However, they felt powerless to do anything about this as they had no direct involvement with the implementation of FAW.

Welfare was viewed as a government issue, as they can implement regulations and legislation to improve and monitor welfare standards. This was better recognised

amongst more educated individuals. The government was perceived as a neutral source as opposed to other stakeholders, such as animal welfare organisations. Respondents in most countries acknowledged the need for improved legislation in their own countries. In China, where FAW was an unfamiliar concept, there was recognition that more regulation is needed.

Responsibility was also assigned to stakeholders, such as animal rights organisations, vets, farmers and retailers, with the latter believed to have a need to ensure that animal products are produced responsibly. Consumer views towards farmers varied, with some sympathetic towards them, stating that they need to make a living, with some studies mentioning the need for compensation for those who adopt higher welfare standards. Others viewed them as just out to make a profit with economic considerations inevitably overriding public opinion, and focusing on efficiency instead of welfare. They were often viewed as being most responsible, and when greater trust in them was displayed, FAW concerns were reduced.

Knowledge and sources of information

Public concern, and general negative attitudes towards modern production, were underpinned by a lack of knowledge about current animal production practices.

"…problems during transportation and at the abattoirs were seldom topics arising during the interviews. Ignorance of pig welfare issues arising beyond the farm gate may, of course, reflect better welfare maintenance at these stages in the production chain. However, it is more likely that it is the result of lay people in Denmark being more familiar with farms than the rest of the production chain"

Lassen *et al* (2006)

A general lack of familiarity with modern farming conditions and practices was apparent, especially of 'off the farm' issues. When asked to rate their current knowledge about farming practices, the majority reported that this was low, ranging from 50% indicating that they are not informed about the subject (Ellis *et al,* 2009), to 80% agreeing that they do not possess a lot of knowledge about FAW (Lu, 2013). These figures are likely to be higher, as when objective knowledge was measured, correct responses were much lower than the corresponding self-reported knowledge values. Evidence of misconceptions was common, especially in relation to what constituted normal farming practices. Participants from Scandinavian countries or those participants who have visited a farm previously appear to have most knowledgeable about FAW.

There was a desire to be better informed and it was thought that there is currently not enough FAW information available. The evidence suggests that those who describe themselves as having some knowledge are more likely to want to know more, although this finding was not consistent across studies. Numerous sources of FAW information were mentioned, including first-hand personal experience, the government, specific welfare organisations and the media, with the latter the predominant news source. Despite being the most frequently consulted source of information, there were mixed feelings as to how credible it was. Television was the most frequent media channel used, followed by the internet which was increasingly preferred in the more recent studies. Not having an information source was also common, as was being unable to recall seeing any FAW information in in the news recently. One study reported that those who were more concerned about welfare reported seeing more stories relating to it. Overall, greater knowledge was associated with more concern and a greater WTP.

3.5 Discussion

3.5.1 Public attitudes towards farm animal welfare

This review identifies and explores public attitudes towards FAW. 80 studies were identified through a two-stage search process, and a thematic analysis led to the identification of six themes, constructed from 15 subthemes. The results indicate that the public are concerned about FAW, with the majority having a negative attitude towards modern farming. These concerns were related to two main concepts; humane treatment and naturalness, and violation of these was associated with more negative attitudes.

Critical assessment indicated that studies were of a mixed risk of bias, with quantitative studies at a lower risk than qualitative studies. The GRADE assessment indicated a moderate overall strength of evidence, meaning that results of the review should be interpreted with some caution. As the methodological aspects of studies, such as participant recruitment, study design and data analysis, were often rated as a higher risk of bias, future studies could improve the existing body of evidence by including as much methodological information as possible. Only nine individual and eight mixed methods studies involved qualitative research. Although these generally had a higher risk of bias they were some of the most insightful studies and provided a number of insights as to the underlying reasoning behind attitudes and concerns. It

would therefore be worthwhile conducting more of these studies to understand particular population groups and aspects of interest, such as naturalness and humane treatment.

Attitudes differed with socio-demographic characteristics and degree of concern. Women, younger participants and those who had spent longer in education demonstrated the highest levels of concern and had more negative attitudes towards modern production systems. They were also those who were most likely to WTP for WFP, supporting findings from a previous review investigating WTP. Women had more negative attitudes, voiced stronger concerns towards modern farming, and had the highest WTP. Women are generally assumed to be more caring, reflected in the social roles they tend to fulfil (Kendall *et al*, 2006), and this links to them being more motivated by welfare concerns, considering the issue more emotively than men, and seemingly tending to anthropomorphise animals more. Younger consumers were more aware of modern farming practices, perhaps due to greater access to information thanks to the internet and social media, with older consumers, perhaps more familiar with more traditional and extensive systems and more traditional media channels, which may evoke less concern and may not give as much attention to FAW issues. In relation to WTP, older consumers are also more likely to be retired and so may not have the financial resources to pay for the more expensive WFP. The difference in age was not explored in depth in any of the qualitative studies, and it would be useful to explore this further to gain more insight into attitudinal differences, especially given the aging population in developed and some developing countries.

Education was linked with greater concern for welfare, with those who have studied longest reporting greater awareness and concern for FAW. Those with more knowledge also reported greater concerns, although those with more familiarity, such as those having previously worked or visited a farm, living in a rural area or having regular contact with farmers, were less concerned with modern production. This would confirm the assumption that self-reported measures of knowledge overestimate knowledge, and that a number of misconceptions exist surrounding animal production which are likely to affect attitudes. For the most part, attitudes are based on perceived farming practices, rather than facts and actual experiences, suggesting a difference between public perception and the reality of farming. It also highlights the benefit of farm visits in raising awareness of current practices and

addressing some of the misconceptions that exist, and the need for future research to include more objective measures of knowledge to provide realistic insights into public understanding.

Previous studies have linked increased income to an increased WTP, but increased income is not necessarily linked with greater concern about FAW. It would appear that those with higher incomes have the means to express their attitudes through their purchasing behaviours, rather than having greater concerns or more negative attitudes, and this seems to be the case with ABC1 (higher socio-economic group) consumers being most likely to consume WFP. One study reports that those of a higher social status value the more advanced quality attributes of products more (Vermuelen and Bienabe, 2010), therefore it may be that they gain more value from WFP, perhaps from association with additional product attributes.

Socio-demographic characteristics and their relation to attitudes and behaviour were primarily discussed in quantitative studies, with few qualitative studies discussing differences between participant characteristics and attitudes. It should be noted that a number of studies reporting no significant differences attributable to socio-economic factors. Although there has been some debate as to the role of traditional marketing segmentation characteristics in ethical purchase decisions (Diamantopoulos *et al*, 2003), clear differences and heterogeneous preferences were observed in the review, providing evidence that niche markets exist, with females, younger individuals and those with a higher education having more affective orientations (Serpell, 2004). This has implications for farmers in terms of potential welfare improvements to make and for private welfare initiatives, ensuring that products can be differentiated accordingly, and also supports the use of market-based solutions for improving welfare.

National and cultural variations in FAW attitudes were also observed and there were differences between countries in relation to several factors, with Scandinavian countries generally reporting higher levels of trust in regulatory systems, knowledge and awareness of farming practices and they were generally the least concerned. Kjaernes and Lavik (2007) highlight that differing institutional contexts play a role in defining consumer attitudes, and the review findings would seem to support this with Scandinavian countries having stricter welfare regulations (Bock and van Huick, 2007). Europe and North America were the two most studied regions, with Asia and South America only having three studies between them, and it would seem pertinent

to investigate attitudes further in these countries. These countries represent large and important markets, where animal product consumption is predicted to increase dramatically, but these regions are also where most animal production is likely to occur in the future (Fraser, 2008a; 2008b). The lack of awareness concerning FAW in China suggests a need to explore this further in terms of FAW legislation, in relation to both internal and export markets.

3.5.2 The concept of welfare

Tuttyens *et al* (2010) describe finding a universal definition of what constitutes good welfare that will satisfy all stakeholders as challenging, with broader, more generalised aspects likely to meet the expectations of the majority. Reflecting this, two core concepts emerged as central to good welfare for the public; naturalness and humane treatment. These themes are not new to the literature (Blockhuis *et al,* 2003). Naturalness was associated with more extensive production systems, (for example, sufficient space and outdoor access). It was also central to what was considered to contribute to animal health and wellbeing, both physically and psychologically, with the latter an increasingly discussed but more contested welfare aspect. This suggests that concern is moving away from the basic health and hygiene of animals, towards a more holistic approach to animal health incorporating both their biological needs and behavioural characteristics (Austin *et al*, 2005). This reflects the shift from FAW measures being based on purely scientific information in relation to basic health and functioning, moving towards the incorporation of criteria in relation to natural living and the animals' affective state (Lassen *et al*, 2006).

No studies specifically focused on production diseases. 21 of the 80 studies (26.25%) referred to production diseases indirectly, and did not specifically ask study participants about these in the study design, or addressed them tangentially, for example asking about antibiotic use. In other words, in most cases this was not mentioned or discussed in depth, but referred to an absence of disease, or avoidance of prophylactic antibiotics. Concerns relating to production diseases also linked to health and safety concerns by consumers. Production diseases, especially when related to the overuse of antibiotics, were an important part of the naturalness concept, and this was mainly in relation to prophylactic antibiotic use and the potential implications for human health. At a time of increased concern about the scale of antibiotic use in farming (European Food Safety Authority, no date), increasing antibiotic resistance (Liu *et al*, 2016) and increased press attention and

public concern over these (Soil Association, 2015), it is pertinent to explore antibiotic use in intensive systems, as although consumers condone their use for treatment, they do not approve of prophylactic use, and this could have implications for future policy and product acceptability (in relation to both quality and safety).

Across the sample, study participants tended to agree that humane conditions were extremely important, and housing conditions were strongly associated with this. Housing conditions were the most frequently discussed aspect of production, which is unsurprising due to increased legislation in these areas in particular in Europe (Fraser, 2008a). Concerns raised in relation to housing systems were primarily associated with outdoor access and space restrictions which were thought to adversely affect animal health and constrain natural behaviours and associated wellbeing. The latter ties in with the increasing recognition that animals are sentient beings, and therefore can experience emotion. There was also a growing recognition of "off the farm" welfare issues, such as transport and slaughter, and the need to make these as humane as possible.

Both of these central concepts pose an interesting challenge for intensive production, as contemporary farming systems inevitably breach one, or both, of these concepts in the trade-off between productivity and welfare. Although modern production delivers benefits which the public recognise such as affordability (Heng *et al,* 2013), quality and safety (Boogaard *et al,* 2011), there is a need to demonstrate that both productivity and welfare need to be taken into consideration. Consumer and citizen expectations will also need to be managed in relation to what is and what is not feasible within these systems, with alternative extensive production systems being offered and promoted as acceptable alternatives. It is also relevant to examine naturalness and humane treatment in the context of both public and private benefits, and the extent to which various intensive production practices and interventions breach these.

3.5.3 Citizen vs. consumer role

Individuals may have different attitudes and behaviours depending on whether they are acting in their role as a citizen or a consumer. As citizens, they report a high level of concern about modern production systems, rating FAW, and having welfare friendly production systems, as important. However, as consumers they have other priorities when it comes to purchasing products. This is exemplified through the

inconsistency between the large proportion reporting concern for welfare, and the much smaller proportion having either altered their consumption habits as a result of welfare concerns, or currently purchasing/ WTP for WFP. The wider concern voiced by citizens and the existence of concerned consumers means that both legislative and market-based solutions are necessary for providing and establishing welfare standards. This ensures that concerns and attitudes of non-consumers are still considered, as in their role as citizens, they may participate in referendums and other pro-welfare behaviours aside from product consumption (Grunert, 2006).

Throughout the analysis the theme of anthropocentric versus zoocentric motives was observed. Consumer concerns were not solely motivated by ethical considerations and concern for animals, reflecting the affect versus utility orientation discussed by Serpell (2004). Perceived consumer benefits, such as healthier and safer products also motivated consumers to select WFP. Anthropocentric motivations also underpinned some of the subthemes in the analysis, such as the underlying naturalness concerns, concerns over production diseases and associations with additional product attributes. Health and safety concerns in particular were important, and this may reflect food safety incidents and disease epidemics involving animal production systems, such as BSE (Grunert *et al*, 2004).

Consumers have dual perspectives of modern farming, being appreciative of the consistent, safe and affordable products it offers yet voicing several concerns about the systems producing it (Boogaard *et al,* 2011). One subgroup of consumers does not let their concerns affect their consumption of animal products, indicating that some use dissonance or coping strategies to enable animal product consumption with a clear conscience and reduced feelings of guilt (Grunert, 2006; Schipper *et al*, 2006; Ingenbleek and Immink, 2011). A sub-group of more concerned consumers were identified who are motivated by ethical concerns and have greater engagement in pro-welfare behaviours, such as being willing to, or already having made, changes to their diet, by reducing animal product consumption or through purchasing WFP. They appear to have the means to do this regularly and also appear to less price sensitive to WFP. These individuals have a much smaller gap between their attitudes and their behaviour, in this case their consumption practices and purchasing behaviour.

3.5.4 Barriers and facilitators to consumption of higher welfare products

Several barriers and facilitators to the consumption of WFP were identified. Different groups of consumers' express different preferences for certain approaches to FAW (de Jonge and van Trijp, 2013). FAW was rarely a consideration whilst shopping, except for more involved consumers, with other intrinsic and extrinsic attributes receiving much higher prioritisation, such as health, safety, quality and sensory characteristics as previously reported in the literature (Frewer and Miles, 2001).

The availability of WFP was a limiting factor in terms of consumers' ability to purchase FAW (Tawse, 2010). The absence of understandable and appropriate labelling also contributed to consumer difficulties with consumers reporting either that they were unable to identify the production systems used from current labels, with many described as unclear, or there being too many labels being available which resulted in consumer confusion. Another criticism on the part of participants was the lack of credibility of current schemes, with consumers viewing them as a marketing strategy. Labels can only be effective if trust exists between consumers and those offering the guarantees associated with a particular product attribute, with this credibility essential for ensuring that displayed information is believed and used (Grunert, 2006; McInerney, 2004). This could be achieved through certification from an independent body, which may reduce risks associated with purchase. However, labelling was the preferred mechanism for conveying information about production systems, providing a clear, consistent approach was taken. This is potentially important given the lack of knowledge consumers have in relation to farming (Ingenbleek and Immink, 2011).

Consumers viewed WFP as more expensive and not affordable by all consumers. Minimum welfare standards should not therefore result in consumers being priced out of the market. This means either subsidies, or additional optional higher welfare schemes that consider the aforementioned considerations; i.e. they are clear, have specific criteria, and are well monitored, are put in place so that additional costs of production are not passed onto consumers. Consumers reported mixed beliefs as to the implications of their food choices, with doubts being expressed regarding whether purchasing WFP actually improves animals' lives. As markets are largely consumer driven this supports Vanhonacker and Verbeke (2009) conclusions that consumers lack any real insight into the implications of their food purchasing behaviour on the supply chain, and further highlights the need for improved communication

surrounding welfare. Potential facilitators to the consumption of WFP were identified, such as the importance attributed to it by most citizens and the associations WFP have with additional product attributes. Although the importance attributed to FAW did not translate into altered consumption practices or the purchase of WFP, this suggests the need to both ensuring higher *de minimis* standards of welfare and markets for WFP.

Consumers associated higher welfare with other product attributes (Grunert, 2006), especially other extrinsic product attributes such as safety, health and quality. For example, WFP were believed to use less or no antibiotics, therefore were thought to be both safer and of a higher quality. This also implies that a welfare friendly guarantee acts as an additional assurance of other relevant product attributes, which means any WTP valuations will also reflect this, as consumers do not just perceive value from welfare alone (Bennett *et al*, 2002a). Environmental attributes were also important for several participants in the studies, with higher welfare systems associated with environmental benefits, although this may not be the case in reality (Leinonon *et al,* 2012). Welfare is an important component of quality assessment, even if it is not motivated by concerns for FAW.

3.5.5 Trust, responsibility and consequences for communication

All stakeholders were viewed as responsible for ensuring FAW in some way, implying tangible demonstration of how this is operationalised throughout the food chain. Communication and reassurances from all stakeholders regarding their commitment and procedures for ensuring welfare will provide greater transparency, and help develop greater trust, and the best ways of communicating need to be explored in the future. The government are viewed as largely responsible, mainly due to their influence and the ability to implement regulations and monitoring procedures to ensure acceptable minimum standards. Ensuring transparent legislation, with both clear and acceptable criteria is therefore important. Farmers were also viewed as responsible for FAW, which is unsurprising given they are directly involved in production. The challenges faced by farmers were acknowledged, as was the need for them to be able to make a living from production. Retailers were also mentioned as responsible for ensuring that they source appropriately produced products, and that their suppliers are adopt FAW practices. A number of retailers, keen to be seen as responsible, have already adopted welfare friendly positions (Waitrose, 2015). Although the public were viewed as having a role in ensuring welfare friendly

production, some had doubts over their impact due to their lack of direct involvement. This ties in with the aforementioned lack of perceived personal influence (3.4.6).

Consumers expressed a requirement to be better informed about FAW, even in light of the dissonance reducing activities. Improved communication was emphasised throughout the food-chain. Involvement of all stakeholders will deliver a more balanced perspective on modern production. Central to communication should be the core concepts of naturalness and humane treatment, and consideration of public concerns should be incorporated into future agricultural policy (Blockhuis *et al,* 2003), as consumers can only act in accordance with their values if they are aware of the issues surrounding production in the first instance (Tawse, 2010).

3.6 Summary

This chapter sought to explore consumer attitudes towards FAW. Attitudes towards modern farming were mostly negative, with women, younger individuals, those with a higher education, or who are less familiar with modern production likely to be more concerned. *Naturalness* and *humane treatment* emerged as two core concepts of welfare and violation of these increased consumer concern for welfare and contributed towards more negative attitudes towards production systems. More welfare friendly systems were associated with additional benefits for the consumer; higher quality, safer and healthier products, and this is most likely linked to naturalness concern. Despite the majority considering FAW conditions a concern, welfare was not a prioritisation when shopping, and a number of barriers to consumption were raised, such as price, availability and perceived personal influence. Several dissonance strategies were also adopted to enable consumers to maintain their current consumption practices with a clear conscience, and improved communication from stakeholders along the food chain was identified.

A research gap was identified in relation to attitudes associated with diseases originating production systems, except for the use of prophylactic antibiotics. No studies investigated production diseases specifically, and only a quarter made some reference to an absence of disease or antibiotic use. Given the importance of gaining insights into public opinion it is pertinent and timely to conduct research public attitudes towards production diseases and their interventions, which will be explored in chapter 6. Chapter 4 will next present a further exploration of public perceptions of FAW and production diseases, by systematically reviewing the WTP literature.

Chapter 4. Consumer willingness to pay for farm animal welfare

4.1 Introduction

The literature reviewed in chapters 2 and 3 highlight research gaps in relation to public attitudes towards production diseases. Willingness-to-pay is one mechanism of exploring public concerns in relation to a topic, and has previously been used as a proxy for attitude (Ryan and Spash, 2011). From this, it can be assumed that WTP can be used to draw conclusions regarding the acceptability to the public, of different farming practices in relation to FAW. This chapter first provides a more detailed background of the evidence-synthesis methodology meta-analysis. It then describes in detail the review and analysis of WTP studies of FAW. Finally, the results are presented, the key policy implications of the results identified and described, and research gaps and future research requirements identified.

4.2 Background

4.2.1 Meta-analysis

Meta-analysis is one of the key methodological developments in evidence synthesis of the past 100 years (Shadish and Lecy, 2014). The term meta-analysis was first used by Glass (1976), and now encompasses all the statistical techniques used for quantitative empirical evidence synthesis (Lipsey and Wilson, 2001). These typically, although not always, are applied following a systematic review, and are intended to include as much of the relevant literature as possible (Stanley, 2001). The application of meta-analysis provides a transparent and explicit methodology which can summarise and interpret evidence focused on a specific topic. In addition, the adoption of a formalised approach helps to remove a number of elements of subjective bias from the interpretation of the results.

This evidence synthesis approach enables a more definitive answer to a research question to be gained, and is primarily used to assess the effectiveness of a given factor or intervention, and describe the pattern of findings (Lipsey and Wilson, 2001). Evidence synthesis is concerned with resolving conflict within a particular research topic, as all available evidence is considered simultaneously (Koricheva *et al,* 2013).

Studies within a meta-analysis are aggregated and viewed as part of a “population” of evidence, rather than as a single, individual piece of evidence within an area of study. This synthesis of results is important as individual studies are infrequently large enough, or are too contextual, to identify trends or enable generalisations to be made (Light and Pillemer, 1984; Rothstein *et al.*, 2006), particularly in the context of applied social science research. This allows for the weight of evidence in answer to a specific question to be addressed, rather than the statistical significance of any one result (Koricheva *et al*, 2013), with the ability to of the method to combine and aggregate findings from a number of studies provides increased power and precision in analysis. It should be noted that this approach is only useful as a decision tool when there is a substantial body of research to be synthesised, such as WTP, and so may not be as relevant to emerging areas of study where limited research has been conducted.

Key to achieving this is the concept of an effect size (Lipsey and Wilson, 2001; Koricheva *et al,* 2013), which facilitates the *meaningful* comparison of conceptually similar studies by standardising the results presented and there are several different ways of doing this (see *inter alia* Higgins and Green, 2011; Koricheva *et al,* 2013). In order to facilitate a successful comparison, studies need to be similar enough so that their findings can be meaningfully compared, both in relation to being conceptually comparable, and having similar enough outputs to enable comparison (Lipsey and Wilson, 2001).

In addition, the greater volume of studies included in a meta-analysis provides increased power for analysis and so enables the formal exploration of other aspects of interest, including heterogeneity within the data, formalised sensitivity analysis and critical appraisal to inform future research (Lipsey and Wilson, 2001; Higgins and Green, 2011; Koricheva *et al*, 2013). The analysis of also enables and to look for additional relationships in the data including to establish the effect that individual moderators have (Lipsey and Wilson, 2001). This may not be possible given the low power of individual studies alone, and can provide additional insight into a topic which may not have been possible otherwise. In addition to providing robust and transparent forms of evidence synthesis, meta-analysis has the added advantage of identifying potential weaknesses in the evidence base, including its ability to assess the validity of findings and the presence of bias in a given topic (Higgins and Green, 2011) such as publication bias, and this will be discussed further in chapter 5.

Meta-analysis is a useful methodological tool which can help to identify which questions have been and need to be, answered in a specific area of research. The ability of meta-analysis to transparently synthesise and explore research results, and allow judgments to be made as to the strength of the evidence, makes it an extremely useful tool for stakeholders, including researchers and policy makers. In the context of this research, meta-analysis will provide insights into the extent and the variability of public attitudes towards FAW by examining WTP and moderating variables, to provide further insights to the key findings obtained in chapter 3, and to develop additional research questions from the available literature.

4.2.2 Economic analysis

The public represent an important stakeholder with interests in the food chain, and drive demand for specific foods and commodities (Jensen, 2006). Consideration of their views, needs and preferences regarding the design and operationalisation of animal production systems in FAW policies is important if these systems are to be acceptable to society, and if regulatory options reflect public priorities, expectations and requirements (Bennett *et al*, 2002a; Farm Animal Welfare Committeel, 2014). Government legislation has traditionally been the main method for ensuring or improving standards within farm animal production systems (Bennett, 1997). However, animal production systems which promote higher standards of animal welfare are believed to lead to higher environmental and financial costs by a number of stakeholders including the public (World Bank, 2011; Leinonen *et al*, 2012), which will ultimately be passed onto the consumer unless subsidies or tax breaks are put in place for producers (Bennett, 1996; 1997). In addition, due to the subjective evaluation of animal welfare, individuals may have different opinions as to what counts as a minimally acceptable standard (McInerney, 2004). It is thus difficult to establish a baseline level of animal welfare in production systems that will satisfy all individuals, and which can be used as the initial point for subsequent policy development.

Market based approaches offer an alternative to aligning different approaches to FAW, as different public needs can potentially be met, assuming ethically acceptable *de minimis* welfare standards are applied. They also ensure that producers and consumers are not priced out of the market should any additional costs be passed down the supply chain (McInerney, 2004). Market based solutions are reflected through the increased numbers of private standards being introduced with many

businesses adopting welfare friendly stances, including the incorporation of welfare into corporate social responsibility schemes or the adoption of FAW labelling schemes (Marks and Spencer, 2015; McDonalds, 2014). As FAW standards are demand driven, it is important to establish the market potential for these. One approach is to assess consumer/ citizen WTP for FAW. WTP has also been used as a proxy for attitude (Ryan and Spash, 2011) and so can be used to assess the acceptability of different FAW practices, to consumers. This evidence can then subsequently be utilised in policy development, and from a market perspective.

WTP is a measure of value of goods or services to an individual (Hanley *et al,* 2011), and is defined as the price premium or maximum price an individual is willing to sacrifice to obtain a certain benefit or to avoid undesirable characteristics (Hanley *et al,* 2001; Breidert *et al,* 2006). Typically, WTP studies have tried to quantify concerns in relation to the value placed on animal lives, their welfare conditions (Lagerkvist and Hess, 2011) and the higher expected benefits associated with them, including product quality that consumers tend to associate with improved welfare (European Commission, 2007; Verbeke, 2009).

4.2.3 Review objectives

Although previous reviews of the WTP literature have been conducted, these have either not used meta-analysis (Bennett *et al,* 2012), or have not comprehensively explored the grey literature as part of rigorous systematic review methodology combined with meta-analysis (Lagerkvist and Hess, 2011). Furthermore, the issue of consumer WTP for reduced animal production diseases has not been a focus of these reviews. Combining systematic review with meta-analysis improves outcome precision and acts to minimise bias in relation to both selection and reporting, taking a comprehensive approach to obtaining and extracting data to ensure that the totality of evidence is considered (Koricheva *et al*, 2013). This will provide more robust evidence on which to base policies. In addition, the increase in intensive production systems in Europe (and indeed internationally) has resulted in attitudes and opinions being potentially influenced by changes in agricultural practices, more intense media reporting of FAW issues, and increased societal discussion of FAW. Precise understanding of consumer attitudes and WTP for FAW interventions specifically designed to address production diseases in intensive systems is required if policy development is to take due account of consumer concerns and priorities.

Both previous reviews have acknowledged the large amount of heterogeneity (variability) in WTP for FAW, for which several moderators have had varying explanatory effects. These include different aspects of welfare (Napolitano *et al*, 2008), socio-demographic variables (Bennett, 1996; Bernard and Bernard, 2009) and socio-economic characteristics (Carlsson *et al*, 2007). There is also evidence that WTP for FAW differs between animal types (Carlsson *et al*, 2007; Cicia and Colantuoni, 2010), which may have implications for both producers and FAW policies. In addition, the previous meta-analyses failed to distinguish between consumers of animal products and general citizens.

In light of the increase in published work regarding WTP for FAW since 2011, and in the absence of a review on WTP for reduced animal production diseases specifically, this systematic review and meta-analysis seeks to extend the work by Lagerkvist and Hess (2011) and aims to establish; 1) what the public are willing-to-pay for FAW, and 2) what the public are willing-to-pay for interventions to reduce production diseases. In addition, heterogeneity within the data will be explored to examine whether certain factors explain the variability in the public's WTP. This will be conducted in relation to; 3) animal type, 4) socio-demographic or socio-economic characteristics, 5) being vegetarian and 6) whether there is a difference in WTP between citizens and consumers.

4.3 Methods

4.3.1 Literature search

The search strategy and meta-analysis protocol were published online prior to starting the review to provide transparency and to enable feedback on the planned research (Clark *et al*, 2014b, Appendix I). Relevant publications were identified through searching Scopus, ISI Web of Knowledge, AgEcon Search and Google Scholar using a combination of keywords outlined in table 4.1, the latter two databases enabling the identification of "grey" literature. Search terms were refined after several trial searches to ensure the most effective search terms were used, and both the trialled and final search terms are in Appendix J. Face validity of the searches was addressed by checking returned searches for key authors and articles included in both the Lagerkvist and Hess (2011) meta-analysis and Bennett *et al* (2012) review. Animal specific search terms were not used as they frequently returned studies that originated in the natural rather than the social sciences.

Type of study and outcome	valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref*OR economic OR reject* OR consumer OR demand OR choice
AND	
Animal type	farm animal OR production animal
AND	
Animal welfare	animal welfare OR health OR disease OR welfare OR production disease

Table 4.1 Keywords considered for search

In addition to the database searches, reference lists associated with the studies included in the analysis were assessed, and key authors in the field were contacted, to identify any additional studies not returned from the searching process. The results were then exported into EndNote (Thomson Reuters, 2011) for further analysis. The studies which had been identified at this stage were screened in a two-stage process in order to assess their relevance in relation to the pre-determined inclusion criteria outlined in table 4.2.

Quantitative empirical studies were included in the review, specifically those that examined the public's WTP for FAW. Measures of welfare were deemed to include anything that was described to participants as altering the lives of animals, ranging from vague descriptors, such as general improvements to overall welfare, to very detailed aspects such as specific stocking densities per m^2, and in relation to specific production diseases. Most studies reported multiple welfare measures and all were extracted for data analysis. All farm animal types were considered for inclusion, including fish. Welfare measures in relation to production diseases were deemed to be anything that specifically mentioned reducing or controlling for diseases. Antibiotic use, including the use of growth promoters (Hughes and Heritage, 2002), was also considered as a proxy for interventions to reduce production diseases, and all studies that measured WTP for animal products produced specifically with or without antibiotics were included.

A broad range of methods used to measure WTP were considered for inclusion in the review. This included, but was not limited to; revealed preference measures (market data, experimental auctions) and stated preference measures (conjoint analysis, contingent valuation studies, choice experiments) as highlighted in table 4.1. Only

studies published in English were included. Studies with duplicate populations (where the same data was presented in two or more publications) were removed, with the study with the lowest critical appraisal (see section 4.3.2) or which reported the fewest WTP or socio-demographic measures being excluded from the current analysis.

Study design	English, quantitative empirical; conjoint analysis, auction, dichotomous choice, contingent valuation, choice experiments, additional methods of willingness-to-pay or intention to purchase
Population	Consumers and/ or citizens
Outcome	Willingness-to-pay, intention-to-purchase, price premium

Table 4.2 Eligibility criteria

An overview of the search process can be found in the PRISMA flow diagram in figure 4.1 (Moher *et al* 2009), including the number of studies excluded at each stage. A list of studies included in the final review and excluded at the full-text stage of screening can be found in Appendix K.

4.3.2 Data extraction and critical appraisal

Information was extracted from all papers in relation to the objectives. WTP was extracted as the price premium expressed by participants to purchase products produced to defined FAW standards and was considered as the dependent variable in the analysis. Values were extracted as the mean ± the standard deviation or standard error or with 95% CI, where reported.

WTP values were adjusted for inflation, based on the year of data collection, and when this was not reported it was assumed to be the year of publication (Australian Bureau of Statistics, 2015; inflation.eu, 2015a; 2015b; 2015c; Statistics Sweden, 2015; Bank of Canada, no date; Bank of England, no date; Bureau of Labor Statistics, no date; Eurostat, no date a; Statistics Denmark, no date). As most studies were conducted in Europe, the WTP values were converted into Euros to provide a consistent currency across studies (European Central Bank, no date). Additional variables were extracted as moderator variables to help in the explanation of heterogeneity within the data. These were either extracted as mean values (income, age), percentages of the study population (female, vegetarian and college/university education) or coded as categorical variables (animal type, product, welfare aspects,

country of data collection, study methodology and economic model used). European countries were grouped according to region based on the United Nations Statistics Division (2013) classification, with the study methods were grouped according to whether they were revealed or stated preference measures as outlined by the Competition Commission (2010).

Sample sizes were recorded in order to provide weights for the meta-analysis. Multiple measures of secondary variables were extracted for each paper reflecting the diverse nature of welfare, and because a large number of studies collected WTP information for a number of animal types and animal products. Summary characteristics for all studies included can be found in Appendix L. Due to heterogeneity in the WTP data, effect sizes were calculated for each price premium recorded in order to provide a standardized value and suitable unit for subsequent data analysis. The price premium was recorded as opposed to the percentage price increase (a ratio approach). Although this does not enable a direct determination of the percentage price increase consumers are willing-to-pay as provided by a ratio approach, it does have the advantage of enabling a more direct comparison between effect sizes. The effect size, a measure of the magnitude of association between two variables, was calculated as the mean WTP divided by the standard deviation (Ferguson, 2009), thus providing a unit of measurement in terms of standard deviations and enabling comparison across studies. When the standard deviation was not available, the standard error and 95% CI were used to calculate this, as per Lipsey and Wilson (2001). For studies where standard deviations, standard errors or 95% CI were not reported the variance of the data was imputed using the sample size and mean WTP. This was true for 17 of the 54 studies (31.5%) and these studies will be referred to as ‘imputed values’ in the analysis. Studies where the effect size was calculated without imputation are referred to as ‘complete case studies’.

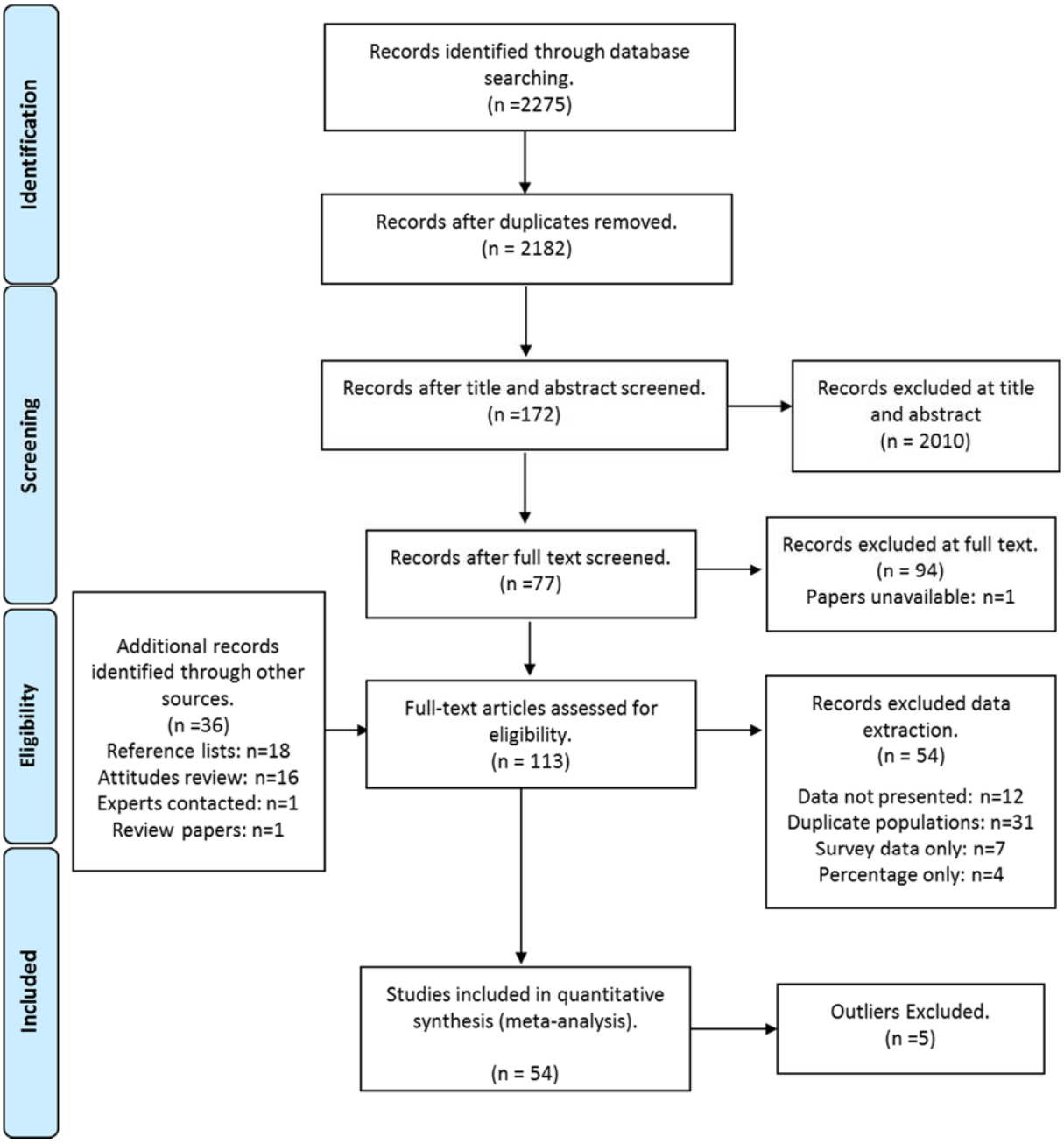


Figure 4.1 PRISMA flow diagram of the search and selection process

The validity and the impact of bias of studies included was addressed by use of a critical appraisal document (Appendix M) that examined several quality criteria that had the potential to impact on the results of the study; the WTP method used, the economic model used, the sample population and the sampling technique for each study. The document met the guidelines set by the Cochrane Handbook for Systematic Reviews of Interventions (Higgins and Green, 2011), Campbell Collaboration (2001), guidelines and recommendations provided by the Centre for Reviews and Dissemination (2009), and provided a document based in a non-healthcare context. No studies were excluded based on the critical appraisal, with the findings being taken into account during the evidence synthesis when assessing the overall strength of evidence as part the GRADE analysis (Meader *et al*, 2014). The results of the critical appraisal can be found in Appendix N.

4.3.3 Meta-analysis

Meta-analysis was conducted using the open source 'metafor' package (Viechtbauer, 2010) in 'R' (R Core Team, 2013). A positive effect size indicates a WTP a premium in relation to current prices for FAW, and results are reported using the estimate, 95% CI, and I^2, the latter of which examined the amount of heterogeneity remaining within the data. The adaptive GRADE framework (Meader *et al,* 2014) was used to assess the strength of evidence for each study, and was adapted to reflect a non-healthcare setting (c.f. Barański *et al*, 2014). GRADE is based on the following 5 criteria:

- **Risk of bias** – determined from the critical appraisal of studies.
- **Imprecision** – the consideration of how big the effect size in relation to zero, as indicated by the lower 95% CI. Values of less than 0.25 are interpreted as being below a minimally important difference (low bias assessment) and values of greater than 0.25 being interpreted as an important difference (moderate bias assessment; Revicki *et al,* 2008; Copay *et al*, 2007).
- **Indirectness** – due to the focus of the project this focused on whether the majority of studies included (greater than 50%) were conducted in Europe.
- **Inconsistency** – the variation of effect sizes in relation to the line and spread of the data to establish whether studies were presenting the same picture, and established by visual inspection of forest plots.
- **Publication bias** – funnel plots were used to establish publication bias, despite their known limitations, with Egger's test also being used to establish funnel plot

asymmetry. The results are reported as either undetected or strongly suspected.

A summary of these findings for the analysis can be found in the strength of evidence table in Appendix O, with the corresponding weighted mean WTP values for the studies included in each separate analysis to aid with the interpretation of the results.

Random-effects, as opposed to fixed effects meta-analysis was used to calculate the effect size, due to the heterogeneity of studies included in the analysis (Hedges and Vevea, 1998). The random-effects model is a special case of the general linear model, and provides an unconditional inference about a larger set of studies, for which the sample of studies in the meta-analysis is only a random sample of the totality of evidence (Hedges and Vevea, 1998). Random effects meta-analysis helps to deal with the diversity of studies (Borrenstein *et al*, 2009), working on the assumption that the effects from the different studies included in the analysis are not identical but follows some distribution i.e. there is not one true effect size. The centre of this distribution describes the average effect, whereas the width of the distribution details the heterogeneity (Higgins and Green, 2011). Therefore, although the model does not solve the problem of heterogeneity of included studies, it does enable analysis of a broad spectrum of studies, indicating the extent of heterogeneity within the data. All analyses were conducted using the restricted maximum likelihood estimator, which is better suited for smaller sample sizes (Viechtbauer, 2010). Effect sizes were calculated for both the complete case studies separately and overall for all included studies (complete case and imputed values). Due to minimal differences in values (Appendix O), only the complete case values were used for further analysis. Funnel plots and forest plots were generated for each analysis, with Egger's test also being conducted for each to test for funnel plot asymmetry, which provides an indication of publication bias. Publication bias is defined as "*the tendency toward preparation, submission and publication of research findings based on the nature and direction of the research results*" (Dickersin, 2005), which can lead to the failure to obtain a true representative sample of studies. As this can lead to the overestimation and formation of unreliable conclusions (Dwan *et al*, 2013) and is therefore important to test for.

Forest plots were used to indicate inconsistency in the data and highlight any outliers, which were deemed to be any paper with an effect size more than 10 times

the pooled effect size for the complete case studies. Five papers were therefore removed from the analysis; Kehlbacher *et al*, (2012); Chang *et al*, (2010), Pouta *et al* (2010), Glass *et al* (2005) and Dickinson and Bailey (2002), with effect sizes between 18 and 387 times bigger than the pooled effect size. These studies used a variety of different WTP methods, welfare measures and payment vehicles and so shared no obvious similarities.

Sub-group random effects meta-analysis and meta-regression were then used to investigate heterogeneity within the data. Variables included in the sub-group analysis related to both the secondary objectives of the study and exploration of Akaike Information Criterion (AIC) amongst the data, used to minimize over-fitting by establishing the most parsimonious compromise between model fit and model complexity (Koricheva et al, 2013). Only findings in relation to animal type, region, socio-demographic characteristics and method are reported in the results section of the report, and corresponding funnel plots can be found in Appendix P. Significant differences were examined between subgroups by establishing whether there was overlap in confidence intervals. A GRADE assessment was also conducted for each subgroup. Finally, the effect size and the weight of effect size values were averaged across studies to provide aggregated values, enabling a cumulative meta-analysis to be conducted, structured by year of publication. A cumulative forest plot was generated to illustrate this.

As per the calculation of the overall effect size, multivariate analysis was conducted using random-effects meta-analysis using the restricted maximum likelihood estimator. A data driven approach was taken with variables selected based on AIC. In addition, due to problems with missing data, and subsequent problems of data not being present across all variable levels, certain variables were excluded from the analysis in order to minimise bias. For example, the socio-demographic characteristics of education and percentage vegetarian were not included, due to too few measures being present (only 74 and 59 respectively of the 227 complete case measures).

Variables included in the analysis were added sequentially based on the number of the measures they contained. For categorical variables (region and animal type) the subgroup with the lowest individual estimate was used as the comparator. In total five variables were used (region, animal type, age, gender and income) resulting in six models for comparison.

4.4 Results

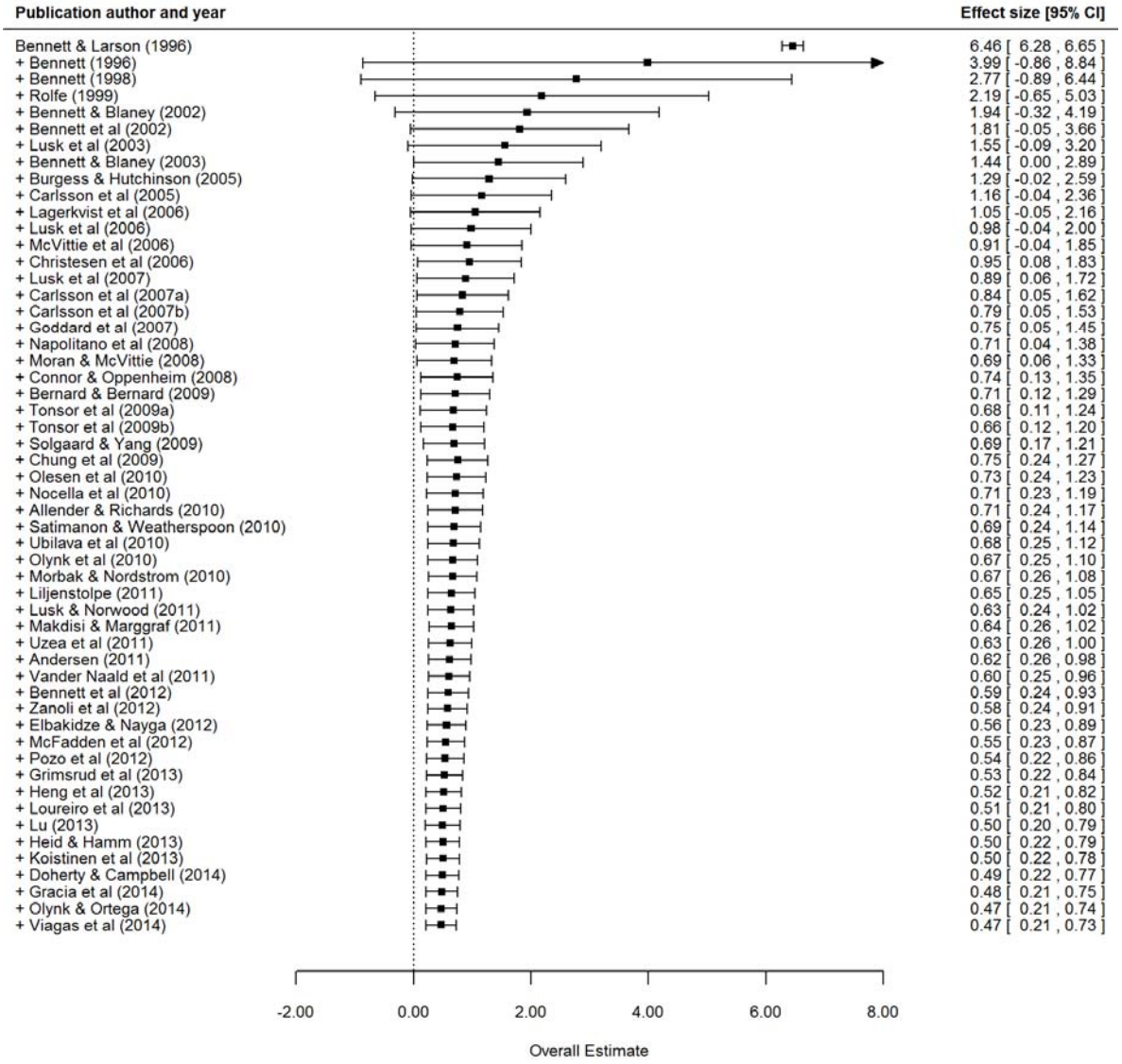
4.4.1 Descriptive statistics

54 studies were included in the final review providing 335 measures of WTP, a summary of which can be found in Appendix L. The majority (43) were stated preference studies, 10 were revealed preference studies, and one contained both stated and revealed preference measures. Data came from 17 different countries, with over half of studies being conducted in Europe (56%), 37% being conducted in the USA, and the remaining studies being conducted in Canada, Australia and South Korea. Pigs and laying hens were the two most frequently researched animals (14 studies each), with a further 10 studies reporting WTP values for multiple animals, with all but one of these including pigs and either broiler chickens or layer hens. Most studies (30) reported WTP for a variety of different welfare measures, with the majority of individual measures relating to overall welfare, free range produce and outdoor access for animals. A range of products were also used, with the most common being eggs and pig meat (pork, ham, salami) reflecting the two most common animal types.

In relation to the main objective, only four studies specifically examined the public's WTP for FAW related to production diseases; Koistinen *et al* (2013) examined disease and health in pigs and beef cows, Grimsrud *et al* (2013) examined WTP for disease resistance in fish, McVittie *et al* (2006) examined tighter (lower) limits for broiler chickens failing health checks in relation to foot pad lesions (and associated dermatitis) and Doherty and Campbell (2014) examined WTP for earlier disease detection in broiler chickens. A further 10 studies examined WTP for animal products produced without antibiotics, with the majority of these being conducted in North America (n=7), and the remainder in Canada, Korea and Denmark. Although other measures which may indirectly affect production diseases were presented, i.e. high stocking density may be associated with respiratory diseases, the relationship between these measures and disease were not described to participants, and it is assumed that study participants were therefore unaware of the link. As a result, a WTP value in relation to production diseases cannot be inferred from these results.

Twelve studies did not report any socio-demographic characteristics, with gender, age and income being the three most commonly provided variables by 36, 33 and 32 studies respectively. The percentage of vegetarian participants was the least

frequently provided piece of information (n=13) with several these have the percentage inferred from their study description i.e. all participants described as consumers of meat products. It is possible that vegetarians were excluded from some studies.



The cumulative meta-analysis of 54 studies demonstrates how WTP has evolved over time, from much larger imprecise estimates, to much smaller, more precise figure of 0.47 standard deviations. This is partly due to methodological advances in cost-benefit analysis

Figure 4.2 Cumulative meta-analysis of aggregate study values (n=54)

4.4.2 Overall WTP

The results of the GRADE assessment (Appendix O) indicate a low strength of evidence for all assessments of general WTP, meaning results should be interpreted with caution. Forests plots and I^2 values highlighted a large amount of variation in the data, for complete case, overall (complete case and imputed) and aggregated values. Visual inspection of the funnel plots and results of the Egger's tests confirm the existence of publication bias for the complete case analysis (effect size 0.6302 (95% CI 0.5016, 0.7587), significance $p < 0.0001$), overall data analysis (0.5709 (0.4599, 0.6819), $p < 0.0001$) and aggregated value analysis (0.6135 (0.4106, 0.8524), $p < .0001$), implying that small studies with large effect size estimates appear to be missing from the search process, and this will be discussed further in chapter 5. Both the complete case (effect size 0.6302, (95% CI 0.5016, 0.7587), I^2 99.71) and the overall data (0.5709, (0.4599, 0.6819), 99.76) produced similar estimates, indicating a low-price premium for improved FAW. The aggregated WTP estimate was also relatively small price premium (0.4690, (0.2075, 0.7036), 99.72).

The results of the cumulative meta-analysis highlight that measures of WTP have become much more precise over time (figure 4.2), as indicated by the confidence intervals becoming much narrower, and effect sizes converging as more studies are added chronologically to the analysis. The evolution and convergence of WTP estimates since 2013 reflects the reduction in the number of methods used, with the more recent studies predominantly being choice experiments or auctions. As all 54 studies report WTP for a variety of different animal types and for several different welfare measures the converging WTP implies that the positive WTP may not be affected by these individual variables i.e. individuals are willing-to-pay for improved welfare regardless of the individual welfare aspect or animal type

4.4.3 Animal Type

A summary of findings for the different animal types can be found in table 4.3 bar calves as results were only obtained from one study. Analysis of the subgroups indicated a WTP for all animal types, with the lowest for pigs (0.2843, (0.1936, 0.3750), 98.33), and the largest for beef cows (1.1176, (0.7776, 1.4575), 99.53).

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Animal Type	I^2	Estimate	Lower 95% CI	Upper 95% CI	Number Measures	Number Studies	Weighted Mean WTP (€)	Egger's Test Result
Pig	98.33	0.2843	0.1936	0.3750	90	13	0.54	2.4579, *p=0.0140*
Layer Hen	99.88	0.7823	0.3594	1.2053	47	10	0.09	1.1088, *p=0.2675*
Broiler Chicken	97.92	0.4024	0.2653	0.5394	26	8	1.24	4.1308, *p<0.0001*
Dairy Cow	99.53	1.1176	0.7776	1.4575	27	7	0.50	2.8086, *p-0.005*
Beef Cow	99.84	1.2022	0.7294	1.6750	24	7	5.00	0.7436, *p=0.4571*
Multiple	94.78	0.6547	0.4206	0.8888	6	2	11.20	-0.0606, *p=0.9516*
Fish	99.29	0.3712	-0.0073	0.7497	6	3	3.53	-0.4668, *p=0.6406*

Table 4.3 Summary of results from the animal species subgroup analysis

Region	I^2	Estimate	Lower 95% CI	Upper 95% CI	Number Measures	Number Studies	Weighted Mean WTP (€)	Egger's Test Results
UK	97.07	0.6479	0.5113	0.7845	27	7	1.72	1.9722, *p=0.0486*
Northern Europe	97.84	0.1060	0.0376	0.1744	76	8	0.41	-2.8201, *p=0.0048*
Western Europe	94.66	1.0741	0.7720	1.3763	7	3	4.28	2.0213, *p=0.4320*
North America	99.74	0.7515	0.5026	1.0004	90	16	0.15	1.0488, *p=0.2943*
Southern Europe	99.73	1.4329	0.9577	1.9082	23	6	0.68	2.3457, *p=0.0190*

Table 4.4 Summary of results from the region subgroup analysis

The lower 95% CI for pigs and fish were below the minimally important difference of 0.25 indicating that the WTP for these animals is not relevantly different from zero. Overlap of the confidence intervals also indicates that the WTP estimates for laying hens, broiler chickens and pigs are not significantly different from one another, although WTP estimates for both pigs and broilers are significantly different to that from dairy cows, beef cows and multiple animal types.

I^2 values were above 97% for all species, indicating that variation was high within the data, even with the animal type accounted for. Both visual inspection of funnel plots and Egger's test result indicate funnel plot asymmetry and publication bias for three of the animal types. Other GRADE criteria also demonstrate bias indicating a low overall strength of evidence.

4.4.4 Region

Table 4.4 summarise the results from the region subgroup analysis. Only one study was conducted in Asia and so the results are not presented in the table or subsequent discussion. All regions reported a premium as confirmed from the model estimates, with the lowest in Northern Europe (0.1060, (0.0376, 0.1744), 97.84) and the largest in Southern Europe (1.4329, (0.9577, 1.9082), 99.73).

Data collected in Western and Southern Europe reported the two highest WTP estimates, although it should be noted that there were only three studies in the Western European subgroup, and it was the only region to have a high risk of bias (all others being moderate). Data from the UK indicated the second lowest WTP estimate (0.649, (0.5113, 0.7845), 97.07), which was significantly different from both the Southern (highest) and Northern European (lowest) WTP estimates.

The lower 95% CI for Northern Europe was lower than the minimally important difference and so the WTP estimate cannot be said to be significantly different from zero, however it is significantly different from all the other regions WTP estimates. This was the only region to have an overall moderate strength of evidence, with all others being low, indicating that we can be more confident in interpreting the results as indicating that Northern European consumers would pay a low-price premium for higher welfare animal products.

I^2 values for all regions were above 94%, again indicating that a large amount of variability existed across studies. Funnel plots and Egger's test results indicate that publication bias is again strongly suspected for most groups

4.4.5 Socio-demographic characteristics

Socio-demographic characteristics (table 4.5) appear to account for the largest amount of variation within the data, with I^2 values as low as 67.75% for the percentage of vegetarians in the sample. However, these results should be interpreted with caution due to the small sample sizes in the analysis and the lack of reporting of selected variables. This was particularly true for the percentage of vegetarians, which was only reported in six studies. In the majority of these the percentage was inferred due to inadequacies in sample descriptions.

The results indicate that WTP decreases with age (-0.0377, (-0.0530, -0.0224), 87.24), increases with income (0.0207, (0.0131, 0.0284), 81.19) and with increased education (0.0086, (-0.0002, 0.0175), 85.69), and is higher for females (0.0246, (0.0113, 0.0379), 98.32) and lower for vegetarians (-0.7024, (-0.9599, -0.4394), 67.75). The WTP estimate for age is significantly different to all the other WTP estimates, highlighting it as an important explanatory variable. Income and level of education are significantly different from one another but are both significantly different to age and the percentage of vegetarians in the sample. Both visual inspection of the funnel plots and the Egger test reveal that publication bias is only detected for education. Imprecision in the results was also low as indicated by visual inspection of the forest plots. Results from the GRADE assessment are therefore more favourable than for previous subgroup analyses with only a low overall strength of evidence for education, with all other variables being either moderate or high (percentage of vegetarians).

4.4.6 Population

Results from the population subgroup analysis can be found in table 4.6. Both consumers and citizens reported positive WTP estimates, with citizens reporting a significantly lower WTP estimate (0.5122, (0.3810, 0.6435), 99.65), which was half that of consumers (1.1796, (0.8287, 1.5304), 99.79). Variation in the data remains high with I^2 values of over 99% for both citizens and consumers. Both Egger's test results and visual inspection of the funnel plots indicate that publication bias was strongly suspected, with inspection of the forest plots indicating strong inconsistency in effect size for consumers but only moderate inconsistency in effect size for citizens.

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Characteristic	I^2	Estimate	Lower 95% CI	Upper 95% CI	Number Measures	Number Studies	Weighted Mean WTP (€)
Age	87.24	-0.0377	-0.0530	-0.0224	156	24	0.19
Income	81.19	0.0207	0.0131	0.0284	123	19	0.11
Gender	98.32	0.0086	-0.0002	0.0175	157	26	0.19
Vegetarian	67.75	-0.7024	-0.9654	-0.4394	59	6	0.25
Education	85.69	0.0246	0.0113	0.0379	74	15	0.17

Table 4.5 Summary of results from the socio-demographic subgroup analysis

Population	I^2	Estimate	Lower 95% CI	Upper 95% CI	Number Measures	Number Studies	Weighted Mean WTP (€)	Egger's Test Results
Citizens	99.65	0.5122	0.3810	0.6435	187	26	0.33	3.7755, *p=0.0002*
Consumers	99.79	1.1796	0.8287	1.5304	40	11	0.25	1.6097, *p=0.1075*

Table 4.6 Summary of results from the population subgroup analysis

Sub-group	I^2	Estimate	Lower 95% CI	Upper 95% CI	Number Measures	Number Studies	Weighted Mean WTP (€)	Egger's Test Results
Revealed Preference	98.72	1.1935	0.9077	1.4793	31	8	€ 0.41	0.3713, *p=0.7104*
Stated Preference	99.73	0.5416	0.4035	0.6796	196	29	€ 0.25	2.7402, *p=0.0061*
Cheap talk script used	99.39	0.3595	0.2259	0.4932	83	9	€ 0.11	1.4715, *p=0.1412*
Cheap talk script not used	99.79	0.6758	0.4600	0.8916	113	20	€ 0.50	1.9413, *p=0.0522*
Cheap talk script not needed	98.72	1.1935	0.9077	1.4793	31	8	€ 0.41	0.3713, *p=0.7104*

Table 4.7 Summary of results from methodological aspects

4.4.7 Methodological aspects

A summary of additional results from the sub-group analysis can be found in table 4.7. Revealed preference studies reported a significantly higher WTP estimate than stated preference studies, the opposite of what is suggested in the literature e.g. Bateman *et al* (2002). As expected, the use of a cheap talk script (a short statement included in stated preference methods to lower hypothetical bias) reduces consumers stated WTP confirming the importance of its inclusion in stated preference study design. Heterogeneity was extremely high for most other subgroups (I^2 > 90%), indicating that these subgroups do not explain a large amount of variation in the data, as is the case for animal type, region and population type

4.4.8 Multivariate Analysis

A summary of the six models can be found in table 4.8. All the models still have high heterogeneity (I^2 values of over 98%). Model 6 appears to have the best fit (R^2=55.93%), and AIC score. As per the sub-group analysis (section 4.4.5), WTP appears to increase with income, decreases with age and is higher for females, although the results are only consistently significant for income.

Interaction effects are present (table 4.8), with certain regions and animal types changing from a positive to a negative WTP with the addition of the socio-demographic characteristics. This is most likely to be due to missing data within the socio-demographic variables, as indicated by the smaller number of measures in the models that containing them (models 4, 5 and 6). The models indicate significant differences between regions, specifically between Asia and North America, and between North America and Southern Europe. The models also indicate a difference in WTP between animal type, with there being a significant difference between fish and dairy cows in model 6 and between beef cows and layer hens in model 5, and between calves and all other species in models 2 and 3. However, it should be noted that there was only one study in the subgroups for Asia and for calves, both with relatively large WTP values which is likely to account for the consistently significant results

	Model 1: Region			Model 2: Animal Type			Model 3: Region + Animal Type		
	β	**95% CI**	**p value**	**β**	**95% CI**	**p value**	**β**	**95% CI**	**p value**
Intercept	0.105	(-0.093, 0.303)	0.297	0.287	(0.101, 0.472)	0.0027 **	0.016	(-0.195, 0.228)	*0.8799*
Asia[1]	2.277	(1.394, 3.160)	p<0.0001 ***				2.060	(1.145, 2.975)	*p<0.0001* ***
North America	0.646	(0.377, 0.915)	p<0.0001 ***				0.470	(0.181, 0.760)	*0.0016*
Southern Europe	1.327	(0.916, 1.738)	p<0.0001 ***				1.188	(0.774, 1.603)	*p<0.0001* ***
UK	0.548	(0.161, 0.934)	0.0057 **				0.667	(0.198, 1.137)	*0.0056*
Western Europe	0.978	(0.293, 1.662)	0.0053 **				0.998	(0.266, 1.730)	*0.0078* **
Beef Cow				0.915	(0.510, 1.320)	p<0.0001 ***	0.306	(-0.140, 0.752)	*0.1778*
Broiler Chicken				0.122	(-0.270, 0.515)	0.5404	-0.108	(-0.588, 0.373)	*0.659*
Calves[1]				4.546	(2.771, 6.325)	p<0.0001 ***	4.348	(2.709, 5.987)	*p<0.0001* ***
Dairy Cow				0.831	(0.443, 1.219)	p<0.0001 ***	0.354	(0.163, 0.906)	*0.005* **
Fish				0.084	(-0.659, 0.826)	0.8244	0.354	(-0.338, 1.046)	*0.3145*
Layer Hen				0.494	(0.176, 0.812)	0.0025 **	0.278	(-0.038, 0.594)	*0.0844*
Multiple				0.368	(-0.376, 1.111)	0.3308	-0.313	(-1.079, 0.452)	*0.4206*
Age									
Gender									
Income									
n	227			227			227		
AIC	583.19			573.25			523.08		
I^2	99.62			99.64			99.56		
R^2	21.57			18.09			31.3		

Table 4.8 Multivariate regression models

	Model 4: Region + Animal Type + Age			Model 5: Region + Animal Type + Age + Gender			Model 6: Region + Animal Type + Age + Gender + Income		
	β	**95% CI**	**p value**	**β**	**95% CI**	**p value**	**β**	**95% CI**	**p value**
Intercept	0.819	(-0.093, 1.730)	0.0779	0.344	(-0.689, 1.377)	0.5108	0.095	(-0.924, 1.114)	*0.8541*
Asia[1]	1.945	(1.290, 2.599)	p<0.0001 ***	1.734	(1.023, 2.438)	p<0.0001 ***	1.833	(1.133, 2.532)	*p<0.0001* ***
North America	0.396	(0.168, 0.625)	0.0008 ***	0.426	(0.197, 0.654)	0.0003 ***	-0.099	(-0.409, 0.212)	*0.5309*
Southern Europe	1.182	(0.873, 1.492)	p<0.0001 ***	1.051	(0.714, 1.389)	p<0.0001 ***	0.240	(-0.223, 0.704)	*0.3064*
UK	0.275	(-0.449, 0.999)	0.4538	0.223	(-0.497, 0.943)	0.5415			
Western Europe	0.928	(0.263, 1.594)	0.0066) **	0.863	(0.200, 1.525)	0.0111 *			
Beef Cow	0.402	(0.019, 0.785)	0.0394 *	0.473	(0.088, 0.858)	0.0165 *	-0.260	(-0.766, 0.247)	*0.3123*
Broiler Chicken	-0.137	(-0.802, 0.528)	0.6845	-0.127	(-0.785, 0.531)	0.7032	-0.478	(-1.065, 0.109)	*0.1092*
Calves[1]									
Dairy Cow	0.380	(-0.059, 0.819)	0.0893	0.321	(-0.117, 0.759)	0.14494	0.099	(-0.268, 0.467)	*0.5922*
Fish	0.017	(-1.078, 1.112)	0.9755	0.044	(-1.041, 1.130)	0.9357	-1.523	(-2.743, -0.303)	*0.0149* *
Layer Hen	-0.181	(-0.439, 0.078)	0.1693	-0.256	(-0.560, 0.049)	0.099	-0.068	(-0.395, 0.259)	*0.6817*
Multiple									
Age	-0.016	(-0.034, 0.003)	0.095	-0.011	(-0.031, 0.008)	0.2485	-0.021	(-0.042, -0.001)	*0.0371* *
Gender				0.005	(-0.004, 0.013)	0.2875	0.007	(-0.003, 0.017)	*0.144*
Income							0.026	(0.011, 0.400)	*0.0006* ***
n	156			150			121		
AIC	254.85			242.56			133.39		
I^2	98.92			98.93			98.3		
R^2	55.73			48.29			55.93		

Confidence intervals are in parentheses. Significance level: *** *p<0.01, **p<0.05, *p<0.1*. [1]Only one study in subgroup.

4.5 Discussion

4.5.1 Consumers' WTP for farm animal welfare

The results from the meta-analysis indicate that consumers are willing-to-pay a small price premium for FAW, equivalent to just over half a standard deviation, which is lower than the WTP identified by Lagerkvist and Hess (2011), who obtained premiums of between 50 and 150% in their analysis (Harvey and Hubbard, 2013a). This is higher than some existing premiums in the market (Baltzer, 2004). This large disparity may in part be due to the 28 studies included since 2010, which are likely to have used more refined methods, therefore reducing the premiums. As any increases in FAW standards are likely to incur increases in production costs, consumers will need to be prepared to absorb some of these in order to allow the chain to compete effectively (Harvey and Hubbard, 2013a), an accurate assessment of WTP is important. The small additional price consumers are WTP for improved welfare may result in consumers changing their behaviour and purchasing higher welfare products, assuming an appropriate and trustworthy identification and certification policy can be implemented to facilitate consumer recognition of such products.

Publication bias was strongly suspected and will be discussed further in chapter 5. Lagerkvist and Hess (2011) found that peer reviewed studies had lower WTP estimates typical of publication bias, although they suggest that this indicates that peer review acts as a form of quality control, rather than traditional publication bias. As a consequence of this bias and the other GRADE assessment criteria such as the high heterogeneity, varied populations and low critical appraisal score, an overall low strength of evidence has been identified in the reviewed literature indicating that the results of the analysis should be treated with caution. As the goal of meta-analysis is to study patterns of answers, heterogeneity within the data is expected (Borenstein *et al,* 2009), especially given the range of assessment of WTP methods, animal types and welfare measures available for analysis. Although extensive variation can be problematic, it can be explored by examining moderator variables or by using regression analysis (Stanley, 2001) to provide a better understanding of underlying variation. Further primary research is therefore needed to confirm the small price premium found, and given the heterogeneity within the data and significant differences between sub-groups, it would be more relevant to look at this in relation

to specific animal products or animal types. In light of how current legislation is currently structured, investigating public WTP in this manner will be more relevant to policy makers. Given the strength of evidence assessment, this is likely to produce much more robust evidence upon which policy can be formulated.

The results of the cumulative meta-analysis indicate that WTP estimates have evolved over time from large imprecise estimates, too much smaller, precise values. This could reflect the developments in WTP methodologies over the past 20 years (Lagerkvist and Hess, 2011), such as advances in modelling and the introduction of cheap talk scripts, the latter of which is known to reduce hypothetical bias (Carlsson *et al,* 2005a). This also reflects the shift towards the use of two main types of study; auctions and choice experiments which have been predominantly used since 2012, and are typically viewed as the more preferable measures of WTP (Bateman *et al,* 2002; Competition Commission, 2010). The convergence in WTP estimates from the cumulative meta-analysis also indicate that a positive WTP exists regardless of the animal type or measure of welfare since the studies all reported different combinations of these. This corresponds with the high I^2 values for the different animal types indicating that they do not explain variance data, especially when compared to variables such as socio-demographic characteristics (see section 4.4.5). The consistently positive WTP reinforces the negative perceptions the public have of modern farming (Chapter 3) and also demonstrates that consumers are concerned about all aspects of welfare. Therefore, a holistic approach to animal wellbeing needs to be considered in policy, which takes into consideration all aspects of welfare such as housing, environment and transport.

A policy evidence gap was demonstrated in relation to consumer WTP for reduced production diseases in intensive farming systems, with only four of the 54 studies specifically mentioning these, reflecting findings from chapter 3, the review into public attitudes towards production diseases associated with FAW. Two of these studies addressed production diseases in relation to human health (i.e. food safety), whereas the other studies addressed production diseases from an animal perspective, with the study by Grimsrud *et al* (2013) examining WTP to reduce production diseases in farmed salmon and the study by McVittie *et al* (2006) examining WTP to minimise the incidence of foot pad lesions (and associated dermatitis) in broiler chickens, by reducing the threshold for the acceptable number of cases detected. Considering the current trend towards implementation of intensive production systems in Europe, and

the role these have to play in future food security policies (e.g. Foresight, 2011), there is a need to address this research gap, as it is not yet clear whether the incidence of production diseases, or the interventions and processes used to treat these will be acceptable to the public, or whether they will represent a barrier to their increased use. Zingg and Siegrist (2012) found that although consumers seem accepting of vaccination programmes for animals for both epidemic and zoonotic diseases, they were not as willing to consume meat from animals that had been vaccinated, which could have serious market implications This also has implications for further development of policies designed to promote FAW though reduced incidence of animal diseases and associated improvements in animal health. In addition, it is important to ensure that the public's views are taken into account in future policy decisions concerning the management of these systems, including any future legislation surrounding animal health and welfare standards to ensure that factors associated with product diseases are effectively incorporated. A better understanding of consumer preferences in relation to aspects associated with production diseases and their interventions may also help to realise any value-added potential from alternative production systems, such as free-range or organic, which are perceived by consumers to be less risky although this may not necessarily be the case (Norwood and Lusk, 2013).

Ten studies addressed consumer WTP for antibiotic free meat and dairy products, with the majority (80%) of these based in the United States where antibiotic use as a growth promoter is still permitted (Hughes and Heritage, 2002), although as indicated by results of the WTP studies, is not viewed favourably. This has implications for how much longer they will continue to be used. The lack of research in Europe highlights a need to examine more relevant aspects related to intensive production, such as whether antibiotic use for disease treatment or disease prevention, is considered acceptable to the European public, especially as previous reviews into consumer attitudes have been identified as a concern (chapter 3) being viewed as unnatural, unnecessary and raising concerns in relation to product safety and human health in addition to FAW. At a time when agricultural antibiotic use for economic gain is coming under increased scrutiny due to antimicrobial resistance (Mateus *et al*, 2016), and is being widely contested (Hughes and Heritage, 2002; Chang *et al,* 2015), there is a need to consider the evaluation of alternatives including the public acceptability of these.

Despite individual studies considering production and welfare attributes associated with the occurrence of production diseases, they were not presented to participants in the studies included in the systematic review. Hence, future research needs to explicitly describe the link between the welfare attributes presented and the role they play in disease reduction, and animal health, in intensive production diseases, thereby providing further insights on how consumers and citizens value specific measures to reduce production diseases, as consumers do not appear to have the necessary knowledge to make the link themselves, with almost one in three European consumers (28%) reporting to know nothing at all about the conditions of farm animals in their respective countries (European Commission, 2007).

4.5.2 Willingness-to-pay by subcategory

Animal type

The public reported a positive WTP estimate for FAW in all animal types indicating that regardless of the animal, consumers are willing-to-pay a premium for improved FAW. Again, the GRADE assessment indicated a low overall strength of evidence for all types, with the exception of layer hens, partly due to the low number of studies available for each individual animal type. The lowest average WTP estimate obtained was for pigs and the highest for beef and dairy cows. The low WTP estimate for pig welfare is surprising due the large number of studies in this field and attention paid to ethical issues in modern pig production (Lassen *et al,* 2006). However, as most studies were conducted in Sweden (71%), and with Northern European consumers having a statistically lower WTP estimate than other regions, this could have influenced the results. Pig meat may also be considered as a low-value meat suitable for everyday consumption and hence other attributes may be more important than welfare, such as price, origin or various intrinsic product characteristics (Grunert, 2006), rather than FAW.

WTP estimates for the welfare of pigs and broilers are significantly different from dairy cows, beef cows and multiple animal types, but not from laying hens. The higher WTP estimates for both dairy cows and layer hens could be because there are few or no substitutes for these animal products (Kjærnes and Lavik, 2007), with dairy alternatives, such as soya, only becoming more readily available over the past few years, after the majority of the studies concerning dairy cows were conducted. Individuals are also familiar with paying price premiums for products such as free

range eggs, and for organic dairy products, a production method which is often associated with higher welfare standards (Bernard and Bernard, 2009). In addition, beef is considered as a premium meat (Verbeke and Viaene, 1999) and so consumers may be more willing to pay a premium for this. Alternatively, chicken and pork can quite easily be substituted by other meats, resulting in consumers having a having a lower price premium for these products as they may buy whichever is cheapest, especially if they are price sensitive consumers.

Results of the systematic review towards public attitudes towards FAW also found that consumers are more concerned about chickens (both layers and broilers), although dairy cow welfare was viewed more favourably by the public (chapter 3). From a policy perspective, this implies that although the public appear to have priorities in relation to certain animals, having acceptable *de minimis* standards for all animals is important. The preferences exhibited in both this review and the review in chapter 3 also highlights the role of information provision and the media within as playing an important role within this, with the animal types generating the highest WTP estimates being those that have received greatest press attention in recent years. Therefore, ensuring that the public are provided with, and have access to, accurate information should also be an important policy consideration (European Union, 2012).

Region

WTP estimated were found to be significantly different across regions. Again, some regions had few studies included in the analysis and the GRADE assessment indicated a low overall strength of evidence for subgroups apart from for Northern Europe. The Northern European region had a significantly lower WTP compared to all the other regions. This compares to findings by Lagerkvist and Hess (2011), whose results indicated that the Swedish public did not have a significantly higher WTP. Sweden provided the most measures of WTP for Northern Europe in this analysis, and had the lowest estimate in subgroup analysis for individual countries, although not significantly different from the other Northern European countries included in the analysis.

Even within Europe, significant differences were detected between regions with Southern European countries likely to pay a higher premium than countries within Northern Europe and the UK. This may reflect that Northern Europe and the UK put

more emphasis on regulations and less on market based solutions than Southern Europe (Kjærnes and Lavik, 2007; Veissier *et al,* 2008). These regions also have stricter minimum welfare requirements compared to the legislative minimum and so the rest of Europe (Bock and van Huik, 2007; Spoolder *et al,* 2011). Swedish and Norwegian consumers have also been found to be less worried about, and have more trust in, national animal production systems (Kjærnes and Lavik, 2007), placing responsibility for ensuring welfare standards with the government rather than themselves (Veissier *et al,* 2008). As a result, individuals from these countries may not be as receptive to, or may not perceive that, further incremental improvements in welfare are required, which may explain the significant difference in WTP estimates compared to Southern Europe. This reflects findings from the 2006 Eurobarometer survey where only 68% Swedes and 67% Finns responded that further improvements to national animal production systems were needed, compared to 90% of Portuguese and 91% of Cypriots (European Commission, 2007). The differences in WTP between European regions implies that future European policy decisions in relation to animal welfare will need to respect the cultural diversity whilst ensuring that the common ethically acceptable *de minimis* standard of welfare enforced by EU legislation does not restrict consumer's freedom of choice by out-pricing them from the market by imposing too large an increase in welfare. Legislation also needs to ensure that European producers are protected from imports from outside the European Economic Area (McGlone, 2001) which may not have been produced to as high a welfare standard and so could be sold at a much lower price. This would also apply to European regions with higher than *de minimis* standards of welfare in their national legislations, where lower priced animal products from other European countries could be imported. If policy cannot protect producers from this trade issue, then products should be regulated so that they are labelled accordingly, so that consumers can make informed purchase decisions.

Socio-demographic variables

Socio-demographic variables were found to account for the largest proportion of heterogeneity within the data compared to the other subgroups analysed, and all had a greater strength of evidence compared to other moderator variables, apart from education. However, due to problems with missing data, especially for the percentage of vegetarians in the study populations, the results should again be interpreted with caution. Age was significantly different to all the other socio-

demographic variables, with an increase in age leading to a decrease in WTP, implying different preferences between older and younger individuals. This finding is in line with the previous meta-analysis by Lagerkvist and Hess (2011) who report a similar decrease in WTP in relation to age. As the authors state, this finding warrants further research to understand the reasoning behind this, due to the aging population in Europe, although it is likely that as people get older their preferences for FAW will not change. Income and education were not significantly different to each other or the percentage of females in the sample, due to non-overlapping confidence intervals. It is not surprising that these variables are linked to a higher WTP, as more educated individuals are more likely to have higher disposable incomes which will provide an individual with a greater ability to reflect their attitudes in their purchasing behaviour.

The heterogeneity within the socio-demographic and socio-economic characteristics confirms that niche markets for products produced to higher FAW standards do exist (Wathes *et al,* 2013), and that segments of the market with different FAW preferences need to be catered for (de Jonge and van Trijp, 2014). This indicates that a blanket policy that maintains acceptable *de minimis* welfare standards for the majority, can be supplemented with market based options, thus ensuring that not all are priced out of the market by high *de minimis* standards of welfare, whilst also maintaining freedom of choice. The lower heterogeneity in WTP estimates with socio-demographics implies that these traditional market segmentation variables are important for the identification of niche markets, especially as there is evidence to suggest that FAW improvements could pay for themselves if products are suitably presented in a way so that consumers can differentiate them from products produced to minimal welfare standards (Verbeke, 2009; Compassion in World Farming, 2014). This also supports findings than market based solutions are a key solution in improving FAW standards (Ingenbleek *et al*, 2012). Ensuring that consumers have enough information to make informed decisions (Mayfield *et al,* 2007) highlights the importance of labelling of higher welfare products as part of market based solutions, providing an authenticity cue that delivers additional assurance to consumers who are prepared to pay more for these products. The authenticity of food is important to consumers enabling them to believe products are what they claim to be (van Rijswijk *et al,* 2008), with consumers willing-to-pay more for authenticity labels (Cicia and Colantuoni, 2010), including on–farm traceability and animal welfare. Suitable

independent regulation and monitoring should be in place to ensure that labelling scheme(s) are maintaining the claimed higher standard so as to obtain public trust.

As the results are confounded and affected by bias, further exploration of the population in relation to these characteristics, or additional attitudinal variables, may help to better understand the variability and rationale behind choices, and add further explanation to these findings so that a stronger evidence-base is created. Therefore, future market based research should seek to further explore the socio-demographic characteristics that accounted for the largest amount of heterogeneity. This will enable more definitive recommendations to be made benefitting both policy makers and producers. In addition, consistent reporting standards would ensure that key variables are recorded in future studies, in order to provide greater transparency and aid in subsequent comparison of results and synthesis. These include but are not limited to; socio-demographic characteristics, standard errors, standard deviations or 95% CI, and key methodological details such as year of data collection.

Population

The literature acknowledges the difference between citizens and consumers in relation to FAW (Harper and Henson, 2001; Grunert, 2006), recognising that both are likely to express positive attitudes towards improving FAW standards. However, consumers are able to express these attitudes through purchasing products whereas citizens, including vegetarians and vegans, may not purchase (some) animal products regardless of the welfare standards, yet still have an interest in the issues surrounding the implementation of and production of these products (Vanhonacker *et al,* 2007). The results of the meta-analysis confirm that consumers have a WTP estimate more than double that of citizens, implying that consumers have much stronger, positive attitudes towards higher welfare products than citizens, thereby exhibiting a much greater WTP. Consumers are also likely to place more value on the products involved (obtaining a private benefit from a perceived higher quality or healthier product), and so are willing-to-pay more to secure this (European Commission, 2005; Bennett *et al,* 2012). It should be noted that only 40% of the options used in non-consumer experiments were suitable for vegetarians (i.e. tax increases, eggs or dairy products), therefore the difference in WTP between citizens and consumers may be exaggerated.

Differences in WTP for different population segments further supports a portfolio policy response for improving welfare, depending on the context and the target audience (Ingenbleek *et al,* 2012). A higher consumer WTP again supports the adoption of market based solutions for improving FAW. Companies are increasingly looking to use FAW standards as a point of differentiation as a driver for company codes of practice (Broom, 2010) and to protect brand capital (Blandford *et al,* 2002). Competitive pressures also thought to encourage the adoption of best practice (Harvey and Hubbard, 2013), as demonstrated by number of retailers have already adopted welfare friendly strategies as part of their differentiation strategies, including to entire product categories (White, 2016), a stance which can appeal to non-consumers too. As aforementioned on socio-demographic variables, suitable regulation and monitoring of private sector schemes is essential, and as they continue to grow in popularity, it may be the case that a more formalised legislation is required to ensure the transparency, consistency and authenticity of these. The ready identification of these consumers (perhaps by the aforementioned socio-demographic variables discussed) along with improved access the higher welfare products, either through transparent labelling, education programs or private assurance schemes (Ingenbleek *et al,* 2012; Kehlbacher *et al,* 2012) are an integral part of this for ensuring success. From a producer perspective, the identification of target markets and indication of whether certain changes to production process will be financially viable is important (Compassion in World Farming, 2014), with transparent regulation of these independent standards being important from a consumer perspective.

Although citizens were WTP less than consumers the positive WTP highlights that the wider public (i.e. non-users) still place a value on higher welfare production systems. It is important to ensure that the growing proportion of those who do not consumer products still have their views taken into consideration in policy formulation. In addition, as most those who consume animal products may adopt dissonance strategies (chapter 3) therefore market based solutions cannot be the only route forward. Policy therefore needs to take into account individuals who still take value from animals being in higher welfare systems yet may not be able to reveal their preferences through market choices, reflecting the social, as opposed to just private benefits, accrued from improvements to animal welfare (Bennett *et al,* 2012). These social benefits support government and farmer based policy solutions,

such as legislation and subsidies which would act to guarantee minimum standards or incentivise higher ones respectively. This is supported by the findings of the review with WTP estimates decreasing as the proportion of vegetarians in the sample increased. Although it would be expected that vegetarians could still obtain utility from higher FAW, especially if this was a motivation for their choice, it could be explained by all the products in the analysis being meat (pork, ham and beef) and so would not be directly consumed by them. Therefore, a multi-faceted policy approach is necessary to support both citizen and consumer preferences and to provide a feasibly acceptable *de minimis* standards of welfare supplemented with more stringent independent standards.

Methodological aspects

Revealed preference studies provided higher WTP estimates than stated preference studies, which is the opposite of what is currently suggested in the literature suggests (Bateman *et al,* 2002). Half of the revealed preference studies were auctions, which also contributed more measures to the analysis. These typically were associated with much higher WTP estimates than either the hedonic analysis or real choice experiments which may explain this difference. Half of these studies were also conducted in Southern European countries, (where the highest WTP estimates were reported), which may also have contributed towards the higher WTP estimates for revealed preference studies. The addition of a cheap talk script, used to reduce hypothetical bias in stated preference methods, to a study decreased the WTP highlighting it as an important and recommended factor in WTP study design (Carlsson *et al,* 2005a; 2005b; Competition Commission, 2010). However, as cheap talk scripts were included only 10 of the 27 stated preference studies published since its first occurrence in the FAW literature in 2005, it appears that this recommendation is still not common practice despite its apparent benefits.

Multivariate analysis

The results from the multivariate models support those from the subgroup analysis, confirming the importance of socio-demographic characteristics and that WTP values appear to differ slightly (although not largely significantly) between animal species and regions. The results for the socio-demographic characteristics confirm that WTP decreases with age, increases with income and is higher for females, with both age and income being significant. This again highlights the potential market based solutions have in improving animal welfare standards (Ingenbleek *et al,* 2012), and

confirms these as important marketing segmentation variables in the targeting of niche markets. As per the subgroup analysis, both animal type and regional differences are apparent in the model, although significant differences were not consistent across models. Again, this reinforces the conclusions from the respective subgroup analyses in that legislation needs to consider regional and cultural differences and should also account for concerns towards specific farm animals. The negative WTP estimates for animal type appear to indicate that individuals wish to be compensated for higher welfare products, although they could be due to interaction effects in the data. This negative WTP is unlikely to be in monetary terms but in terms of the additional credence attributes often associated with higher FAW, such as quality, health and taste (Harper and Henson, 2001; European Commission, 2007).

As per the subgroup analysis, there were problems with missing data. Not all animal types were surveyed in all regions, and some regions had very few studies which reported socio-demographic characteristics (mainly those from the UK and Western Europe). This is a potential source of the interaction effects present across animal types and regions. However, despite this limitation it is likely that the regional and species differences as well as the trends observed for the socio-demographic variables are likely to be apparent, due to the consistency with results observed in the subgroup analysis.

4.6 Limitations

The heterogeneity of the data, in relation to several the study variables, makes it difficult to draw firm conclusions from the findings especially in relation to overall WTP values. However, the more modern approach to meta-analysis used in this research focus' less on the mean effect size provided, but more on the distribution of the effect sizes and any potential underlying relationships (Lipsey and Wilson, 2001), and this was comprehensively explored within the analyses.

Missing data introduced bias into the results and subsequently, due to the small sample sizes and heterogeneity for certain variables, the sub-group analysis should be interpreted cautiously. It is also important to note that the multivariate analysis was exploratory, due to missing data problems and cofounding between variables, as indicated by AIC and the interaction effects apparent in the analysis. Multivariate analysis also assumed linearity of the variables, which may not be the case. It is also possible the results may be confounded by ecological bias (Stewart *et al,* 2012).

However, despite the heterogeneity in the data, and small sample sizes in some sub-group analyses, meta-analysis was still a useful method for formal exploration of the data, providing a more transparent, formalised and robust assessment of the consistency of the effect (Pettigrew and Roberts, 2008; Higgins and Green, 2011) compared to a simple *ad hoc* summary of the literature (Borenstein *et al,* 2009). This transparent framework can also be updated as more evidence becomes available, and has had a transformative effect in other disciplines (Koricheva *et al,* 2013; Higgins and Green, 2011). In addition, as only a small amount of heterogeneity was explained by study characteristics (table 4.7), it is likely that variation in WTP estimates are more likely due to other factors, such as socio-demographic characteristics and other potential influential drivers not measured or reported in primary studies. This large variability, combined with the public preferring a holistic approach to welfare (Spooner *et al,* 2014), question the usefulness of economic measures such as WTP on highly specific welfare aspects, in the first instance, when there is very little replication of methodologies to enable direct comparison.

4.7 Summary

This chapter sought to establish public WTP for FAW with a specific focus on interventions to reduce production diseases in intensive production systems. The results indicated that consumers report a small premium for higher FAW products, although this should be treated cautiously due to the high heterogeneity and low strength of evidence presented. Although there are attributes which relevant for reducing production diseases, a research gap was highlighted in relation to the primary objective of the research with only four of the 54 studies specifically examining production diseases.

Chapter 5 will further discuss the publication bias identified in the review and the implications this has on the interpretation of the results of this research, and the wider implications this has for conducting reviews of the WTP literature. Chapter 6 will then look to explore the research gaps identified in this chapter, and chapter 3, in relation to public attitudes towards intensive production systems and production diseases, and the potential policy implications this may have.

Chapter 5. Publication bias

5.1 Introduction

Chapter 4 detailed and presented a meta-analysis on WTP for FAW including evidence to indicate that publication bias is present in the results of the systematic review. As publication bias can have significant implications for the interpretation of and recommendations drawn from the synthesis of research results, it is important to explore this finding more comprehensively. This chapter therefore looks to explore publication bias more comprehensively. The problem of publication bias will be described in detail. The methodology for identifying and quantifying publication bias within the WTP data obtained in chapter 4 are then outlined. The results of the assessment of publication bias are presented, before the findings and implications of these are discussed.

5.2 Background

5.2.1 What is publication bias?

Evidence synthesis methods such as systematic review and meta-analysis are being more frequently adopted in the study of consumer behaviour for several reasons (see chapter 3). These include increases in the volume of information available, the increased focus on research which delivers the basis for evidence-based policy and practice, and the need to assess and present the totality of evidence in relation to a given topic to all stakeholders concerned (Solesbury, 2001; Petticrew and Roberts, 2008; Organisation for Economic Co-operation and Development, 2016). These methods have had transformative effects in other disciplines such as medicine, social reform and education. However, it is suggested that systematic review and meta-analysis focused on synthesising evidence relevant to the development of food policy remain insufficient and are normally only done in part.

Chapter 4 recommended that, that in addition to providing a robust and transparent form of evidence synthesis, meta-analysis has the added advantage of identifying additional weaknesses in the evidence-base, such as publication bias. Publication bias was first identified in the psychology literature (Rosenthal, 1979; Smart, 1964; Smith, 1956), although many of the methodologies are now applied within medical and healthcare disciplines (Torgerson, 2006). Within the social sciences, publication bias been defined as "*the tendency toward preparation, submission and publication*

of research findings based on the nature and direction of the research results" (Dickersin, 2005, p.13). In other words, the publicly available literature is not fully representative of all the completed and robust studies within a given topic of interest (Banks *et al.*, 2015). Failure to publish results could occur for a number of reasons (Cassey *et al*, 2004; Kepes *et al*, 2012). These include researchers failing to write up non-significant or negative results (i.e. the "file drawer" problem) (Rosenthal, 1979), or such results being peer reviewed less favourably with editors being less likely to publish results which do not support existing findings (Higgins and Green, 2011). Conversely, studies with statistically significant and supportive outcomes are more likely to be published (Sutton *et al*, 2000), with the same piece of work likely to be published on several occasions (Sterne *et al*, 2001). In addition, studies involving greater number of observations require a smaller study effect to have a significant result compared to studies with a smaller number of observations (Lipsey and Wilson, 2001). One consequence is that studies involving more observations are more likely to be published than those involving fewer observations i.e. publication bias is a function of sample size (Torgerson, 2006).

The failure to obtain a true representative sample of all studies addressing a specific topic can threaten the validity of the meta-analysis (Hedges and Vevea, 1996; Weiß and Wagner, 2011; Kicinski, 2013), especially if the studies that are missing from the systematic review process are systematically different from those that were included (Torgerson, 2006). It is important to note that this is not a failure of the search process to locate a representative sample of studies (Jennions *et al*, 2013), but is a problem with the availability of the literature due to non-publication, with studies that have positive and/ or significant results more likely to be published in the peer reviewed literature, and thus retrieved much more easily and frequently than studies with non-significant results (Torgerson, 2006).

Within social science in particular, the publication processes create potential for publication bias to be present, with there being few platforms for study or analysis plan registration, and a lack of requirement by journals for articles to meet reporting standards such as PRISMA (Moher *et al,* 2009). In addition, there are few journals which ask for data submission as a requirement for publication, although this is beginning to change (Miguel *et al,* 2014). Taken together, this encourages researchers to present and analyse data in a way which makes the resulting paper

more publishable. For example, researchers are less likely to spend time submitting papers where significant effects have not been identified (Miguel *et al,* 2014).

In light of the growth of evidence based policy and practice, the assessment of bias is an important part of policy design. In particular, acknowledgement of the limitations of the results obtained represent an important part of facilitating the correct interpretation of results. Failure to do so can lead to the overestimation and formation of unreliable conclusions (Stanley, 2005; Dwan *et al*, 2013), including the creation of an unrepresentative and distorted evidence base (Miguel *et al,* 2014). This will have subsequent impacts on cumulative knowledge and evidence based practice, which if used in policy, can lead to misinformation in policy decisions, which can potentially have extremely negative impacts (Miguel *et al,* 2014). It is therefore imperative that publication bias is assessed as part of the process of meta-analysis.

Publication bias is a widely acknowledged problem (Thornton and Lee, 2000). The majority of evidence for this comes from the medical sciences (Jennions *et al*, 2013). However, there is also evidence of a growing body of evidence in the social science literature (Franco *et al*, 2014), for example in economics (Stanley, 2005; Weiß and Wagner, 2011) and psychology (Kepes and McDaniel, 2015). However, publication bias is rarely tested for in meta-analyses within economics (Lusk *et al.*, 2005; Sundt and Rehdanz, 2015) nor the wider consumer behaviour literature (Cicia and Colantuoni, 2010; Deselnicu *et al*, 2013; Frewer *et a.*, 2013). Where it has been explored, recommended tests (Higgins and Green, 2011) have often not been used (Lagerkvist and Hess, 2011), and publication bias has been missed when tested for (Ma *et al*, 2015). It is important to conduct a formal assessment of publication bias, in order to provide an indication as to the robustness of the results (Banks *et al,* 2015), and strength of evidence of the conclusions made.

In relation to WTP, several criticisms of the methodology exist. These include the assumption that individuals are the best judge of their own wellbeing (Bateman *et al*, 2002), that there is no common unit, scale or monetary values to assess the value of ethical issues and values associated with welfare or the environment (Hwang, 2015), and that WTP estimates are influenced by the wealth of the individual providing them. The criticisms also extend to a number of types of bias exist in WTP studies, including hypothetical bias (Bateman *et al*, 2002), non-response bias (Fujiwara and Campbell, 2011) and information bias (Bateman *et al*, 2002). There are also the advantages and disadvantages of the individual methods themselves which are

partially attributed to different types of bias (Gsottbauer *et al*, 2015). The majority of these criticisms of the WTP method are well known (Bateman *et al*, 2002), and are commonly taken into consideration. However, publication bias continues to receive relatively little attention despite the implications this could have for the interpretation of the results.

5.2.2 Chapter objectives

This chapter looks to further explore publication bias within the WTP studies identified in chapter 4. More specifically it aims to assess:

1. Whether publication bias is present in the meta-analysis of WTP for FAW?
2. Whether publication bias influences the results of the meta-analysis, and if so, to what extent?
3. What are the implications of the findings for the results of the meta-analysis?

5.3 Methods

The search and screening strategy followed the methods outlined in section 4.3. Given that most studies have reported multiple measures of WTP, all were extracted for analysis. A broad range of methods used to measure WTP were considered for inclusion in the review. This included, but was not limited to; revealed preference measures (market data, experimental auctions) and stated preference measures (conjoint analysis, contingent valuation studies, choice experiments). Studies with duplicate populations (where the same data was presented in two or more publications) were removed, with the study with the lowest critical appraisal score [3], or which reported the fewest WTP or socio-demographic measures, being excluded from the current analysis.

The search and screening process led to the inclusion of 54 studies, providing 335 measures of WTP, with studies on average providing six WTP measures. 17 of these studies (31.5%) failed to provide variances for their WTP estimates, leading to their measures being imputed. These will be referred to these as imputed values, with studies that did provide variances referred to as complete case values. Average

[3] As mentioned in section 4.3, the critical appraisal score was based on the assessment of a number of quality criteria that had the potential to impact on the results of the study; the WTP method used, the economic model used, the sample population and the sampling technique for each study. No studies were excluded based on the critical appraisal, with the findings being taken into account during the evidence synthesis when assessing the overall strength of evidence as part the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) analysis (Meader *et al,* 2014).

effect sizes for each study were calculated, and these will be referred to as aggregated values. All data analysis was conducted in 'R' (R Core Team, 2015). using the 'metafor' package (Viechtbauer, 2010); As described in section 4.3.3, effect sizes were calculated for each analysis as the standardised mean difference (mean WTP divided by the corresponding variance). A positive effect size indicates WTP a price premium for products produced to above minimum standards of welfare, with the resulting units of analysis being in units of standard deviations due to the use of the standardised mean difference as the effect size measure. Forest plots were generated for overall WTP calculations, and for all the sub-group analyses, to establish whether any inconsistencies were present in the data (Palmer *et al.*, 2008).

Vevea and Hedges (1995) describe three main ways of dealing with publication bias;

1) To use methods that eliminate differential selection of studies, such as registries of studies conducted, and mandatory protocol registration of proposed studies;
2) Methods that attempt to detect the presence of publication bias in datasets;
3) Methods to compensate for publication bias, by establishing what the combined effect sizes would be if the bias (or censorship) had not been present.

As there are very few measures in social sciences to prevent publication bias from occurring, due to the lack of widely used or available study registration databases, measures of assessment were focused on the last two ways of addressing publication bias.

As none of the commonly used methods for detecting publication bias are thought to be entirely satisfactory (Light and Pillemer, 1984; Jennions *et al.*, 2013), five different methods were used in the analysis in order to provide a triangulation of results, and subsequently greater confidence in the findings of the analysis[4]. All tests were performed on the aggregated, complete case and overall study values (both complete case and imputed values) to enable a comparison of publication bias within the data. The results for all tests of publication bias are presented for the complete case (n=227), overall (n=335, complete case and imputed values) and aggregated

[4] Rosenthal's Fail Safe N (Rosenthal, 1979) is also commonly used to assess publication bias, and looks to establish the number of studies that would be required to reduce the obtained summary effect to a non-significant level (>0.05). This method is not recommended by Cochrane (Higgins and Green, 2011) due to its overreliance on the P value (Dalton *et al,* 2016)

values (n=54) respectively, and all tests were conducted with the below null hypothesis:

H_0: There is no asymmetry (public bias) in the data.

Results were also conducted on all the different sub-groups of the data analysed and discussed in section 4.4; animal type, region, population and methodological variables.

First, contour enhanced funnel plots were used to establish whether publication bias was present. Funnel plots aid in the interpretation of results and are the most common means of identifying publication bias. These are scatter graphs which plot the included studies effect size against their sample size (Hedges and Vevea, 1996), with the estimate precision increasing as the sample size increases (Sterne *et al.*, 2001) as the study result is less likely to have occurred by chance (Torgerson, 2003). If no publication bias is present the dispersion of studies should be shaped like a funnel, with the typically more variable (imprecise) and numerous smaller studies on the bottom, and the larger, generally more precise studies, being nearer the top. If publication bias is present asymmetry around the average effect size (and so the funnel) occurs, with studies with small negative results (usually indicated by missing studies in the bottom left hand corner of the funnel) (Sutton *et al*, 2000), or non-significant results (if the funnel is hollow with no studies in the middle) normally missing (Torgerson, 2006). However, it should be noted that the detection of asymmetry, or a significant result, is not necessarily related to bias and should be considered as an exploration of small study effects[5] (Higgins and Green, 2011) from a variety of sources (Egger *et al*, 1997; Møller and Jennions, 2001). Contour enhanced funnel plots aid with the interpretation of the funnel plot (Sterne *et al*, 2001), examining the plot in the context of the statistical significance of the results. It does this by looking at the distribution of the studies on the plot to see whether the areas of missing studies are due to statistical significance (Palmer *et al*, 2008). The areas of statistical significance at the 10%, 5% and 1% significance levels are clearly indicated on the funnel plot to make it as transparent as possible as to whether missing results are likely to be statistically significant.

[5] Small study effects are when the effects of interventions in small studies are different from those estimated in large studies (Sterne, 2000)

Second, the Egger test (Egger *et al*, 1997) was used to check for publication bias. The Egger test uses a regression based approach to test for asymmetry in the data by plotting the effect sizes included against a measure of their variance, and examines whether the intercept of the regression line significantly deviates from zero. When publication bias is present, the regression line will not run through the origin, leading to a significant result which indicates that publication bias is present in the data. Third, the Begg and Mazumder rank test (Begg and Mazumdar, 1994) was applied. This uses the Kendall's rank correlation to examine the significance between the effect sizes and their sampling variances. A significant correlation is taken as indicating that publication bias is present in the data.

The Vevea and Hedges model (Vevea and Hedges, 1995) was also used to establish the difference between adjusted and unadjusted effect sizes. This weight function model corrects for publication bias by using a weight function to represent the process of selection. The model has two parts that incorporate a model for the distribution of the effect size estimates before selection occurs, and a model for the selection process which will describe how it has affected the distribution of the estimates (Vevea and Hedges, 1995). These models are quite complex and involve a lot of computation, and are therefore less widely used than the previously described tests of publication bias previously discussed. However, the Shiny app by Coburn and Vevea (2015), provides a more accessible means of utilizing the Vevea and Hedges model. P value cutpoints of 0.05 were used in the analysis due to this being a commonly used and widely understood value, with the weights fixed to 1, and all subsequent weights and values relative to this (Coburn and Vevea, 2015). Hedges and Vevea (1996) also recommend examining the effect size of published *versus* unpublished studies (i.e. peer reviewed vs. non-peer reviewed) to assess whether there are any differences in effect size. This was utilised as the fifth and final test for publication bias.

5.4 Results

Average effect sizes are as follows; complete case analysis (I^2 99.71%, effect size 0.6302 (95% CI 0.5016, 0.7587), significance *p <0.0001*), overall data analysis (99.76%, 0.5709 (0.4599, 0.6819*), p <0.0001*) and aggregated value analysis (99.72%, 0.6135 (0.4106, 0.8524), *p<.0001*). Effect sizes for each analysis were reasonably consistent with one another as discussed in chapter 4. To summarise,

effect sizes for each analysis were reasonably consistent with one another and all indicated that the public are WTP a small price premium for products produced with higher than minimum animal welfare standards e.g. free-range eggs, compared to barn eggs. Results from the assessments of publication bias are presented below and are summarised in table 5.1 for the overall data and in table 5.2 for the subgroup analysis, with the results of the Vevea and Hedges model displayed in table 5.3.

The contour enhanced funnel plots for each sample are displayed in figures 5.1-5.3, and, as expected, the studies with more observations show less variation in their effect size estimates compared the studies with fewer observations. The results of the contour enhanced funnel plots for the complete case, overall, and aggregated values demonstrate asymmetry indicating that publication bias is present in the results. The contours on the plots indicate that asymmetry occurs on the left-hand side of the plot, indicating studies with smaller than average effect sizes are missing. These missing studies on both sides appear to be in the area of significance at the 5% level and below to the left of the average effect size. In addition, there appeared to be few small studies with non-significant results as indicated by the lack of studies in the white region in the centre of the funnels.

The results of the Egger's test are significant for the complete case values only (z=3.7300, *p=0.0002*), leading to rejection of our null hypothesis (H_0 = there is no asymmetry) and indicating asymmetry in the data, consistent with the suspected publication bias from the funnel plots. Although asymmetry is detected in the Egger's test for the overall values (z=1.2310, *p=0.2183*), this was not statistically significant. For the aggregated data the negative z value (z=-0.5939, *p=0.5526*) supports the findings from the contour enhanced funnel plots that studies from the right hand side of the funnel plot appear to be missing.

Results of the rank test lead to the rejection of the null hypothesis, indicating that publication bias in present in all datasets. This was significant at the 0.1% level for the complete case (0.3103, *p=0.0001*) and overall values (0.2594, *p<0.0001*), and at the 5% level for the aggregated values (0.1944, *p=0.0392*). The correlation was weakest for the aggregated data set, which may be a reflection of the smaller number of values in this dataset, and also the studies missing from the right-hand side as indicated from both the funnel plot and the Egger's test.

		Data values		
Test		**Complete case**	**Aggregated**	**Overall**
Egger test (z score)		3.7300, *p=0.0002****	-0.5939, *p=0.5526*	1.2310, *p=0.2183*
Ranktest (Kendalls tau)		0.3103, *p=0.0001****	0.1944, *p=0.0392**	0.2594, *p<0.0001****
Contour enhanced funnel plot		Yes	Yes	Yes
Average effect size (95% CI)	**Peer reviewed**	0.6390 (0.4858, 0.7922)	0.4798 (0.1861, 0.7736)	0.5654 (0.4393, 0.6914)
	Non-peer reviewed	0.5839 (0.4393, 0.6914)	0.4003 (-0.0666, 0.8671)	0.6017 (0.4367, 0.7666)
Number measures		227	54	335
Number studies		37	54	54
Model results (effect size, 95% CI, I^2)		0.6302, (0.5016, 0.7587), 99.71	0.6135 (0.4106, 0.8524), 99.72	0.5709, (0.4599, 0.6819), 99.76

Significant at: **p<0.05, **p<0.01, ***p<0.001*

Table 5.1 Results from four assessments of publication bias

	No. measures	No. studies	I^2	Effect size (95% CI)	Regtest (z value)	Ranktest (Kendalls Tau)	Funnel plot
Animal Type[6]							
Beef cow	24	7	99.84	1.2022 (0.7294, 1.6750)	0.7436, *p=0.4571*	0.1888, *p=0.2106*	Yes
Pig	90	13	98.33	0.2843 (0.1936, 0.3750)	2.4579, *p=0.014***	0.1680, *p=0.0239***	Yes
Layer hen	47	10	99.88	0.7823 (0.3594, 1.2053)	1.1088, *p=0.2675*	0.2551, *p=0.0163***	Yes
Broiler chicken	26	8	97.92	0.4024 (0.2653, 0.5394)	4.1308, *p<0.0001****	0.5364, *p=0.0002****	Yes
Mixed	6	2	94.78	0.6547 (0.4206, 0.8888)	-0.0606, *p=0.9516*	0.0667, *p=1.0000*	Yes
Dairy cow	27	7	99.53	1.1176 (0.7776, 1.4575)	2.8086, *p-0.005****	0.3395, *p=0.0177*	Yes
Fish	6	3	99.29	0.3712 (-0.0073, 0.7497)	-0.4668, *p=0.6406*	-0.0861, *p=0.8216*	Yes
Population							
Citizens	187	26	99.65	0.5122 (0.3810, 0.6435)	3.7755, *p=0.0002****	0.2845, *p<0.0001****	Yes
Consumers	40	11	99.79	1.1796 (0.8287, 1.5304)	1.6097, *p=0.1075*	0.1634, *p=0.1545*	Yes
Region							
UK	27	7	97.07	0.6479 (0.5113, 0.7845)	1.9722, *p=0.0486***	0.2357, *p=0.3920*	Yes
Northern Europe	76	8	97.84	0.1060 (0.0376, 0.1744)	-2.8201, *p=0.0048****	-0.1551, *p=0.0655*	No
Western Europe	7	3	94.66	1.0741 (0.7720, 1.3763)	2.0213, *p=0.4320****	0.3504, *p=0.2820*	Yes
North America	90	16	99.74	0.7515 (0.5026, 1.0004)	1.0488, *p=0.2943*	0.2296, *p=0.0019***	Yes
Southern Europe	23	6	99.73	1.4329 (0.9577, 1.9082)	2.3457, *p=0.0190***	0.2967, *p=0.0596**	Yes
Use of a cheap talk script							
Script used	83	9	99.39	0.3595 (0.2259, 0.4932)	1.4715, *p=0.1412*	0.2359, *p=0.0027***	No
Script not used	113	20	99.79	0.6758 (0.4600, 0.8916)	1.9413, *p=0.0522*	0.2083, *p=0.0015***	Yes
Script not needed	31	8	98.72	1.1935 (0.9077, 1.4793)	0.3713, *p=0.7104*	0.0334, *p=0.7974*	No
Willingness to pay method							
Revealed preference	31	8	98.72	1.1935 (0.9077, 1.4793)	0.3713, *p=0.7104*	0.0334, *p=0.7974*	No
Stated preference	196	29	99.73	0.5416 (0.4035, 0.6796)	2.7402, *p=0.0061***	0.2563, *p<0.0001****	Yes

Table 5.2 Results of the subgroup analysis

[6] Calves and Asia are not included in the analysis due to there being only one study for each respective subgroup in the analysis

	Total no. of effects	Unadjusted Model		Adjusted Model		Likelihood ratio test		
	n	Intercept	Variance component	Intercept	Variance component	2*difference	df	p value
Case Complete	227	0.63 ± 0.07	0.97 ± 0.09	-0.23 ± 0.18	1.40 ± 0.16	60.51	1	*p<0.001*
Aggregated	54	0.47 ± 0.13	0.94 ± 0.18	0.96 ± 0.18	0.76 ±0.13	10.03	1	*p<0.05*
Overall	335	0.57± 0.06	1.06 ± 0.08	-0.25 ± 0.14	1.44 ± 0.13	81.28	1	*p=0.000*
Region	227	0.10± 0.10	0.74 ± 0.07	-0.73 ± 0.18	0.99 ± 0.11	62.69	1	*p<0.001*
UK		0.55 ± 0.19		0.70 ± 0.27				
North America		0.65 ± 0.13		0.84 ± 0.18				
Western Europe		0.98 ± 0.34		1.38 ± 0.50				
Southern Europe		1.33 ± 0.21		1.94 ± 0.29				
Asia		2.28 ± 0.44		3.09 ± 0.54				
Animal Species	227	0.29 ± 0.09	0.77 ± 0.07	-0.54 ± 0.18	1.04 ± 0.12	61.9	1	*p<0.001*
Fish		0.08 ± 0.37		0.11 ± 0.49				
Broiler Chicken		0.12 ± 0.20		0.16 ± 0.26				
Multiple		0.37 ± 0.37		0.50 ± 0.53				
Layer Hen		0.49 ± 0.16		0.69 ± 0.23				
Dairy Cow		0.83 ± 0.19		1.25 ± 0.29				
Beef Cow		0.92 ± 0.20		1.40 ± 0.30				
Calves		4.55 ± 0.89		5.38 ± 1.04				
Population	227	0.51 ± 0.07	0.90 ± 0.09	-0.36 ± 0.17	1.27 ± 0.15	62.14	1	*p<0.001*
Consumers		0.67 ± 0.17		1.07 ± 0.26				
Preference	227	0.54 ± 0.07	0.92 ± 0.09	-0.31 ± 0.18	1.30 ± 0.15	60.63	1	*p<0.001*
Revealed Preference		0.65 ± 0.19		1.00 ± 0.29				
Cheap Talk Script	227	0.36 ± 0.10	0.89 ± 0.08	-0.53 ± 0.20	1.26 ± 0.15	59.97	1	*p<0.001*
Cheap Talk Not Used		0.32 ± 0.14		0.43 ± 0.19				
Cheap Talk Not Needed		0.83 ± 0.20		1.24 ± 0.30				

Table 5.3 Results of the Vevea and Hedges model

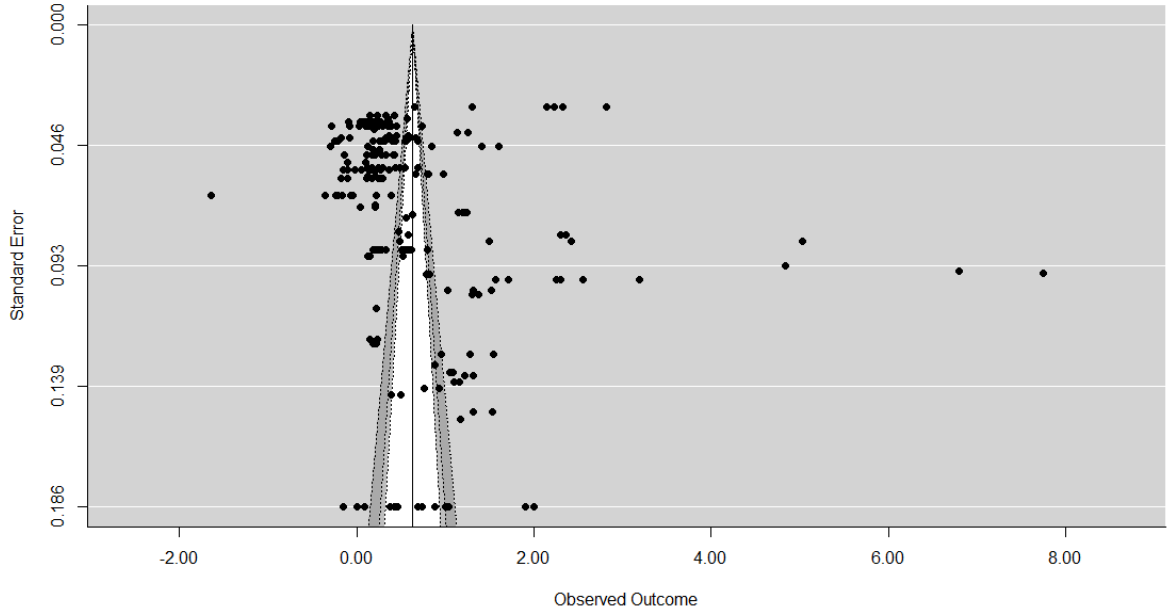

Figure 5.1 Contour enhanced funnel plot for complete case values (n=227)

Light grey is <1% significance, medium grey is 1-<5% significance, dark grey is 5-10% significance, white is area of non-significance

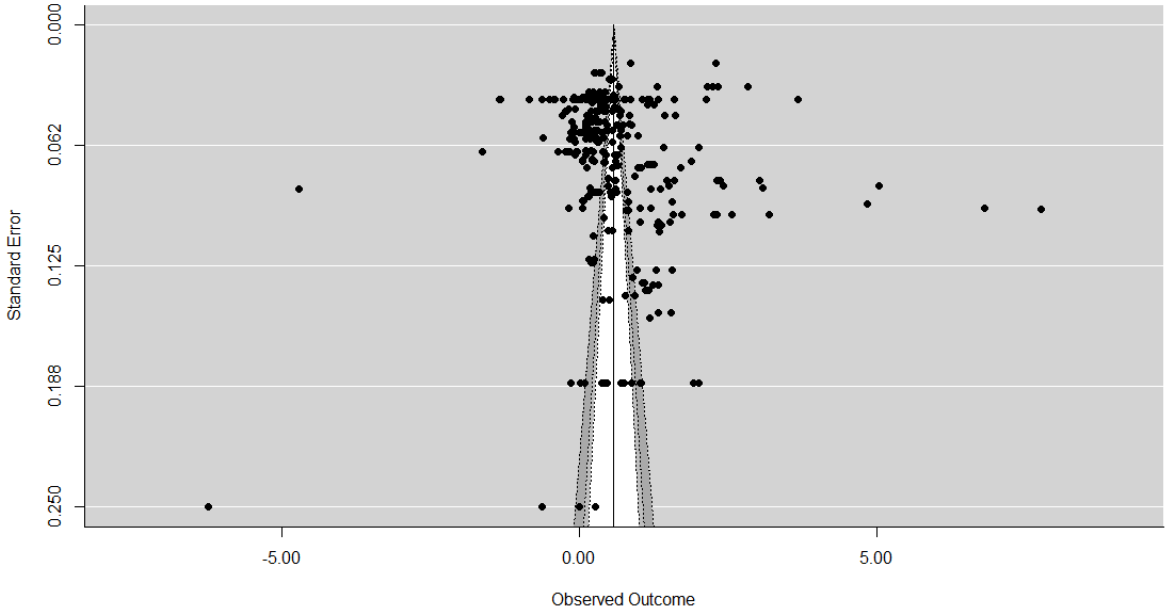

Figure 5.2 Contour enhanced funnel plot for overall values (n=335)

Light grey is <1% significance, medium grey is 1-<5% significance, dark grey is 5-10% significance, white is area of non-significance

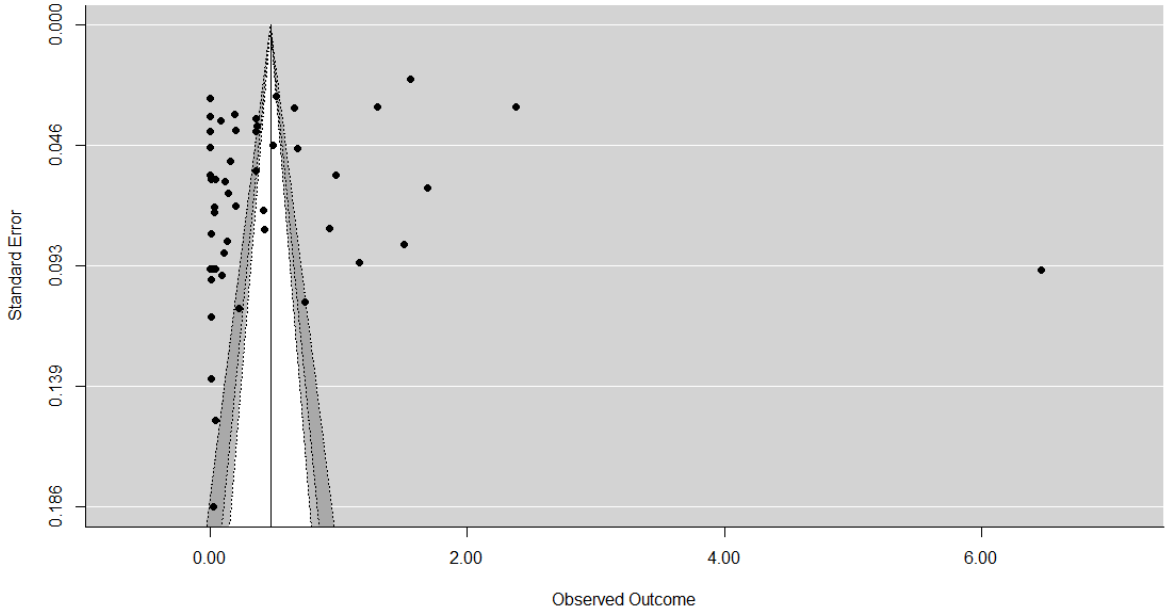

Figure 5.3 Contour enhanced funnel plot for aggregated values (n=54)

Light grey is <1% significance, medium grey is 1-<5% significance, dark grey is 5-10% significance, white is area of non-significance

The Vevea and Hedges test again confirmed that publication bias was present in the data, with there being statistically significant differences between the unadjusted and adjusted WTP estimates for the complete case χ_2 (1) = 60.51, *p<0.0001*, overall χ_2 (1) = 81.28, *p<0.0001* and aggregated values χ_2 (1) = 10.03, *p=0.0015*, as highlighted in table 3. The significant result indicates that the adjusted models fit the data better. (Coburn and Vevea, 2015) For both the case complete and the overall values, the adjusted values are lower than the initial estimates, with values becoming negative following adjustment, changing from 0.63 to -0.23, and from 0.57 to -0.25 respectively. It should be noted that this negative effect size does not imply that individuals are not willing-to-pay or wish to be compensated for purchasing higher welfare products, rather that they expect them to have additional benefits, such as being healthier or safer products, or to have been produced in a more environmentally friendly manner (Grunert, 2006). For the aggregated data, the opposite was true, with the effect size increasing from 0.47 to 0.96, which is unsurprising as from the previous analyses it would appear that positive WTP estimates will have been added to create the adjusted estimate.

Finally, the mean effect size between published and unpublished studies was compared. There was little difference between them for all datasets (table 5.1), with all having overlapping confidence intervals between published and unpublished values. For both complete case and aggregated values, peer reviewed publications deliver slightly higher values, while for the overall dataset average published values are slightly lower, which is likely due to larger standard deviations obtained through imputation (as they were not reported).

Overall, it would seem that publication bias is suspected in this example of the WTP literature, and this was consistently demonstrated across all tests, particularly for the complete case values, compared to the other two datasets where values had been imputed. For the aggregated values, publication bias is suspected across all tests bar the Egger's test, although the slight negative correlation would appear to support the overall finding that smaller studies with larger effect sizes appear to be missing. Few studies appear to be missing from the left-hand side of the funnel plots, although for all graphs there were missing studies from areas of non-significance implying that studies with non-significant results are not being published. The results of the subgroup analysis support these findings, with the Vevea and Hedges model (table 5.3) indicating publication bias across all subgroups, and the contour enhanced funnel plots, Egger and rank tests indicating publication bias for the majority of the subgroups as shown in table 5.2.

5.5 Discussion

5.5.1 General discussion

The results of the analysis indicate asymmetry, and a likely relationship between effect size and study size in the data, which leads to the conclusion that publication bias is strongly suspected in the meta-analysis of WTP for FAW. It would appear that small studies, with non-significant or small WTP values, are not being published, leading to an overestimation of WTP for FAW, because when the detected bias is adjusted for using the Vevea and Hedges model, the mean effect size reduced considerably. The aggregated data indicated that small, and some large, studies with large WTP estimates are either not being published, or are difficult to retrieve. For the smaller studies, this could be due to publication policy with editors reluctant to publish studies with large WTP values based on a small sample size. For the larger studies, which were consistently missing across the different data values, editors and

reviewers may be again reluctant to publish studies with such high WTP values. Alternatively, individuals may not be WTP large amounts for welfare friendly products, compared to conventionally produced products. Editorial reasons may also partly explain why there were few studies with non-significant results identified, as well as hypothetical bias (Bateman *et al*, 2002; Carlsson *et al,* 2005a), and social desirability bias (Vanhonacker *et al,* 2007). Hypothetical bias is where respondents will report a WTP value in a survey or experiment which is greater that their actual WTP, due to it being a hypothetical scenario. Social desirability bias is where individuals may report a WTP for a price premium for higher welfare products even though this may not be there preference, so that they do not appear unwilling or uncaring, and this phenomenon is particular apparent in WTP for ethical products or attributes (Vanhonacker *et al,* 2007).

As WTP can be used as a proxy for attitudes, these findings are supported by results of the qualitative evidence synthesis presented in chapter 3, in that although consumers appear concerned about FAW, several barriers to purchasing higher welfare products were identified, and a number of dissonance strategies were adopted to enable the consumption of conventionally produced products, without consumers experiencing any feelings of guilt. The findings also provide some explanation for the adjusted WTP estimate provided by the Vevea and Hedges weight function model, indicating that the implications of a negative WTP does not necessarily mean consumers are not WTP for higher welfare products. Instead, consumers may associate additional attributes other than the perceived better welfare for animals with higher welfare products, such as product safety and quality (Harper and Henson, 2001; Kjærnes and Lavik, 2007), with these attributes being interlinked in the mind of the consumer. They thereby expect additional product guarantees to reflect this.

The results of the subgroup analysis presented in table 5.2 reflect findings from the overall publication bias assessment, indicating bias present within the results by region, animal type, population and methodological factors. In addition, within the subgroup analysis, some significant differences between variables were detected. However, due to the bias within the results, it is not clear whether this is due to suspected publication bias, or is a true reflection of the data itself. Findings of the meta-analysis should therefore be interpreted with caution.

The presence of publication bias in the results of the meta-analysis emphasizes the need for more formalised assessment procedures, to both detect publication bias in the first instance, and subsequently aid with the interpretation of the results, so as to ensure that confidence can be given in the recommendations and that transparency is provided regarding the strength of evidence presented, as part of a GRADE assessment. As WTP information is used in policy decision making, it is important that the potential for publication bias is recognised, tested for by several means, and taken into consideration, when conducting reviews of the economic valuation literature and interpreting the results. This is important as systematic review and meta-analysis are being more frequently applied in the social sciences. Consequently, there is a need to ensure that comprehensive search strategies are used, and appropriate tests for bias are conducted and interpreted correctly. As is the case in other disciplines, ensuring consistency and transparency, as part of applying best practice in the review and synthesis process, is essential. Guidance should be developed in light of this, especially when the evidence base is being provided to inform policy decisions. Future systematic reviews and meta-analyses within the field should therefore look to test for publication bias as a form of sensitivity analysis as routinely, (Dalton *et al,* 2016), or even as standard, and guidance should be developed as to best practice regarding this process. The development of these measures will help to improve both the credibility and the quality of evidence synthesis within the social sciences (Torgerson, 2006).

Awareness of the problem of publication bias is a necessary pre-requisite for change (Meerpohl *et al.*, 2015). Although unpublished work can be tracked using all reasonable measures available (Begg and Mazumdar, 1994), this can be a very time consuming and resource intense activity, and may not be feasible. In addition, the grey literature is not always included in the systematic review process, with its exclusion often viewed as a form of quality control due it not having been peer-reviewed (Torgerson, 2006). The critical appraisal of all available literature within a review should help overcome concerns in relation to this, as even if the returned grey literature was of a low quality (which may be one reason why it is unpublished), the results of the critical appraisal will highlight this, and results can be interpreted accordingly. Reviewers should therefore be encouraged to search for grey literature to ensure that as wide a range of literature, and potentially results, is obtained as possible (Dalton *et al,* 2016), as reliance on peer-reviewed literature alone is thought to lead to bias in itself (Pettigrew and Roberts*,* 2008).

In other disciplines, increased use of meta-analysis has caused a re-evaluation of publication practices (Møller and Jennions, 2001), so as to avoid the problem of publication bias in the first instance by eliminating differential selection (Vevea and Hedges, 1995). The most common way of attempting to avoid publication bias is to encourage reporting mechanisms, such as the publication of analysis plans (Miguel *et al,* 2014) and trial registration (as per medicine and other social science disciplines) (Sutton *et al*, 2000) to enable a complete database of studies to be built up (Thornton and Lee, 2000). However, such mechanisms for avoiding publication bias are currently infrequently available in the social sciences (Franco *et al*, 2014). Those that do exist tend to be highly domain specific. The only long term solution to the problem would therefore appear to be a change in scientific publication practices (Jennions *et al*, 2013), both to ensure guidelines for primary research are published and to enable preventative measures to be put into place. The former will provide a means of ensuring that enough information is provided to enable meta-analysis and corresponding sensitivity analysis. The latter are required to prevent publication bias from occurring in the first instance (Sutton *et al*, 2000). Care needs to be taken when establishing guidelines for reporting and study conduction. The diverse nature of social science disciplines and methodologies means that a “one size fits all” approach is unlikely to work (Miguel *et al,* 2014). Organisations such as The Berkeley Initiative for Transparency in the Social Sciences are looking to capitalise on the interdisciplinary nature of social science to formulate and advance best practice within the discipline, reflective of the complexities of the diversity (Berkeley Initiative for Transparency in the Social Sciences, 2015).

In addition, organisations such as the Centre for Open Science (Open Science, 2012) encourage the preregistration of research and data availability to increase inclusivity and transparency in research (Kepes and McDaniel, 2013). The increased use of supplementary data facilitates this, and the use of such facilities should be encouraged, along with considerations such as making original data sets available for access by other researchers (Kepes *et al*, 2012). In addition, researchers should be equally encouraged to publish in lower tier, in addition to higher ranking, journals (Kepes and McDaniel, 2013). This includes the removal of a focus from publishing in top tier journals only, will increase the chances of research being made publicly available. Efforts from multiple stakeholders to achieve the successful implementation and adoption of such systems to ensure their completeness,

comprehensiveness and accessibility is needed (Cassey *et al*, 2004; Meerpohl *et al*, 2015), and it will take a comprehensive effort to achieve this.

5.5.2 Limitations

Several potential limitations of this research should be considered. Firstly, problems with the heterogeneity of the data may affect the interpretation of the results due to moderating effects (Kepes *et al*, 2012). There will always be an element of diversity in the studies brought together in a systematic review (Higgins and Thompson, 2002), and heterogeneity is likely to be common within this field, and it should be acknowledged that it makes the detection of publication bias more complex as it may or may not contribute towards any differences in results. However, despite the heterogeneity present, it is important to note that, in some instances, it is still more useful to look at the effects across studies rather than looking at the results of one study individually. The only way to get around this issue would be to look at the raw data from each study addressing a problem. This can be difficult and time consuming to obtain and so may not be possible in all instances.

In addition, there is always the need to consider that the publication bias may not be due to statistical significance. It could be due to any factor that influences both the study effect and the study size (Peters *et al*, 2008), such as the large number of studies with small effect sizes and the greater flexibility in research designs and analytical methods available to assess WTP (Ioannidis, 2005). To establish the cause of this apparent bias, the prevalence and extent of publication bias in reviews of other WTP studies should be assessed. There is also the problem of small sample sizes (<10) within the sub-group analysis, which can make some of the tests for publication bias unreliable (Higgins and Green, 2011). However, as the different methods used to assess publication bias arrive at the same conclusion, greater confidence can be had that publication bias is likely present in the data (Kepes *et al.*, 2012).

It would also be beneficial to test for publication bias within the qualitative review of attitudes towards FAW (chapter 3), especially as it is thought that publication bias is thought to exist within qualitative literature, although it appears to be more related to study quality than negative results (Pettigrew and Roberts*,* 2008). However, given the qualitative nature of the data, the systematic assessment of publication bias (or dissemination bias as it is often called in relation to qualitative research), is not possible using the traditional methods employed in this chapter (Lewin *et al,* 2015).

Although research is being conducted in this field in relation to both the extent and nature of this type of bias and how it is likely to impact upon the findings of qualitative research synthesis (Lewin *et a*l, 2015), there is currently no formal way of testing for publication bias. The adaption of the GRADE framework to assess the quality of evidence (chapter 3), is therefore the best evaluation of any potential bias and the implications for the quality of the evidence and research findings for this review.

Finally, although all meta-analyses may not be influenced by publication bias (Kepes and McDaniel, 2015), it is still important to test for this to provide an indication as to the strength of the results as part of a sensitivity analysis, and this is not currently being conducted.

5.6 Summary

This chapter sought to explore publication bias in the results of the WTP systematic review and meta-analysis conducted in chapter 4. Results of the analysis indicate that publication bias is present in the literature, both overall and at a subgroup level. When adjusted for, the bias would appear to make the positive price premium paid for higher welfare products disappear, indicating that the premium for these may not be as high as first thought. Chapter 6 will now explore the research gaps identified by the two systematic reviews in chapters 3 and 4. Specifically it will assess public attitudes towards intensive animal production systems, production diseases and interventions associated with these.

Chapter 6. Consumer attitudes towards production diseases

6.1 Introduction

The public are an important stakeholder at the end of the food chain, however, they are generally ill informed about current food production practices, including intensive animal production systems which are on the increase. Production diseases are particularly prevalent in these systems, and these can have negative effects on FAW. The two systematic reviews in chapters 3 and 4 have demonstrated that the public are concerned over FAW, including in relation to aspects such as antibiotic use. However, there is little research specifically exploring public attitudes towards production diseases. Given the growth in intensive production systems, and the impact production diseases have within these, it seems pertinent to explore public attitudes towards interventions designed to address these. This chapter firstly recaps the research gaps identified in the two systematic reviews and details the theory underpinning the consumer survey designed to address the research gaps. The methods for data-analysis are then outlined, before the results and conclusions are presented and discussed.

6.2 Background

Research has indicated growing societal concern over farming practices (Harper and Henson, 2001; European Commission, 2016), focused on all aspects of the animals' lives, from how the animals are reared and housed, to transportation and finally slaughter (chapter 3). These concerns have been linked to both animal and human wellbeing (Boogaard *et al,* 2011; Spooner *et al,* 2014), with poor animal welfare being linked to consumer concerns over product safety (Verbeke *et al,* 2010) and human health (Bennett *et al,* 2012). Conversely, higher welfare products are perceived as a means to guarantee safer and healthier products (Harper and Henson, 2001; Lusk *et al,* 2007). Despite the wealth of literature, chapters 3 and 4 have demonstrated research gaps in relation to public attitudes towards production diseases in intensive pig and poultry production systems and their WTP for reducing these diseases. The scarce literature has examined WTP for reducing animal diseases from a human health (i.e. zoonotic diseases) perspective (Doherty and Campbell, 2014) and from an animal-focused approach, considering only measures to reduce production diseases in farmed fish (Grimsrud *et al,* 2013) and ways to minimise foot pad lesions (and associated dermatitis) in broiler chickens (McVittie *et al,* 2006). In addition,

studies have identified consumer raised concerns regarding antibiotic use in animal production systems (Bernard and Bernard, 2009; Vanhonacker *et al,* 2010; Miele *et al,* 2011), with public concerns primarily relating to prophylactic use of antibiotics (chapter 3). Antibiotics use can be considered as a proxy for production diseases (Hughes and Heritage, 2002), and may be used unnecessarily (Hudson *et al,* submitted). These studies highlight public concern over FAW, and demonstrate that some consumers are willing-to-pay premiums to improve FAW, to ensure the safety of their food and reduce the risks they perceive with intensive animal production systems.

As noted, previous research does not address the public's views regarding the impacts of production diseases in pigs and poultry systems specifically, nor does it assess public perceptions of, and attitudes towards, interventions designed to reduce production diseases. Given the increase in intensive production systems, and the importance production diseases have within these, research is urgently needed to explore public attitudes towards interventions designed to reduce production diseases. This research therefore aims to:

1. Determine the factors underlying public attitudes towards intensive production systems together with production diseases within these systems
2. Identify the concerns, risks and benefits the public perceive to be associated with intensive animal production systems
3. Assess the acceptability of different interventions used to mitigate production diseases.
4. Identify consumer priorities regarding production diseases and intervention policies, information needs and willingness to accept and purchase pork and poultry products.
5. To assess whether consumers accept the proposed interventions, and assess their priorities in relation to animal antibiotic use, human and animal health and their information needs
6. Explore cross-country differences in public perceptions and attitudes

Special attention will be paid to information needs and consumer priorities in relation to animal antibiotic use, human and animal health in five countries.

6.3 Theoretical perspective

6.3.1 The importance of risk communication and public engagement

Risk can be defined as the scale and probability of an adverse event occurring, and should be communicated in relation to any hazard which is known, or perceived, to have an intrinsic ability to cause adverse effects (Scheer *et al,* 2014). Risk communication is part of the risk analysis process, which consists of three elements; risk assessment, risk management and risk communication (Food and Agriculture Organization of the United Nations/ World Health Organization, 1998). It has applications within the food chain including in relation to different agricultural practices or the adoption of new food processing technologies (Frewer *et al,* 2016), or as a consequence as a food safety incident or crisis (van Kleef *et al,* 2006; Kher *et al,* 2013). Effective risk communication strategies aid with the development of more transparent, and subsequently more credible decision making-processes (Frewer *et al,* 2016). Risk communication is also important for consumer protection (Verbeke *et al,* 2008), and for maintaining and increasing societal trust in organisations and institutions involved in risk assessment and management process (Poortinga and Pidgeon, 2005). Trust can be improved by including public concerns into effective communication and policy making, at the same time ensuring that these processes are transparent and inclusive of broader societal priorities (Frewer, 2003; Kher *et al,*2011).

As public concerns over food safety increase, greater demand is being placed on risk communication (Food and Agriculture Organization of the United Nations/ World Health Organization, 1998), with failure to account for public concerns threatening the legitimacy of associated regulatory frameworks and regulatory agencies (Frewer *et al,* 2004). In addition, failure to take into consideration public perceptions during the risk communication process can affect the commercialisation potential of foodstuffs, and acceptance of innovative technologies used in food production (Hansen *et al,* 2003). Ineffective communication, which does not address consumer concerns as well as technical risk estimates, may lead to the consumer rejection of food products and result in public distrust of regulators and industry (Frewer *et al,* 2004).

An understanding of public perceptions and attitudes is therefore necessary in order to develop a successful risk communication strategy, with insights also essential for ensuring that information conveyed is meaningful, relevant, accurate and

understandable to a specific target audience (Food and Agriculture Organization of the United Nations/ World Health Organization, 1998; Bearth and Siegrist, 2016), and to enable them to make informed choices regarding, for example, food choices (Miles *et al,* 1999; van Dijk *et al,* 2011), in addition enabling prediction of reactions to emerging food risks. The identification and acknowledgement of public perceptions and attitudes of food-related risks should be taken into consideration when making decisions concerning food safety so that communications can be tailored accordingly (de Jonge *et al,* 2008).

An integral part of this involves the interactive exchange of assessments, estimations and opinions between various stakeholders including the public (Van Kleef *et al,* 2006; Scheer *et al,* 2014), and this is especially important as perceptions of risks are known to differ between stakeholders (Fischhoff *et al,* 1984). Different perceptions all represent legitimate concerns (Jenson *et al,* 2006). In particular, the public may not tend to judge risk information using the same decision rules as experts, with the former having little understanding of, or familiarity with, the technicalities underpinning risk assessments (Bearth and Siegrist, 2016). Risk assessment information may not be considered as rationally or systematically by the public as by experts, resulting in the public's judgements being simplified (Fischer and Frewer, 2009). Food choices in particular, are usually made with minimum cognitive effort (Grunert, 2002) and risk information is usually handled quickly and automatically (Slovic *et al,* 2004), either through the use of mental shortcuts such as heuristics (Grunert, 2002) or through the generation of an effective response such as feeling or intuition i.e. the "affect heuristic" (Finucane *et al,* 2000; Slovic *et al,* 2004).

Understanding attitudes and perceptions towards a given hazard is an important part of establishing the motivation and rationale behind individuals' behaviours (Frewer *et al,* 2004), and how they may potentially respond to the hazard in question. To develop a successful and more salient risk communication strategy, it is therefore essential to understand public concerns in relation to the perceived risks of intensive animal production and interventions to treat production diseases. In order establish public concerns and attitudes, it is first important to understand how the public construct attitudes and perceptions of risks and benefits. Several theories have been developed in relation to this and are outlined in the subsequent subsections in relation to attitude formation and risk-benefit assessment.

6.3.2 The theory of planned behaviour

Consumers make a number of decisions regarding the food they purchase and consume, many of which are made subconsciously as a trade-off between a number of different attributes and factors (Ueland *et al,* 2012). In addition, the perceived risks and benefits of foods, and how they are produced, may contribute towards decision making. Attitude is defined as the tendency to evaluate an entity or object with a certain degree of favour or disfavour (Eagly and Chaiken, 1993). Numerous studies have identified attitudes to be a reliable predictor of behavioural intention in relation to food choice (Zingg and Siegrist, 2012), including predicting behavioural intention in relation to behaviours such as organic food consumption, FAW, healthy eating behaviours or the adoption of personalised nutrition (Arvola *et al,* 2008; Nocella *et al,* 2012; Brouwer *et al,* 2015; Poínhois *et al,* 2015). To develop a thorough understanding of behavioural intentions, it is therefore important to study attitudes concerning a specific behaviour or product.

Attitudes incorporate both global and abstract evaluations of risk and benefits, and can be can be clearly differentiated from intentions which are based on tangible and concrete benefits (Fischer and Frewer*,* 2009*).* The idea that attitude predicts behavioural intention, and subsequently behaviour, originates within the TPB developed by Ajzen (1985; 1991), a modification of the Theory of Reasoned Action developed by Fishbein and Ajzen (1975). As figure 6.1 demonstrates, behavioural intention is predicted by three separate constructs and corresponding antecedent beliefs; attitude, subjective norm and perceived behavioural control, with the latter also having a direct effect on behaviour. The attitude towards a behaviour or an object is influenced by an individual's attitudinal beliefs in relation to the object or behaviour in question. The more favourable the individual's evaluation of the behaviour, and the outcomes of performing the behaviour, the more likely the individual is to engage in that behaviour (Ajzen, 1991). Subjective norm is influenced by normative beliefs, which are concerned with an individual's perceptions of the perceived social pressure from their reference groups (such as friends or family), to perform or to not perform the behaviour (Ajzen, 1991). The more likely an individual is to perceive that these groups will approve or condone the behaviour in question, the more likely the individual is to perform that behaviour (Armitage and Connor, 1991). Perceived behavioural control is influenced by control beliefs, and is concerned with how hard or easy an individual believes it is to perform the behaviour in question (Ajzen, 1991), as some behaviours may not be under complete volitional

control. Perceived behavioural control can reflect past experience and any perceived or anticipated barriers to performing or not performing the behaviour under consideration.

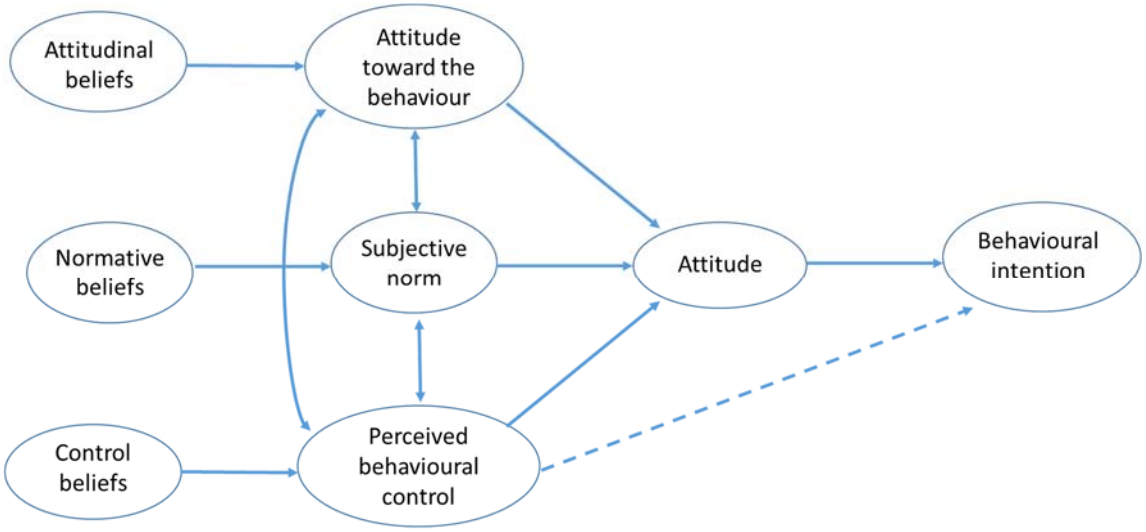

Figure 6.1 The Theory of Planned Behaviour (Ajzen, 1991)

The framework has been criticised (Sniehotta *et al,* 2015), predominantly in relation to its focus on rational rather than irrational behaviours (Ajzen, 2011). Whilst the TPB does have criticisms, this does not mean that the framework "*does not have resonance"* (Hagger, 2015), with parsimonious models like this having been designed and developed to provide a much greater understanding of the behaviour in question (Gollwitzer and Oettingen, 2015), with the contribution and usefulness of this theory still readily acknowledged, especially in relation to its understanding of behavioural intention (Hagger, 2015; Rhodes, 2015). In addition, the TPB has been used to successfully predict attitudinal strength and behavioural intention, with correlations between constructions frequently around 0.60 (Ajzen, 2011). The TPB has been applied to a range of different health and environmental behaviours, including fair trade (Shaw *et al,* 2000), food choice and purchasing behaviour. Several meta-analyses have highlighted the effectiveness of the model, and its individual components, in predicting behavioural intention (Ajzen, 1991; Connor and Armitage, 2001). The framework has also successfully been applied to animal-friendly foods (Nocella *et al,* 2012). It is therefore logical to apply the framework to the context of production diseases.

The TPB has also been successfully modified to incorporate several additional constructs or factors which increase the explanatory power of behavioural intention in the model. These modifications can be considered as a means of extending and further developing the TPB (Schwarzer, 2015). Ajzen (2011) recommends caution in relation to modification of the framework, highlighting that this should only be done when the constructs are specifically related to the behaviour in question, are conceptually measurable and are causal antecedents of attitude and behavioural intention. Examples of constructs successfully incorporated into the TPB include past behaviour (Connor and Armitage, 1998), self-efficacy (Armitage and Connor, 2001), self-identity and perceived ethical obligation (PEO) (Shaw *et al,* 2000; Sparks *et al,* 1995). The latter two constructs are particularly relevant in relation to intensive production systems, with attitudes towards animal production and animal welfare closely related to individuals moral or ethical beliefs (Bennett *et al,* 2002a; 2002b). The inclusion of these variables has provided additional explanatory power to models on organic food purchase (Arvola *et al,* 2008), and FAW (Nocella *et al,* 2012). Moral obligation has been a particularly useful addition in relation to food choice (Dowd and Burke, 2013).

Attitude has been shown to be influenced by several factors including perceptions of risks and benefits, and the interaction or relationship between the two (Poínhois *et al,* 2014). Previous research has demonstrated that the public are becoming increasingly concerned about how the food they consume is produced, including the raw ingredients used and the technologies and processes involved in its manufacture (Zingg *et al,* 2013; Frewer, 2017). A number of food safety incidents and new technological developments have highlighted the role risk perception can play in the formation of attitudes (Fife-Schaw and Rowe, 1996), including the 'Horse Meat' crisis (Barnett *et al*, 2016; Premandah, 2013) the contamination of food (Kher *et al,* 2011), GM food (Frewer *et al,* 2013) and nanotechnology (Giles *et al,* 2015). However, there is also evidence that a proportion of consumers do not want to know everything about their food (Thunström *et al,* 2016). In order to produce acceptable food products, it is necessary to understand how individuals evaluate potential or apparent risks associated with specific foodstuffs (Fischer and Frewer, 2009), as the public's perceptions are likely to play a significant role in attitude formation regarding food risks and associated food quality issues (Grunert, 2005).

6.3.3 Psychometric paradigm

Most hazards, especially in relation to food, convey some form of risks and benefits (Fife-Schaw and Rowe, 1996). Perceived risks are thought to be weighed more heavily in an individual's decision-making than benefits, with individuals also more likely to respond more negatively to risk information than compared to responding positively to benefit information (Ajzen, 1991). However, this may depend on existing attitudes towards the target issue (Van Dijk *et al,* 2011).

Rather than being independent, research suggests that risk and benefits may not be perceived in isolation from one another (Verbeke *et al,* 2005), and may be inversely related (Fischhoff *et al,* 1978; Alhakami and Slovic, 1994; Frewer *et al,* 1998), implying that individuals weigh the risks and benefits of a perceived hazard against each other before coming up with an overall perception. This has been demonstrated in relation food-related intentions, such as willingness to adopt personalised nutrition (Poínhos *et al,* 2014). Ultimately it means that the greater the perceived benefit of the behaviour or outcome, the greater the tolerance for risk will be, providing that the level of risk is tolerable in the first instance (Frewer, 1999). It is therefore important to identify any benefits from the hazard or object in question, which are of interest to the target audience (Frewer *et al,* 2016), along with the perceived risks.

Research has found that communicating integrated risk-benefit information can be as effective as communicating them separately (van Dijk *et al,* 2011), although benefit information may only increase benefit perceptions if presented before risk information under circumstances where respondents are unfamiliar with the attitude object (e.g. unfamiliar foods) (Fischer and Frewer, 2009). The link between risk-benefit perception and information suggests that the perceptions of risks can be changed by providing information on benefits and *vice versa* (Alkhami and Slovic, 1994), potentially due to the need to have consistency in beliefs (Alhakami and Slovic, 1994) and the need to reduce cognitive dissonance (Siegrist and Cvetkovich, 2000). It is therefore necessary to understand the factors mediating perceptions of risks and benefits.

6.3.4 Mediating factors of risks and benefits

Although each hazard has its own "*personality"* of different characteristics (Miles and Frewer, 2001), there are mediating factors which moderate the affect risk and benefit perceptions have on attitudes, such as naturalness, level of control and familiarity (Slovic, 1992; Bennett, 1997). These mediating factors need to be considered in

relation to the hazard itself and the target audience of the intended message (Frewer *et al,* 2016).

The theory of perceived risk has demonstrated that the two main dimensions of risk perception are risk intensification (dread) and risk attenuation (comfort/ familiarity) factors (Fischhoff *et al,* 1984). The characteristic most associated with perceived risk was dread (Slovic, 2000), which can be described as hazards individuals may have a perceived lack of control over, and which may have catastrophic and fatal consequences, with an unequal distribution of risk and benefits (Slovic, 1987). The unknown/ familiarity factor is associated with a lack of knowledge or awareness of a hazard and also increases the perceived risk (Fife-Schaw and Rowe, 1996), with a lack of understanding leading to a feeling of scepticism (Scudamore, 2007).

Other mediating factors associated with perceptions of risks and benefits include; the types of risks perceived e.g. financial, social, psychological (Hornibrook *et al*, 2005), perceived usefulness, morality and ethics (Frewer, 1999), value similarity between senders and receivers of messages (van Kleef *et al,* 2006), knowledge, trust, naturalness, voluntariness (Frewer *et al,* 2004) and a number of different socio-demographic and socio-economic factors (Food and Agriculture Organization of the United Nations/ World Health Organiation, 1998) including gender, age, income and education (Kirk *et al,* 2002).

6.3.5 Dual processing theories

In addition to the individual factors that affect perceptions of risk, factors such as cognition and affect also play a role in risk perceptions, and subsequent communication. Dual-process theories, such as the elaboration likelihood model (ELM; Petty and Cacioppo, 1986), work on the principle that both intuition (affect) and reasoning (cognition) can be used in decision making depending on the context and the characteristics of the information being presented to and processed by an individual (Bearth and Siegrist, 2016; Frewer *et al,* 2016). These theories posit that there are both central and peripheral routes of persuasion (Petty and Cacioppo, 1986), and that different systems work in different situations. On one hand, central processing (cognition), a more reasoned choice, is more likely to be used by individuals where the informational content of the message is high, and individuals are more motivated to spend time reading and processing the information (Frewer, 2000). On the other hand, affect is more likely to be used when the information is complex and a simpler judgement is required, or where there is low motivation or a

time pressure to process the full message (Petty and Cacioppo, 1986; Finucane *et al,* 2000). As extended problem solving, or cognitive reasoning, is not common in everyday decision making (Verbeke *et al,* 2006), especially in choices related to food which are often based on habit, affect is likely to be commonly used in decision making.

This affective mental shortcut achieved is deemed the affect heuristic (Finucane *et al,* 2000), and works on the assumption that all people, institutions and objects are associated with varying degrees of affect by an individual (Finucane *et al,* 2000). These associations of affect can then be used as a heuristic during decision making by means of a simplification strategy for judgement making. The affect heuristic can be considered as a cue for making more important judgements concerning risk (Slovic *et al,* 2004; Poortinga and Pidgeon, 2005; Visschers and Siegrist, 2008). Additionally, it can affect the way subsequent information is interpreted by acting as a bias (Slovic *et al,* 1982), and there is also thought to be a relationship between trust and affect (Visschers and Siegrist, 2008).

Whereas benefits may be consciously and subconsciously received, for risks some form of conscious processing of information usually occurs, normally provided by a third party (Ueland *et al,* 2012). Individuals subjectively assess perceived risk based on their everyday experiences and information conveyed by other stakeholders. Their messages originate from a variety of sources, including the media (Zingg *et al,* 2013) who are an important part of communication (Löfstedt and Frewer, 1998). Public debate (Rosati and Saba, 2004), and concern (Frewer *et al,* 2013) around food hazards have increased in recent years. The transfer of information concerning risk and the response mechanisms of society are termed the social amplification of risk (Kasperson *et al,* 2000) and is the social responses to risk analysis. More specifically it is the "*phenomenon by which information processes, institutional structures, social group behaviour and individual responses shape the social experience of risk"* (Kasperson *et al,* 2000, p154). This process can both attenuate and amplify information surrounding a given hazard. It is this social amplification that is thought to explain why some small risks get a large response (Verbeke *et al,* 2006). Understanding public perceptions of risk and benefits, and the context of their decision making, is therefore an important part of a communication strategy as it helps to address any social amplification of risk communication.

6.3.6 The role of trust

The risk or safety of a product is a credence attribute, it can be difficult for consumers to judge this by evaluating the product itself, instead they must rely on the supply chain actors to aid with these decisions (Lobb *et al,* 2007). When knowledge about a potential hazard is missing, people rely on additional cues and heuristics such as affect and trust to make assessments about risks and benefits (Siegrist and Cvetkovitch, 2000; Verbeke *et al,* 2006; Visschers and Siegrist, 2008). Individuals may therefore rely on the people who are more familiar with making judgements around these topics (Siegrist and Cvetkovitch, 2010) to help simplify their decisions (Savadori *et al*, 2004), as well as personal experience or media communication (Frewer and Salter, 2002), to reduce the complexity involved with decision making. However, as public concern over risks has increased, trust in science and scientific institutions has decreased (Frewer, 1999). This stems from a failure by regulators to address the drivers of public concerns and communicated uncertainties, and instead focusing on technical risk assessments, which can lead to a distrust of the information being circulated, such as seen in the case of BSE and foot and mouth disease (Breakwell, 2003; Poortinga *et al,* 2004).

Trust is also important in relation to the source of the message, with previous research demonstrating that trust and distrust was linked to specific sources of information (Frewer *et al,* 1996; Frewer *et al,* 2003). Trust in different institutions is linked to how competent the institution appears to be (Metlay (1999, referred to in Cvetkovich and Löfstedt, 2013), with recent food scares, and institutional responses, acting to decrease trust in relation to these stakeholders. This has implications for social trust and source credibility (Siegrist *et al,* 2000). Trust in information sources is a predictor of reactions to certain hazards and associated risks (Rosati and Saba, 2004; Poortinga and Pidgeon, 2005; Siegrist *et al,* 2005), and it is especially important in situations where an individual has little personal control over the hazard (Frewer *et al,* 2004). Although some research would suggest that if individuals hold very strong attitudes then trust in the information source is unlikely to change their perceptions (Frewer, 1999), other research has indicated that social trust can influence both perceived risks and perceived benefits (Siegrist *et al,* 2000) having both a positive influence on perceived benefits and a negative influence on perceived risks. This emphasises a need to ensure that any information conveyed addresses public concerns. Trust is only likely to be improved by understanding and addressing

any underlying concerns the public have in relation to that issue (Poortinga and Pidgeon, 2005).

6.3.7 Intensive animal production, production diseases and interventions

The previous sections have highlighted a need to ensure that any information conveyed to the public addresses any salient concerns that they may hold in relation to a given hazard. This requires that research needs to be undertaken to identify and understand the specific factors that underpin the public's concerns and risk perceptions. Factors likely to be important in perceptions of intensive production systems and production diseases are now discussed in more detail.

Differences in people's risk perceptions and acceptance of interventions, such as vaccination, to address epidemic animal disease are due to the citizen-consumer duality (Grunert, 2006), such as levels of meat consumption, with those who consume less meat being more sceptical (Zingg and Siegrist, 2012). This indicates a need to assess individuals' preferences, especially in relation the consumption of different types of animal product when assessing perceptions of risks and benefits, as this could provide an indication of the relevance of messages to them.

Previous research has highlighted that the public are unfamiliar with modern animal production systems and approaches. It is therefore unlikely that they will be familiar with production diseases and the different interventions proposed to treat, reduce and prevent production diseases in intensive animal production systems. This lack of familiarity and knowledge surrounding farming may mean that individuals struggle with interpreting the risks and benefits associated with production technologies and interventions. Without this familiarity of understanding they rely on knowledge from others, with trust having previously been shown to be an important factor in relation to FAW, with increased trust in stakeholders associated with less perceived risk. It would therefore seem pertinent to explore whether this reflects overall attitudes towards production diseases and associated interventions.

The public are heterogeneous in their attitudes towards to FAW, as well as in relation to vaccination in response to animal epidemic disease outbreaks (Breakwell, 2003). Being able to segment and target the public based on their attitudes and perceptions is therefore important. Those from higher socio-economic groups also perceive less risk than those of lower categories (Frewer, 2000), with income and education also

linked to concerns over FAW (chapters 3 and 4). Women are more concerned about FAW and perceive more risks than men (Frewer, 2000).

Cultural differences have been observed in relation to risk-benefit perception and responses to risk-benefit communication, with differences both within and between countries having previously been identified (van Kleef *et al,* 2007). A possible polarisation of views and beliefs regarding acceptable practices between different population groups has been identified (Frewer, 2000). This has implications for information transmission and adaptation, suggesting information strategies targeting the needs of different groups are required (Frewer, 1999). The findings from chapter 3 also been suggested that consumers view FAW as an additional cue that products are safe and of a high quality, with perceived "naturalness" linked to production equating to good welfare. An examination of the associations between these factors, intensive production systems and production diseases is also important.

6.3.8 Hypotheses

This research aims to establish the extent to which perceived risks and perceived benefits, concerns, intervention preferences, familiarity and trust influence public attitudes towards production diseases in intensive production systems. The relationship between these variables and the acceptance of different interventions will also be examined.

This research tested the following hypotheses:

H_1: A positive attitude towards intensive animal production systems will lead to a positive behavioural intention towards products produced using these systems.

H_2: Perceived risks of intensive animal production systems will negatively influence attitudes towards these systems

H_3: Perceived benefits of intensive animal production systems will positively influence attitudes towards these systems

H_4: Greater concern over production diseases will increase the perceived risks associated with intensive animal production systems.

H_5: Greater concern over production diseases will decrease the perceived benefits associated with intensive animal production systems.

H_6: Greater concern over production diseases will lead to less favourable attitudes towards intensive animal production systems.

Hypotheses 1-6 can be illustrated figuratively as in figure 6.2, which highlights the hypothesised relationship between the different variables included within the analysis.

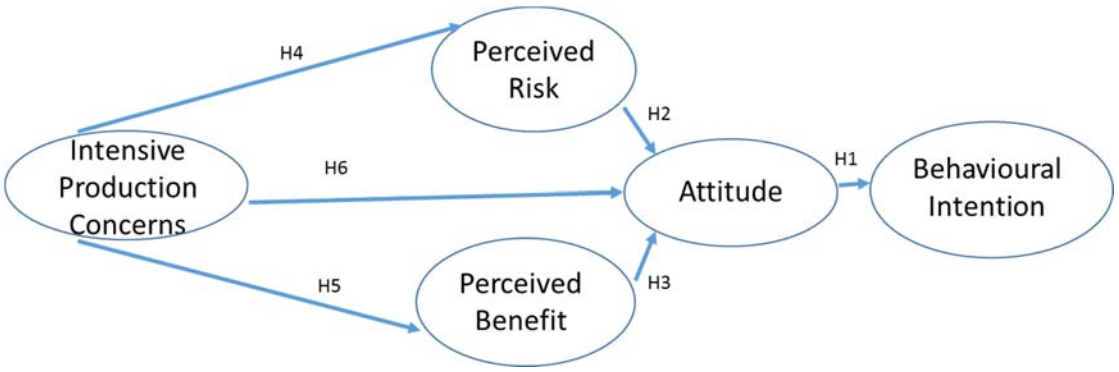

Figure 6.2 Hypotheses to be tested in the research

6.4 Methods

6.4.1 Survey design

A survey instrument specifically designed to enable the testing of the hypotheses itemised in section 6.3.8 was developed. Three separate versions of the survey instrument were created, for pigs, layer hens and broiler chickens respectively, with the content only varying in relation to the interventions asked for each animal type, and the wording of questions to make them specific to each animal. Separate survey instruments were developed to reduce the amount of time required for survey completion and eliminate cross-over effects from one type of animal to another. These farm animals were chosen due to the increasing tendency to rear them in intensive animal production systems.

The questions used in the survey were based on those in the existing attitude and consumer behaviour literature, so as to enable the use of validated scales that could be adapted and subsequently tested in the context of the literature, (see also Poínhos *et al*, 2014). In this case, questions were adapted to make them specific to the context of intensive animal production diseases and the potential risks and benefits in relation to these resulting from the incidence of production diseases. Both semantic differential and Likert scale designs were used, which are the preferred

methodological approach to measuring attitudes, and perceived risks and benefits (see *inter alia* Frewer *et al,* 1994; 1996; van Dijk *et al,*2011), and which enables a quantitative analysis to be conducted. These are typically constructed from multiple items that are thought to be reflective of the attitudinal construct of interest. In total, seven scales were developed: 1) *perceived benefits associated with intensive animal production, 2) perceived risks associated with intensive animal production, 3) attitudes towards intensive production systems, 4) trust in food chain stakeholders, 5) attitudes towards interventions to treat and prevent production diseases, 6) concerns related to intensive animal production systems and 7) behavioural intention towards products from intensive production systems.* A summary of these scales and the questions utilised are detailed in appendix Q, with further details described below.

Scales for responsibility and trust were modified to include stakeholders from across the pig and poultry supply chains, and to ensure a mix of supply chain members. The stakeholder list was constructed in consultation with members from both pig and poultry industries to ensure that it incorporated relevant stakeholders.

For risk and benefit perceptions, scale items were modified to ensure a greater relevance to production diseases and concerns over intensive animal production in general as identified in chapters 3 and 4. Attitude questions were based on those commonly used within the consumer behaviour literature (Crites *et al,* 1994; Van Dijk *et al,* 2011), the statements having been developed to reflect the range of attitudes held towards modern animal production systems identified in existing literature as highlighted in chapter 3.

The general concern scale was modified from Rosati and Saba (2004), to focus on more specific aspects in relation to intensive animal production systems and production diseases. These statements were included within three different questions to assess concerns from three different perspectives; general, human and animal. This was done to establish whether there were differences in concern between the three, and relates to the finding of the public having both anthropocentric and zoocentric views towards animals.

Several additional questions were also asked based on the *apriori* hypotheses and the research gaps and findings, such as in relation to familiarity with both modern farming and production diseases, to examine the roles of familiarity and knowledge.

Perceived ethical obligation, self-identity, trust and responsibility have also been shown to be important in risk-benefit perceptions as (section 6.3.4).

According to pig and poultry industry stakeholders, both reactive and proactive intervention measures are available to combat production diseases within intensive pig and broiler chicken systems (Jones *et al,* 2016). However, given how unfamiliar the public are with modern farming (European Commission, 2007; Bernard and de Cock Buning, 2013), and human treatments such as vaccination (Zingg and Siegrist, 2012), it was decided to examine generic intervention measures to keep them comprehensible. The intervention measures included a range of possible proactive and reactive interventions. The specific interventions used in the survey were consistent with those covered by a stakeholder consultation of production diseases on pigs and poultry (Jones *et al,* 2016). Wording of the interventions were adapted to make them less technical following the initial pilot study, with the revised phrasing checked with academic and industry experts to ensure that the re-wording did not change the meaning of the intervention description.

Section 6.2.4 indicated that previous research has demonstrated the effect of several socio-demographic characteristics on perceptions of perceived risks and benefits including the role of gender, age, and education, in general, with clear differences in these having also been demonstrated two systematic reviews in chapters 3 and 4 Questions relating to demographic characteristics of participants were included in the survey instrument.

Religion, education, income and place of residence have all also been shown to have different degrees of explanatory potential in relation to attitudes to FAW in the two reviews, with the latter broken down into three separate areas; cities, towns and rural areas, as defined by the EU (Eurostat, 2015). Income is based on the European Living Standard Measurement Survey (ESS-ERIC, 2012). The income ranges included were developed to reflect the spread of income in the five countries surveyed, and were displayed in the home currency for each country i.e. Euros for Finland, Germany and Spain, British Pounds for the UK and the Zloty for Poland. The income brackets for each currency were equivalent to enable comparison between countries, with the average exchange rate for January 2017 used for conversions. Education was based on the International Standard Classification for Education levels (United Nations Educational, Scientific and Cultural Organization, 2012) to facilitate a comparison between the five countries. A question on diet, specifically on

animal product consumption, was also included as it has been shown to be an important factor determininng attitudes to animal production systems (Vanhonacker *et al,* 2010). Additional background questions in relation to employment status, household composition and responsibility for shopping were also asked.

The survey instrument was developed in English and piloted using face-to-face interviews prior to distribution on a sample of 11 UK residents to establish the comprehensibility of the questions and length of the survey. Based on feedback, the survey was refined by rephrasing questions to make them easier to comprehend. Certain statements that were reported by pilot study participants to be irrelevant or too repetitive of one another were removed. Following refinement, the survey instrument was further piloted with 45 participants in the UK (n=20 face to face; n=23 online) and, following translation, in Finland (n=5 face to face). Based on feedback, changes were made to provide a definition of intensive production systems (based on the Food and Agriculture Organization of the United Nations definition) for question 7, and a definition of probiotics was added to question 10, so as to enable participants to make more informed responses. Examples of animal welfare organisations and quality assurance schemes were also provided for questions 4, 5 and 6 in English and Finnish, to enable participants to make more informed responses as before, and these were tailored to be specific to each country except Spain, Poland and Germany where no similar organisations were noted to exist.

The revised survey was then translated into Finnish, German, Polish and Spanish, and subsequently back-translated to check for comprehension and ensure consistency in the measurement of the constructs. A blank copy of the survey instrument for each animal type is in Appendix R.

6.4.2 Sampling and distribution

The two systematic reviews summarized in chapters 3 and 4 highlighted Europe as an area of interest in relation views regarding intensive animal production, WTP for higher welfare products and attitudinal patterns identified. It is also an area of policy relevance and diversity. The survey was distributed in five EU countries which represented Northern, Eastern, Western and Southern Europe, areas identified as having different preferences for WFP in chapter 4. A purposeful quota sampling technique was used to obtain samples representing citizens in each of the five countries surveyed (UK, Finland, Germany, Poland and Spain), based on gender and age. Respondents were obtained from a panel of a social research agency Qualtrics

(2017) to facilitate access to all countries. All survey instruments were distributed online using Qualtrics. Data was collected between the 10th March and 10th April 2017.

6.4.3 Ethical approval

The research received ethical approval from Newcastle University's Faculty of Science, Agriculture and Engineering prior to commencement of data collection. Information in relation to the purpose of the study was outlined to participants at the beginning of the survey, and issues of confidentiality and anonymity of the data were also outlined along with an explanation of how participation was voluntary. Informed consent was obtained by all participants prior to completion of the questionnaire. Only an anonymised data file was kept.

6.5 Data analysis

6.5.1 Descriptive statistics

All data analysis was conducted in SPSS version 20 (IBM Corp, 2011) and R (R Core Team, 2015). Complete data sets were obtained for all surveys and all variables with the exception of question6 (trust in stakeholders to provide information) in the pig survey, where up to five respondents were missing on some items. Descriptive statistics were obtained for all variables and scale items. In preparation for the analysis, responses obtained in Likert scale were transformed to an index ranging from one to five. This approach allows the calculation of parameters such as the mean, but it also assumed that the scale between each category is linear. The index, nevertheless, reasonably describes the overall situation on each question.

Comparisons in terms of participant responses between countries were then conducted using Chi square test and Kruskal Wallis test for categorical, semantic differential and Likert scale data respectively. The Shapiro-Wilk test for normality indicated that none of the variables had normal distributions, therefore the Kruskal Wallis test was also used to check for differences between countries for household size and number of children. All tests were carried out with the null hypothesis that *there was no significant difference between countries*. Faceted bar chats were used to explore differences in participant acceptance of different interventions.

6.5.2 Exploratory factor analysis

Factor analysis is a data reduction technique to enable relationships and patterns within a dataset to be understood, based on shared variance (Yong and Pearce, 2013). It essentially aims to achieve parsimony i.e. the simplest method of interpretation of the observed data (Harman, 1976; Fabrigar *et al*, 1999). It does this by reducing measurable data into fewer latent variables (hypothetical constructs) that share variance. In other words, it reduces dimensionality (Stevens, 2002; Bartholomew *et al*, 2011). Factor analysis also reflects the random error encompassed in most measures of psychological research (Fabrigar *et al*, 1999).

There are two main approaches to factor analysis; exploratory factor analysis (EFA) which tries to uncover complex patterns within the data, and confirmatory factor analysis (CFA) which attempts to confirm hypotheses. EFA is used to discover the number of factors influencing variables by understanding the structure of correlations, therefore placing variables into meaningful categories (Yong and Pearce, 2013). EFA and CFA are commonly used together, with EFA used to provide a basis for specifying a CFA model (Fabrigar *et al*, 1999).

Several methodological decisions are required for factor analysis, including factor extraction (model fitting) and rotation and several options for factor extraction and rotation are available and the choice of which to use depends on the nature of the data being analysed. Principle factor extraction makes no distributional assumptions (Fabrigar *et al*, 1999), and was used in this instance due to the non-normal distribution of the included variables. For any given solution from factor analysis, meaning that there are an infinite number of alternative orientations available (Fabrigar *et al*, 1999). One single solution therefore needs to be selected for interpretation, normally assessed by a simple structure obtained by rotating the factors in multidimensional space to give the solution with the simplest structure (Field, 2013). There are two main types of rotation; orthogonal and oblique. Orthogonal rotation looks for linear combinations of original factors that maximise the variance of the loadings from the items included in the analysis, whereas oblique rotations permit correlations between factors, to establish whether they are related (Stevens, 2002). Oblique rotation gives a more realistic representation of how the latent variables may be related to one another (Fabrigar *et al*, 1999), especially for psychological variables where relationships between factors are likely to occur.

Analysis followed the recommended approach and compared both to compare solutions and examine correlation between the factors identified.

All EFA was conducted in SPSS (IBM Corp, 2011). Varimax (orthogonal) and direct-oblimin (oblique) rotations were used in the data analysis. In total, 145 variables from the pigs' survey and 146 variables from the broilers and layers surveys were included in the EFA. More specifically questions 4-10, question 13, and question 16 were analysed. Only these questions were included in the EFA due to their theoretically relevant potential explanatory power. All questions were five-point Likert scales, anchored from 1-5 (strongly disagree to strongly agree) for all questions excluding question 7, where the Likert scale was anchored in seven different attitudinal pairs (Unpleasant/ pleasant; bad/good; worthless/ valuable, useless/ useful, unsafe/ safe and unethical/ ethical) in line with previously published research.

To confirm whether the data were suitable for factor analysis several checks were performed: inspection of the correlation matrix and the anti-image matrix, the Kaiser-Meyer-Olkin (KMO) (Kaiser, 1974) test for sampling adequacy, Bartlett's test of sphericity and assessment of the determinant. The correlation matrix was inspected to check for multicollinearity and singularity in the data, and to assess whether the variables were correlated. The KMO is also used to assess correlations within the data and that they are relatively compact. A value above 0.5 is recommended as acceptable (Kaiser, 1974), with the closer the value gets to 1, the more appropriate factor analysis is (Field, 2013). The diagonal of the anti-image matrix was inspected for values greater than 0.5. For the determinant, a value below 0.00001 recommended to proceed with factor analysis (Field, 2013). Bartlett's test of sphericity was established whether the data was suitable for factor analysis. The null hypothesis was that the correlation matrix is an identity matrix, in that the correlation coefficients would be zero (Field, 2013). Rejection of the null hypothesis is necessary for factor analysis to be feasible.

Criteria for deciding how many factors to include were based on the Kaiser criterion. All factors with an eigenvalue greater than one were retained (Kaiser, 1960), together with the use of a scree plot, which plots the eigenvalue against the factors (Cattell, 1966). The number of points above the point of inflexion (break in the line), indicates through inspection an appropriate number of factors to include. Only items with a factor loading greater than 0.4 were retained. Although a smaller loading cut-off can be used for larger sample sizes, such as the ones in this sample, using a cut-off of

0.4 facilitates interpretation (Stevens, 2002), and enables the inclusion of items which share a greater proportion of variance with the factor (Stevens, 2002). Face validity of the factors was also assessed by evaluating which items had loaded onto each factor.

The internal consistency of each returned factor was assessed using Cronbach's alpha (Field, 2013). Two methods were used to create factor scores. First, the regression method was chosen to enable some correlation between scores (as with the data), and to enable factor scores to be used in subsequent analysis. A score of zero equates to the average score of the sample in questions, with a negative result indicating a lower than average rating for the factor, and conversely a positive average rating indicating a higher than average score. Second, these scores were also generated to provide an average factor score based on the original scale of the items included in the factor analysis (DiStefano *et al,* 2009). Non-refined scores were created by calculating the average score for each item which loaded onto a factor.

6.5.3 Structural equation modelling

Structural equation modelling (SEM) was conducted using the Lavaan and semTools packages (Rosseel, 2012; semTools Contributors*,* 2016), using the maximum likelihood approach, and a two-step process (Anderson and Gerbing, 1988). Separate models were created for each of the three questionnaires, due to the different intervention questions used. As a latent approach was taken, first the measurement model was assessed using CFA. The measurement model describes the relationships between the latent variables included in the analysis, and their observed indicators, created based on the results of the EFA for each of the five variables included in the analysis. Identification was ensured by fixing all factor loadings to one and having at least three indicators on all factors. This was followed by the full structural model, including the causal dependencies between constructs, based on the findings from the two systematic reviews in chapters 3 and 4, and of the attitudinal and risk-benefit theory (section 6.2.3), and hypotheses generated (section 6.2.8), These underpinned the development of the SEM to be tested empirically (figure 6.2).

Overall model fit statistics and significance tests were generated for each path within the model. Several indices of model fit were used to examine the model, including the Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Root Means Squared Error of Approximation (RMSEA) and Standardised Root Mean Squared Residual

(SRMR) and chi square. A good fitting model should have RMSEA below 0.05, TLI above 0.9, CFI above 0.9 and SRMR below 0.08 and a non-significant chi square test (*p>0.05*) (Hu and Bentler, 1999; McDonald and Hu, 2002). AIC and Bayesian Information Criteria (BIC) were also assessed.

The model was built by adding in the latent variables step-by-step based on the hypotheses outlined in figure 6.2 i.e. beginning with the attitude-pro-consumption relationship. All first item loadings on each factor were constrained to 1. Modification indices (MI) were checked at each stage to establish whether correlation between residuals was needed, as indicated by a high MI. Typically this is deemed to be any value greater than 10, but as a larger number of modifications were recommended, and in the interest of parsimony, this was only done for values greater than 60. Any correlation recommended was also checked to see whether it was theoretically justifiable, and correlations were only made where this was the case. MI were made iteratively to establish whether this led to improvements in model fit parameters, and changes in AIC and BIC.

Once the final model was confirmed, multi-group analysis (MSEM) was performed to assess difference across groups, in this instance country (i.e. UK, Finland, Germany, Spain and Poland). MSEM works by testing for degrees of invariance or measurement equivalency across groups (Stevens, 2002). This establishes the moderating effect of the variables by comparing a series of models, starting from an unrestricted baseline model (model 1) against several increasingly restricted models (Byrne, 2001). Each model (models 2, 3, and 4) has an increasing number of parameters restricted. If there are no differences in the model fit indices for the unrestricted model and the various restricted models, then this indicates that the parameters in measurement and structural components of the theoretical model are equivalent (i.e. invariant) across the sub-groups being compared, and that mean differences can therefore be attributed to these variables (Stevens, 2002). Absence of measurement invariance therefore indicates that there is no clear bases for drawing inferences from the model (Kline, 2016). In this study the increasingly restricted models are as follows;

- **Baseline/ configural invariance (model 1):** measurement equivalence model with equal loadings of latent variables on factors similar across sub-groups. Factor items are constrained to be 1 with the other parameters being freely estimated.

- **Metric/ weak invariance (model 2):** this included model 1 constraints and factor loadings constrained across groups. This enables comparison of the relationships between the latent variables across groups. If this is rejected it means that the factor structure across groups is not the same (Evermann, 2010; Stevens, 2002).
- **Scaler/ strong invariance (model 3):** this included model 2 constraints and the intercepts are constrained across groups. This enables comparisons of the means of the latent variables across groups as it indicates that group differences are not from an unrelated bias (Evermann, 2010).
- **Strict invariance (model 4):** this included model 3 constraints and equal factor means
- **Fully constrained (model 5): this included model 4** constraints and equal residuals (i.e. fully constrained).

Evidence of invariance within the model is traditionally assessed using model fit indices, including the chi square statistics (Byrne, 2001). If this is significant (i.e. less than 0.05) then there is evidence that some or all parameters are not invariant across the sub-groups and further tests are required to determine which parameters are accounting for these non-invariant findings. It should be noted that an increase in the model constraints will lead to a decrease in the model fit indices, as there will be less free parameters to estimate (Stevens, 2002), so chi square is likely to be a poor indicator of fit (Stevens, 2002). The chi square statistic is an excessively stringent test of invariance and recent research suggests that it is more prudent to base invariance decisions on the difference in CFI (Stevens, 2002; Byrne, 2001). A change in CFI of less than 0.01, the cut of point proposed by Cheung and Rensvold, (2002) indicates that the null hypothesis of invariance/equivalence should not be rejected

6.6 Results

6.6.1 Descriptive statistics

Population characteristics

An overview of sample characteristics for each of the three surveys is presented in Appendix S. The samples for each country within each survey are largely representative of national characteristics based on gender and age, with the higher age group being underrepresented, a limitation of the online approach to distribution used. Although differences were observable across countries, subsequent summary

statistics are presented in general for respondents in able for more general trends arising from the survey to be assessed. Nearly all respondents remained in education past the primary education stage. Those in Poland and Spain had a lower proportion of respondents in the top income categories reflective of the lower average incomes in these countries. Most respondents were employed either full or part-time, with Spain and Finland having the highest proportion of retirees. Most participants lived in 1-3 person households with most households having no children. Most respondents from all countries were either Christian or Atheist/ agnostic. Most respondents indicated that they were omnivores, with few respondents being vegan or vegetarian. Germany, Finland and the UK had the highest proportion of vegetarians. At the country-level, there were some differences between the demographics of respondents in the three datasets

Unfamiliarity with farming

Unfamiliarity	Layers	Broilers	Pigs
Q1: Connections to raising farm animals[7]	74.1%	78.6%	77.1%
Q2: Have you visited a working farm?	78.4%	83.3%	77.5%
Have you heard about production diseases from;			
Q3: Television	57.3%	51.6%	58.1%
Q3: Radio	81.0%	79.6%	82.8%
Q3: Newspaper	73.2%	71.7%	74.7%
Q3: Magazine	87.5%	85.7%	88.5%
Q3: The internet	64.2%	62.1%	66.7%
Q3: Social media	82.4%	75.7%	80.7%
Q3: Friends and family	75.6%	74.7%	79.2%

Table 6.1 Proportion (%) of respondents who reported not being connected to raising farm animals, nor having visited a farm and nor having heard about production diseases from various sources if information.

The majority of respondents in all countries were unfamiliar with farming practices (table 6.1), with most not having lived, worked or having friends or family involved with farming, with at least three quarters of participants in each survey answering no to question 1, the main connection being through family or close friends. This was also reflected with most respondents not having visited a working broiler chicken, layer hen or pig farm in the past three years. Most respondents had not heard anything about production diseases from any of the information sources mentioned in

[7] A full breakdown of responses for this question is available in appendix S

the survey, with television or the internet being the two sources from where information was most likely been obtained. In terms of cross-country differences (Appendix S), respondents from Poland were the most likely to have heard about production diseases.

Attitude and purchase intentions

The three intensive production systems were viewed unfavourably by the public (mean scores in relation to all six attitudinal questions averaged 3 or below (table 6.2), corresponding to the negative end of each scale. Attitudes varied significantly by country (Appendix S), with German respondents rating intensive systems particularly unfavourably, especially in relation to being unpleasant, bad and unethical.

I feel intensive production systems are …	Layers	Broilers	Pigs
Unpleasant (1)/pleasant (5)	2.22 ± 1.04	2.09 ± 1.03	2.18 ± 1.06
Good (1)/bad (5)	2.44 ± 1.05	2.32 ± 1.05	2.43 ± 1.04
Worthless (1)/valuable (5)	3.06 ± 1.08	2.72 ± 1.05	2.76 ± 1.03
Useful (1)/useless (5)	3.06 ± 1.08	3.06 ± 1.11	3.09 ± 1.06
Unsafe (1)/safe (5)	2.64 ± 1.07	2.63 ± 1.08	2.65 ± 1.08
Ethical (1)/unethical (5)	2.17 ± 1.04	2.12 ± 1.06	2.23 ± 1.10

Table 6.2 Overall attitudes of citizens in five countries towards intensive animal production systems of laying hens, broilers and pigs (mean response on a semantic differential scale 1 to 5 ± SD)

In relation to purchase intentions (table 6.3), most respondents were unsure or disagreed that they purchased foods produced from intensive animal production systems. This could be due to respondents being unclear as to how the food they purchase has been produced. Although respondents, on average, disagreed rather than agreed intending to or considering purchasing foods from intensive animal production systems, they also did not plan to reduce their consumption of food products from these systems, or avoid purchasing products from these systems, potentially because many of them think that they do not purchase from them currently. There were significant differences between countries in relation to purchase avoidance and intention to purchase.

Despite their negative attitudes, lack of perceived benefits, and concerns over intensive farming practices, respondents tended not to perceive themselves as being concerned about FAW or intensive production systems, or having an ethical obligation to avoid products produced from these systems. Respondents from all countries more frequently agreed than disagreed that they had an ethical obligation to avoid products from intensive production systems. Again, there were significant differences across the five countries in relation to these differences (Appendix S).

Behavioural intention	Layers	Broilers	Pigs
I purchase foods produced using intensive production systems	3.00 ± 1.06	3.04 ± 1.06	3.01 ± 1.02
I intend to purchase foods produced using intensive production systems	2.84 ± 1.12	2.79 ± 1.08	2.79 ± 1.06
I would consider purchasing foods produced by intensive production systems	2.91 ± 1.11	2.90 ± 1.07	2.94 ± 1.06
I plan to reduce my consumption of foods from intensive production systems	3.43 ± 1.02	3.53 ± 1.02	3.42 ± 1.07
I avoid purchasing foods from intensive production systems	3.38 ± 1.05	3.36 ± 1.09	3.34 ± 1.07
I feel that I have an obligation to purchase animal products from intensive production systems	2.62 ± 1.16	2.56 ± 1.15	2.59 ± 1.13
I feel that I have an ethical obligation to avoid animal products from intensive production systems	3.53 ± 1.11	3.57 ± 1.05	3.53 ± 1.10
I think of myself as someone who is concerned about intensive animal production systems	3.53 ± 1.00	3.57 ± 1.01	3.53 ± 1.03
I think of myself as someone who is concerned about farm animal welfare	3.70 ± 0.97	3.67 ± 1.01	3.67 ± 0.99

Table 6.3 Overall behavioural and purchase intentions of respondents in five countries towards food originating from intensive animal production systems involving laying hens, broiler chickens and pigs (mean response on a linear scale 1 (strongly disagree) to 5 (strongly agree)

	Layers			Broilers			Pigs		
Stakeholder	**Responsible health**	**Responsible welfare**	**Trusted information**	**Responsible health**	**Responsible welfare**	**Trusted information**	**Responsible health**	**Responsible welfare**	**Trusted information**
Animal welfare organisations	3.91 ± 1.08	4.11 ± 0.87	3.93 ± 0.97	3.89 ± 1.03	4.09 ± 0.95	3.81 ± 1.03	3.93 ± 1.00	4.06 ± 1.02	3.78 ± 1.04
European Commission	3.91 ± 1.02	3.91 ± 1.02	3.39 ± 1.03	3.96 ± 0.96	3.97 ± 0.99	3.36 ± 1.06	3.87 ± 1.06	3.90 ± 1.05	3.34 ± 1.06
National government	3.99 ± 1.04	4.02 ± 0.98	3.27 ± 1.10	4.06 ± 0.94	4.07 ± 0.93	3.26 ± 1.10	4.01 ± 0.99	4.00 ± 1.01	3.25 ± 1.09
Veterinarians	4.12 ± 0.98	4.09 ± 0.96	3.79 ± 0.96	4.11 ± 0.94	4.16 ± 0.89	3.71 ± 0.97	4.23 ± 0.90	4.23 ± 0.90	3.79 ± 0.92
Animal health authorities	4.33 ± 0.85	4.28 ± 0.86	3.76 ± 0.96	4.34 ± 0.86	4.31 ± 0.84	3.74 ± 1.01	4.33 ± 0.90	4.28 ± 0.89	3.80 ± 0.95
Veterinary medicine producers	3.96 ± 0.89	3.94 ± 1.00	3.23 ± 1.10	3.99 ± 0.78	3.93 ± 1.00	3.20 ± 1.09	4.05 ± 0.97	3.97 ± 1.01	3.22 ± 1.06
Animal breeding companies	4.28 ± 0.92	4.27 ± 0.89	3.12 ± 1.16	4.35 ± 0.89	4.31 ± 0.87	3.01 ± 1.18	4.31 ± 0.91	4.29 ± 0.89	3.14 ± 1.14
Animal feed producers	4.04 ± 1.01	3.92 ± 1.01	3.09 ± 1.10	4.02 ± 0.99	3.95 ± 1.00	2.96 ± 1.09	4.11 ± 0.97	4.00 ± 1.00	3.07 ± 1.06
Animal housing manufacturers	3.96 ± 0.98	4.00 ± 0.97	3.05 ± 1.06	3.81 ± 1.05	3.96 ± 1.01	2.98 ± 1.05	3.81 ± 1.05	3.96 ± 1.01	3.07 ± 1.06
Farmers	4.39 ± 0.86	4.39 ± 0.85	3.27 ± 1.13	4.43 ± 0.85	4.44 ± 0.82	3.19 ± 1.12	4.46 ± 0.82	4.42 ± 0.84	3.33 ± 1.11
Animal transporters	3.96 ± 0.98	3.96 ± 1.02	2.96 ± 1.09	4.08 ± 0.97	4.04 ± 1.00	2.89 ± 1.07	3.98 ± 1.00	4.10 ± 1.00	2.91 ± 1.05
Slaughterhouses	3.95 ± 1.08	3.96 ± 1.02	2.98 ± 1.11	4.05 ± 1.02	4.04 ± 1.03	2.95 ± 1.13	4.09 ± 1.04	4.05 ± 1.06	3.01 ± 1.12
Quality assurance systems	4.16 ± 0.92	4.10 ± 0.93	3.61 ± 0.99	4.17 ± 0.92	4.14 ± 0.92	3.59 ± 1.02	4.15 ± 0.93	4.09 ± 0.96	3.63 ± 0.95
Food manufacturers	4.07 ± 0.94	3.92 ± 1.00	3.09 ± 1.11	4.13 ± 0.94	3.97 ± 0.99	3.02 ± 1.10	4.04 ± 1.00	3.91 ± 1.04	3.05 ± 1.07
Food retailers	3.71 ± 1.00	3.67 ± 1.01	3.08 ± 1.05	3.76 ± 0.99	3.77 ± 1.01	3.02 ± 1.05	3.72 ± 1.03	3.68 ± 1.07	3.08 ± 1.01
Consumer organisations	3.77 ± 0.97	3.77 ± 1.00	3.69 ± 0.93	3.76 ± 1.02	3.81 ± 1.00	3.66 ± 0.95	3.75 ± 1.01	3.74 ± 1.03	3.63 ± 0.92
The general public	3.39 ± 1.09	2.46 ± 1.11		3.41 ± 1.09	3.50 ± 1.08		3.39 ± 1.10	3.50 ± 1.11	
You as a consumer	3.38 ± 1.14	3.48 ± 1.11		3.37 ± 1.16	3.45 ± 1.11		3.34 ± 1.19	3.42 ± 1.13	
Social media			3.01 ± 1.12			2.98 ± 1.10			2.94 ± 1.13
Traditional media			3.40 ± 0.96			3.36 ± 0.97			3.33 ± 1.02

Table 6.4 The respondents' views in five countries regarding overall trust in information provision and responsibility for information provision and animal health and welfare of laying hens, broiler chickens and pigs (mean response on a linear scale 1 (strongly disagree) to 5 (strongly agree)

Trust and responsibility

All stakeholders included were perceived to be responsible for ensuring both the health and welfare (table 6.4) of animals in intensive production systems, although the level of agreement varied significantly between countries (Appendix S). In general, farmers, animal health authorities and animal breeding companies were identified as being the most responsible stakeholders for animal health and welfare in most countries. In contrast, the public and consumers were identified as being the two least responsible stakeholders in all countries. Stakeholders at the beginning of the food chain are generally perceived as more responsible for animal health and welfare (e.g. farmers, veterinarians and animal health authorities), whereas stakeholders towards the end of the food chain are generally perceived as least responsible (table 6.4).

In relation to which stakeholders should bear the costs for any changes made to animal production systems, increased taxation was the least preferred mechanisms for all countries (table 6.5, Appendix S), with either food manufacturers, the European Commission and national governments all having consistently high majorities (all over 60%) in all countries. This shows a discrepancy in views as the public funding and subsidies are funded by raising funds especially in the form of taxes. Significant between country differences were observed in terms of stakeholder responsibilities (Appendix S). These links in with who respondents perceive as being responsible for animal health and welfare, with the public and consumers viewed as least responsible.

Mean trust scores for most items were around 3 (table 6.4), indicating that respondents neither agree nor disagree as to whether each of the stakeholders listed could be trusted to provide them with accurate information in relation to production diseases. Veterinarians, animal health authorities, animal welfare organisations, quality assurance schemes and consumer organisations were generally rated as being the most trusted to provide information, which is similar to those stakeholders viewed as being responsible for animal health and welfare, apart from for farmers, who were less trusted. Mean scores varied significantly between countries for most stakeholders (see Appendix S). Members of the supply chain, such as animal transporters and slaughterhouses, were generally least trusted to provide information.

Stakeholder	Layers	Broilers	Pigs
Livestock farmers/ producers through making less profits	66.6%	65.4%	62.6%
Food manufacturers through making less profits	80.0%	81.7%	77.9%
Food retailers through making less profits	69.5%	67.0%	64.4%
Consumers, through higher product prices	52.2%	50.1%	51.7%
The general public, through increased taxes	31.6%	28.4%	28.6%
National government through providing subsidies and funds	67.3%	68.1%	70.4%
European commission, through providing subsidies	71.1%	71.4%	73.6%

Table 6.5 The overall view of respondents in five countries regarding who should bear the costs for incurred as a result of any interventions introduced to prevent production diseases in intensive production systems (percentage response answering yes).

Risk and benefit perceptions

In general, few benefits were perceived from any of the intensive animal production systems with mean scores all below 4 (agree; table .6.6). *Reduced animal stress* and *natural production method* received the lowest mean scores for all countries of 2.5 (disagree) or lower for all countries bar Spain for which the mean score related to neither agree nor disagree (see Appendix S). The strongest benefits offered from intensive animal production systems equated to greater protection for animals and in relation to economic benefits and increased animal product availability.

Only German respondents had mean scores that equated to agreeing with perceived risks being associated with from intensive animal production systems (see Appendix S), although this was only in relation to *increased animal stress, increased incidence of animal disease* and *an unnatural production method*, although these factors did receive the highest rating of agreement by respondents in the other four countries too. Any mean scores which consistently related to disagreement in risks presented by intensive animal production systems related to economic factors (e.g. increased food price and reduced availability), and protection of animals from predators. The majority of the rest of the mean scores are close to the option neither agree nor disagree, indicating uncertainty in assessments of risks in this context. This could be due to respondents' unfamiliarity with the topic.

Concern of intensive production systems

A degree of uncertainty was also demonstrated towards concerns in relation to intensive animal production systems overall, and in relation to human and animal health (Appendix S). Although concerns differed significantly across countries (see

Appendix S) in relation to the majority of aspects, there were similarities in the highest concerns across the five countries (see Appendix S) with the top concern in each country associated with antibiotic use and resistance and food safety overall and in relation to human health, and antibiotic usage and resistance, and whether minimum welfare standards were actually achieved in intensive animal production systems. The statements which generated the least concern (similar to a neither agree nor disagree response), were related to proactive and preventative health measures, such as vaccination and probiotic use, but *not* to the use of antibiotics, and the use of antibiotics to treat diseases.

Perceived as a benefit	Layers	Broilers	Pigs	Perceived as a risk	Layers	Broilers	Pigs
Reduced animal stress	2.47 ± 1.31	2.49 ± 1.32	2.52 ± 1.32	**Increased animal stress**	3.96 ± 1.00	3.99 ± 1.03	3.88 ± 1.10
Reduced incidence of animal diseases	2.69 ± 1.26	2.71 ± 1.29	2.80 ± 1.28	**Increased incidence of animal diseases**	3.74 ± 1.03	3.71 ± 1.02	3.61 ± 1.08
Faster treatment of animal diseases	2.97 ± 1.19	2.96 ± 1.22	3.10 ± 1.20	**Slower treatment of animal diseases**	3.43 ± 1.07	3.44 ± 1.06	3.31 ± 1.08
Improved FAW monitoring	2.87 ± 1.24	2.84 ± 1.27	3.00 ± 1.25	**Compromised FAW monitoring**	3.64 ± 1.05	3.64 ± 1.04	3.55 ± 1.06
Improved human food safety	2.87 ± 1.20	2.89 ± 1.24	2.99 ± 1.25	**Reduced human food safety**	3.52 ± 1.06	3.54 ± 1.06	3.46 ± 1.08
Improved human food quality	2.76 ± 1.24	2.77 ± 1.28	2.85 ± 1.29	**Reduced human food quality**	3.61 ± 1.07	3.60 ± 1.05	3.56 ± 1.07
Improved nutritional quality of food	2.71 ± 1.23	2.72 ± 1.27	2.80 ± 1.28	**Reduced nutritional quality of food**	3.59 ± 1.07	3.64 ± 1.05	3.50 ± 1.07
Improved consumer health	2.76 ± 1.23	2.77 ± 1.26	2.87 ± 1.26	**Negative effects on consumer health**	3.50 ± 1.05	3.54 ± 1.05	3.42 ± 1.08
Cheaper food of animal origin	3.58 ± 1.10	3.58 ± 1.14	3.65 ± 1.05	**More expensive food of animal origin**	2.77 ± 1.13	2.76 ± 1.10	2.75 ± 1.12
Increased availability of animal based products	3.52 ± 1.05	3.56 ± 1.08	3.56 ± 1.03	**Decreased availability of animal based foods**	2.82 ± 1.12	2.75 ± 1.10	2.72 ± 1.08
Benefits to the environment	2.90 ± 1.16	2.94 ± 1.15	2.96 ± 1.17	**Risks to the environment**	3.36 ± 1.01	3.27 ± 1.00	3.27 ± 1.02
A more sustainable approach to animal production	2.84 ± 1.19	2.80 ± 1.21	2.89 ± 1.24	**An unsustainable approach to animal production**	3.50 ± 1.07	3.46 ± 1.09	3.40 ± 1.05
More cost-efficient production method	3.59 ± 1.11	3.63 ± 1.06	3.66 ± 1.07	**Non-cost efficient production method**	2.94 ± 1.10	2.74 ± 1.12	2.78 ± 1.11
Greater protection from predators	3.41 ± 1.08	3.42 ± 1.12	3.42 ± 1.09	**Less protection from predators**	2.94 ± 1.10	2.85 ± 1.10	2.91 ± 1.09
Greater protection from bad weather	3.43 ± 1.06	3.41 ± 1.13	3.41 ± 1.09	**Less protection from bad weather**	2.80 ± 1.11	2.74 ± 1.10	2.78 ± 1.10
More professionally run farms	3.07 ± 1.14	3.04 ± 1.15	3.12 ± 1.17	**Less professionally run farms**	3.10 ± 1.10	3.05 ± 1.11	3.04 ± 1.10
Benefits to agriculture	3.16 ± 1.12	3.16 ± 1.64	3.18 ± 1.14	**Risks to agriculture**	3.21 ± 1.07	3.24 ± 1.05	3.23 ± 1.04
Benefits to you personally	2.89 ± 1.19	2.91 ± 1.26	2.87 ± 1.22	**Risks to you personally**	3.23 ± 1.09	3.34 ± 1.06	3.30 ± 1.01
Benefits to your family	2.90 ± 1.19	2.88 ± 1.23	2.89 ± 1.21	**Risks to your family**	3.32 ± 1.08	3.36 ± 1.06	3.33 ± 1.11
Benefits to consumers	3.06 ± 1.18	3.01 ± 1.18	3.07 ± 1.17	**Risks to consumers**	3.33 ± 1.10	3.38 ± 1.06	3.34 ± 1.10
Increased consumer trust in food	2.81 ± 1.19	2.78 ± 1.24	2.83 ± 1.25	**Decreased consumer trust in food**	3.53 ± 1.05	3.59 ± 1.04	3.51 ± 1.09
A natural production method	2.56 ± 1.33	2.54 ± 1.32	2.54 ± 1.34	**An unnatural production method**	3.82 ± 1.04	3.82 ± 1.07	3.78 ± 1.10

Table 6.6 Risk and benefit perceptions of respondents in five countries regarding intensive animal production systems of layers, broilers and pigs (mean response on a linear scale 1 (Strongly agree) to 5 (Strongly disagree) ± SD).

Intervention preferences

Table 6.7 highlight the results regarding the acceptability of the different interventions used to prevent production diseases in intensive broiler chicken, layer hen and pig production systems. Significant differences existed between countries for most interventions (see Appendix S). Option *doing nothing* was consistently disagreed with by the majority of respondents. The only other statement to be disagreed with was *the preventative use of veterinary drugs*, indicating that respondents are generally accepting of or uncertain towards the different active interventions apart using an intervention which reflects the main concerns identified in the previous section. The acceptability of the use of veterinary drugs may be related to the risk of antimicrobial resistance. Respondents from Spain and the UK were more often accepting of the preventative use of veterinary drugs in broiler chickens and pigs compared to respondents in Finland, Germany or Poland. German respondents were more accepting of breeding for genetically more resistant pigs, and the use of feed supplements for layers chickens substantially less than respondents in other countries.

Despite the differences that existed between countries, there were similarities in which interventions were and were not perceived as being most acceptable. The least preferred interventions also reflect these concerns, with these interventions involving use of medicines, vaccination, genetic selection and food supplements, although most of these all received scores equating to 'neither unacceptable or acceptable'. Although several of these factors e.g. vaccination and use of probiotics, were ranked as *least concerning* in previous questions, they may still not be *acceptable* to the public. The most preferred interventions involved changes to housing design, enhanced hygiene, reducing stocking densities and providing enrichment materials. These could generally be perceived as more natural and less invasive interventions than other proposed interventions.

In relation to the rationale behind respondent's acceptability of the different interventions, significant differences were observed across the five countries for each of the interventions presented. There were some similarities across animal species and countries, with medicine based interventions being not preferred based on food safety concerns, whilst the more housing and hygiene based interventions that were more acceptable, were perceived as being more humane (Appendix S).

Intervention	Broilers	Laying hens	Pigs
Enhanced hygiene and disease prevention measures	1	1	4
Providing materials and an environment where animals can perform natural behaviours	2	3	1
Housing that allows birds greater freedom to move	3	2	-
Efficient monitoring of pigs and pig housing conditions	-	-	3
Reducing the number of animals in a given area	4	4	6
Improvements in housing design	5	5	6
Enhanced maintenance of the quality of the bedding	6	6	-
Housing that protects the animals from adverse natural conditions	7	7	9
Enhanced control of air movement in the houses	8	8	4
Providing farmers with a price premium that encourages enhanced animal health	9	8	8
Adjustments to feed or diet composition	10	10	2
Changes in the amount and time of light provision	11	11	-
The use of vaccination	12	13	11
Adjustments to the quantity of feed available	13	12	10
Using antibiotics and medicines to treat sick animals	14	14	12
Breeding for genetically tougher or more resilient pigs	-	-	13
Use of feed supplements e.g. probiotics	15	15	14
The preventative use of veterinary drugs including antibiotics	16	16	15
Doing nothing	17	17	16

Table 6.7 The list of preferred interventions when ranked according to their acceptability by the public in the survey data for broiler chickens, laying hens and pigs (the smaller the number, the higher is the acceptability ranking).

In terms of likelihood that these interventions (appendix S) will come into use, all scores for each country for each statement were under 4, with most equating to *neither agree nor disagree*. Significant differences between countries were apparent across most statements (see Appendix S). Providing enrichment materials, housing that allows greater freedom of movement, reducing stocking density and providing farmers with price-incentives were seen as more likely than measures such as adjusting feed composition or feed supplements. Respondents in Germany tended to think interventions in poultry in general less likely to be applied than respondents in other countries.

6.6.2 Exploratory factor analysis

Summary of findings

Summaries of the EFA, can be found in tables 6.8 to 6.10 for each of the three animal types. Results for the eigenvalues, and percentage variance are not reported

due to the oblique rotation used. The analysis for broilers, layers and pigs had a KMO values of 0.945, 0.947 and 0.946 respectively, which is greater than the value of 0.5 Kaiser (1974) describes as acceptable for factor analysis to proceed, with Bartlett's test of sphericity producing significant results for all scales indicating that factor analysis was appropriate. Comparison of the unrotated, orthogonal and oblique rotations for all scales led to the oblique factor rotation factor loadings being chosen for inclusion in the analysis, due to the correlations that were present between most factors identified within each scale. Both scree plots and eigenvalues were used to select the most appropriate number of factors to include, and each returned factor solution was checked for face validity. Scale reliability for all returned factors was good, being above the generally accepted value of 0.7 for all factors, bar factor 16 for broilers and factor 15 for layers, whereby Cronbach's alpha scores of 0.622 and 0.668 (media) for the layers, broilers and pigs surveys respectively. However, it has been noted that, for psychological variables, values below 0.7 can be expected (Kline, 2016), with reliability score values from 0.5 to 0.6 suggested as the minimum acceptable level in these instances (Nunnally (1967), as cited in Peterson, 1994). Therefore, all the factors are reliable.

Broilers

Inspection of the initial eigenvalues led to a 16-factor solution being obtained which explained 69.41% of the variance in the data. Thirteen items had factor loadings less than 0.4 and so were not included in the factors. One item (Q6_13, quality assurance schemes) loaded similarly onto two factors (factors 4 and 11), and so was not included in the analysis. Factor 1 ("Lack of- benefits") accounted for the largest proportion of the data, explaining 21.63% and contained several items in relation to a range of purported benefits of intensive animal production systems. The mean factor score was under 3 for all countries, with the exception of Spanish respondents, whose mean score suggested that they do not perceive that any of the items loading onto this factor represented benefits of intensive production systems. Factor 2 ("Concern"), incorporated several general concerns, including those which related to human health, food safety, whether welfare standards are achieved and concerns associated with antibiotic usage. The mean factor score was just under 4 for all countries, indicating that respondents are slightly more than neutral about these items.

Factor 3 (“Proactive”), related to several of the different proactive interventions listed more specifically those related to housing, hygiene and farmer incentivisation to prevent diseases. This had a factor score of over 4 for all countries with the exception of Poland (3.94) indicating that participants find these interventions acceptable. Factor 4 (“Distrust”) included items related to the extent to which respondents trusted, or distrusted, several supply chain stakeholders including farmers to retailers, as well as national governments. All factors had a negative factor loading indicating that these stakeholders are not trusted to provide information. This is reflected by the factor score, which averaged between 2 and 3 for all countries implying that respondents either disagree or neither agree nor disagree as to whether these stakeholders can be trusted. Factor 5 (“Personal risks”) contained items that relate to risks experienced by consumers and their family members as well as to agriculture. Mean factor scores across all countries averaged around 3 indicating respondents neither agreeing nor disagreeing that these represent risks. Factor 6 (“Perceived benefits”) related to the benefits of intensive animal production systems perceived by consumers, such as price and availability, and greater protection to the animals for weather and predators. Average factor scores across all countries averaged around 3 indicating respondents neither agree nor disagree that these are benefits. Factor 7 (“Pro-consumption”) related to consumption behaviours in relation to the products of intensive animal production systems, such as the behavioural intention measures or *I intend to purchase, I purchase* and *I would consider purchasing* products from intensive animal production systems. Average factor scores varied between 2 and 3 for all countries implying that respondents either disagreed, or neither agreed nor disagreed, with consuming of products from intensive animal production system behaviours.

Factor 8 (“Attitude”) included all the attitudinal items included in the research, and explained 1.77% of variation in the data. Average factor scores across all countries were less than 3 indicating that respondents rated each attitudinal item negatively, and so have unfavourable attitudes towards intensive production systems. Factor 9 (“Treatment”) contained items related to more drug-based interventions, specifically those in relation to the use of antibiotics, prophylactic medicine use and vaccination. All these items had negative loadings indicating that these were not acceptable, with mean factor scores averaging around 3 indicating that participants neither agreed nor disagreed that these interventions are acceptable.

Factor 10 (“Medicine concerns”) related to the concern items surrounding animal treatment with antibiotics and medicines and the preventative measures including probiotics and vaccination. Mean factor scores averaged around 3 indicating that participants neither agreed nor disagreed that these are concerns. Factor 11 (“Governance”) is comprised of one item, negatively loaded onto animal health authorities. As for the other trust factor, all these items negatively loaded indicating that they are not trusted. All average scores across all countries were around 3 indicating that respondents could not agree or disagree that these stakeholders could be trusted. Factor 12 (“Anti-consumption”) contained the behavioural intention items, self-identity items and PEO to avoid animal products from intensive production systems. All means scores averaged around 3, indicating a degree of uncertainty towards this behaviour. Factor 13 (“Perceived risks”) contained items in relation to human health and food safety, as well as animal health and welfare. Again, all means scores averaged around 3, indicating uncertainty towards this behaviour. Factor 14 (“Non-risks”) contained the reversed phrased items to factor 6, in relation to animal protection and cheaper, more available animal products. The factor score all under 3 (i.e. disagrees with), indicating that respondents do not perceive these items to be risks of intensive animal production systems.

Factor 15 (“Feed and light”) is related to the three interventions that involved changes in the feed and light provided to animals. These were all negatively loaded again indicating that interventions associated with this factor were not acceptable, with the average scores all 3 indicating that participants may in fact be more unsure of the acceptability of these items. Factor 16 (“Media”) had the two items in relation to trusted information from social and traditional media channels, and average factor scores of 3 across all countries indicate that respondents neither agreed nor disagreed that the media can be trusted.

	2	6	7	8	13
Concern					
Q10_12: Impacts of animal diseases on food quality	0.852				
Q10_13: Impacts of animal diseases on food safety	0.815				
Q10_10: Impacts of animal diseases on human health	0.796				
Q10_16: Animal production diseases in general	0.715				
Q10_15: Antibiotic resistance as a result of the use of antibiotics in animals	0.711				
Q10_14: Impact of animal diseases on the environment	0.696				
Q10_11: Impacts of animal diseases on animal welfare	0.680				
Q10_9: Antibiotic residues in food	0.674				
Q10_3: Use of antibiotics in production animals as a growth promoter	0.670				
Q10_2: Whether animal welfare standards are actually achieved in broiler chicken production	0.495				
Q10_4: Use of antibiotics in production animals to prevent diseases	0.452				
Perceived benefit					
Q8_13: A more cost-efficient production method		0.727			
Q8_9: Cheaper food of animal origin		0.723			
Q8_10: Increased availability of animal based products		0.700			
Q8_14: Greater protection from predators		0.636			
Q8_15: Greater protection from bad weather		0.633			
Pro-consumption					
Q16_2: I intend to purchase foods produced using intensive production sytems			0.871		
Q16_1: I purchase foods produced using intensive production systems			0.831		
Q16_3: I would consider purchasing foods produced by intensive production systems			0.769		
Attitude					
Q7_1: unpleasant/ pleasant				0.750	
Q7_2: bad/ good				0.710	
Q7_6: unethical/ ethical				0.670	
Q7_5: unsafe/ safe				0.603	
Q7_3: worthless/ valuable				0.599	
Q7_4: useless/ useful				0.520	
Perceived risk					
Q9_2: Increased incidence of animal diseases					0.770
Q9_5: Reduced human food safety					0.666
Q9_7: Reduced nutritional quality of human food					0.657
Q9_3: Slower treatment of animal diseases					0.652
Q9_6: Reduced human food quality					0.649
Q9_4: Compromised animal welfare monitoring					0.637
Q9_8: Negative effects on consumer health					0.625
Q9_1: Increased animal stress					0.594
Cronbach's alpha	0.944	0.865	0.897	0.880	0.937

Table 6.8 EFA results for the broiler survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.945 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5995)=75035.232$, $p=0.000$), indicating that there was sufficient correlation in the data to proceed with factor analysis.

**Cronbach's alpha was not calculated for scales with only one item*

Layers

Inspection of the initial eigenvalues led to a 17-factor solution being obtained which explained 70.11% of the variance in the data. Twelve items had factor loadings less than 0.4 and so were not included as factors, and two factors had no items with factor loadings greater than 0.4. Factor 1 (“Lack of- benefits”) accounted for the largest proportion of the data explaining 21.40% and contained several items in relation to a range of purported benefits of intensive animal production systems. The mean factor score was under 3 for all countries with the exception of Spanish respondents, indicating that they do not perceive any of the items loading onto this factor as benefits of intensive production systems. Factor 2 (“Concern”), related to several general concerns, including those in relation to both human health, food safety, whether welfare standards are achieved and concerns in relation to antibiotic usage. The mean factor score was just either 3 or 4 for all countries, indicating that respondents either agreed or neither agreed nor disagreed that these items are sources of concern.

Factor 3 (“Non-risks”), contained the reversed phrased items to factor 6, in relation to animal protection and cheaper, more available animal products. The factor score were all under 3 indicating that respondents did not perceive items to represent risks of intensive animal production systems. Factor 4 (“Distrust”) contained several supply chain stakeholders ranging from farmers to retailers, as well as national government. All factors had a negative factor loading indicating that these stakeholders were in fact not trusted to provide information. This is reflected by the factor score, which averaged around 3 for all countries. Factor 5 (“Medicine concerns”) related to the concern items surrounding animal treatment with antibiotics and medicines and preventative measures such as probiotics and vaccination. However, mean factor scores averaged around 3 indicating that participants neither agreedd nor disagree that these were concerns. Factor 6 (“Perceived benefits”) related to the benefits of intensive animal production systems perceived by consumers, such as price and availability, and greater protection to the animals for weather and predators. Average factor scores across all countries averaged around 3 indicating respondents neither agreed nor disagreed that these represent benefits.

Factor 7 (“Anti-consumption”) contained the behavioural intention items, self-identity items and PEO to avoid intensively produced products. All means scores averaged around 3, indicating a degree of uncertainty towards this behaviour. Factor 9

("Personal risk") contained several negatively loaded items in relation to the direct perceived risk of intensive animal production. The factor score all under 3 indicating that respondents do not perceive items as risks of intensive animal production systems. Factor 10 ("Attitude") included all the attitudinal items included in the research, and explained 1.39% of variation in the data. Average factor scores across all countries were either 2 or 3 indicating that respondents rated each attitudinal item negatively or unsurely, and so have unfavourable attitudes towards intensive production systems. Factor 11 ("Pro-consumption") related to pro-intensive consumption behaviours, such as the behavioural intention measures or *I intend to purchase, I purchase* and *I would consider purchasing* products from intensive animal production systems. Average factor scores varied between 2 and 3 for all countries implying that respondents either disagreed, or neither agreed nor disagreed, with pro-consumption of products from intensive animal production system behaviours.

Factor 12 ("Perceived risks") contained items in relation to human health and food safety, as well as animal disease. Again, all means scores averaged around 3, indicating a degree of uncertainty towards this behaviour. Factor 13 ("Feed and light") related to the three interventions that involved changes in the feed and light provided to animals. The average scores were all 3 indicating that participants may in fact be more unsure of the acceptability of these items. Factor 14 ("Treatment") contained items related to more drug based intervention measures, specifically those in relation to the use of antibiotics, prophylactic medicine use and vaccination. Mean factor scores averaging around 3 indicating that participants neither agreed nor disagreed that these interventions are acceptable. Factor 15 ("Media") contained the stakeholders of both social and traditional media and consumer organisations. As per the other trust factor, all these items are negatively loaded indicating that they were not trusted. The mean scores across countries were 3 implying that respondents either disagreed or neither agreed nor disagreed as to whether these stakeholders can be trusted. Factor 16 ("Proactive") related to the different proactive interventions listed more specifically those related to housing, hygiene and farmer incentives to prevent diseases. This had a factor score of over 4 for all countries indicating that participants found these interventions acceptable.

	2	6	10	11	12
Concern					
Q10_13: Impacts of animal diseases on food safety	0.855				
Q10_12: Impacts of animal diseases on food quality	0.835				
Q10_10: Impacts of animal diseases on human health	0.815				
Q10_11: Impacts of animal diseases on animal welfare	0.756				
Q10_16: Animal production diseases in general	0.640				
Q10_14: Impact of animal diseases on the environment	0.601				
Q10_9: Antibiotic residues in food	0.564				
Q10_15: Antibiotic resistance as a result of the use of antibiotics in animals	0.537				
Q10_3: Use of antibiotics in production animals as a growth promoter	0.491				
Perceived benefit		0.723			
Q8_13: A more cost efficient production method		0.650			
Q8_10: Increased availability of animal based products		0.650			
Q8_14: Greater protection from predators		0.646			
Q8_9: Cheaper food of animal origin		0.628			
Q8_15: Greater protection from bad weather					
Attitude			0.686		
Q7_3: worthless/ valuable			0.647		
Q7_2: bad/ good			0.640		
Q7_1: unpleasant/ pleasant			0.582		
Q7_6: unethical/ ethical			0.534		
Q7_5: unsafe/ safe			0.532		
Q7_4: useless/ useful					
Pro-consumption					
Q16_2: I intend to purchase foods produced using intensive production systems				-0.780	
Q16_1: I purchase foods produced using intensive production systems				-0.755	
Q16_3: I would consider purchasing foods produced by intensive production systems				-0.754	
Perceived risk					
Q9_4: Compromised animal welfare monitoring					0.606
Q9_2: Increased incidence of animal diseases					0.602
Q9_3: Slower treatment of animal diseases					0.572
Q9_5: Reduced human food safety					0.499
Q9_1: Increased animal stress					0.452
Q9_6: Reduced human food quality					0.421
Cronbach's alpha	0.936	0.864	0.867	0.903	0.906

Table 6.9 EFA results for the layers survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.947 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5995)=74906.485$, $p=0.000$), indicating that there was sufficient correlation in the data to proceed with factor analysis.

**These factors had no items with factor loadings greater than 0.4 therefore Cronbach's alpha values were not calculated*

Pigs

Inspection of the initial eigenvalues led to a 15-factor solution being obtained which explained 68.93% of the variance in the data. Six items had factor loadings less than 0.4 and so were not included in the factors, and two factors had no items with factor loadings greater than 0.4. Factor 1 ("Lack of- benefits") accounted for the largest proportion of the data explaining 22.34% and contained several items in relation to a range of purported benefits of intensive animal production systems. The mean factor score were under 3 for all countries bar Spain indicating that respondents disagreed with this, indicating that they did not perceive any of the items loading onto this factor as benefits of intensive production systems. Factor 2 ("Concern"), related to several general concerns, including those in relation to both human health, food safety, whether welfare standards are achieved and concerns in relation to antibiotic usage. The mean factor scores were around 3 for all countries, indicating that respondents neither agreed nor disagreed that these items are concerning.

Factor 3 ("Proactive") related to the different proactive interventions listed more specifically those related to housing, hygiene and farmer incentives to prevent diseases. This had a factor score of over 4 for all countries but Poland, indicating that participants found these interventions acceptable. Factor 4 ("Distrust") contained several supply chain stakeholders ranging from farmers to retailers. All factors had factor scores which averaged at 2 or 3, indicating that respondents either disagreed or neither agreed nor disagreed that these stakeholders are not trusted. Factor 5 ("Perceived risks") contained items in relation to human health and food safety, as well as animal disease. Again, all means scores averaged around 3, indicating uncertainty towards this behaviour. Factor 6 ("Perceived benefits") related to the benefits of intensive animal production systems perceived by consumers, such as price and availability, and greater protection to the animals for weather and predators. Average factor scores across all countries averaged around 3 indicating respondents mostly neither agreed nor disagreed that these are benefits.

Factor 7 ("Pro-consumption") related to pro-intensive consumption behaviours, such as the behavioural intention measures or *I intend to purchase, I purchase* and *I would consider purchasing* products from intensive animal production systems. Average factor scores were all 2 for all countries bar Spain implying that respondents either disagreed, or neither agreed nor disagreed, with pro-consumption of products from intensive animal production system behaviours. Factor 8 "(Anti-consumption")

contaied the behavioural intention items, self-identity items and PEO to avoid intensively produced products. All means scores averaged around 3, indicating a degree of uncertainty towards this behaviour. Factor 9 (“Medicine concerns”) related to the concern items surrounding animal treatment with antibiotics and medicines and the more preventative measures such as probiotics and vaccination. All items had negative factor loadings indicating that these were not a concern however, mean factor scores averaged around 3 indicating that participants neither agreed nor disagreed that these were concerns. Factor 10 (“Independent assurance”) contained stakeholders such as consumer and animal welfare organisations, as well as the media and government. All items had negative factor loadings indicating that these stakeholders were also not trusted, although mean scores for all countries were around 3 indicating more uncertainty about the trustworthiness of these stakeholders.

Factor 11 (“Treatment”) contained items related to more drug based intervention measures, specifically those in relation to the use of antibiotics, prophylactic medicine use and vaccination, as well as genetic selection. Mean factor scores for all countries bar Germany (disagree) averaged around 3 indicating that participants neither agreed nor disagreed that these interventions are acceptable. Factor 14 (“Attitude”) included all the attitudinal items included in the research, and only explained 1.05% of variation in the data. Average factor scores across all countries were all 3 indicating that respondents may have been unsure as to how they feel towards intensive animal production systems. Factor 15 (“Non-risks”), contained the reversed phrased items to factor 6, in relation to animal protection and cheaper, more available animal products. The factor scores were all under 3 indicating that respondents do not perceive items as risks of intensive animal production systems.

	2	5	6	7	14
Concern					
Q10_13: Impacts of animal diseases on food safety	0.909				
Q10_12: Impacts of animal diseases on food quality	0.875				
Q10_10: Impacts of animal diseases on human health	0.844				
Q10_16: Animal production diseases in general	0.702				
Q10_15: Antibiotic resistance as a result of the use of antibiotics in animals	0.695				
Q10_9: Antibiotic residues in food	0.689				
Q10_11: Impacts of animal diseases on animal welfare	0.677				
Q10_3: Use of antibiotics in production animals as a growth promoter	0.633				
Q10_14: Impact of animal diseases on the environment	0.630				
Perceived risk					
Q9_6: Reduced human food quality		0.781			
Q9_20: Risks to consumers		0.777			
Q9_19: Risks to your family		0.768			
Q9_18: Risks to you personally		0.754			
Q9_7: Reduced nutritional quality of human food		0.742			
Q9_21: Decreased consumer trust in the food they buy		0.735			
Q9_8: Negative effects on consumer health		0.735			
Q9_5: Reduced human food safety		0.709			
Q9_2: Increased incidence of animal diseases		0.600			
Q9_11: Risks to the environment		0.598			
Q9_12: An unsustainable approach to animal production		0.594			
Q9_17: Risks to agriculture		0.593			
Q9_4: Compromised animal welfare monitoring		0.585			
Q9_1: Increased animal stress		0.575			
Q9_3: Slower treatment of animal diseases		0.560			
Q9_22: An unnatural production method		0.553			
Q9_16: Less professionally run livestock farms		0.430			
Perceived benefit					
Q8_9: Cheaper food of animal origin			0.672		
Q8_13: A more cost efficient production method			0.595		
Q8_10: Increased availability of animal based products			0.572		
Q8_14: Greater protection from predators			0.546		
Q8_15: Greater protection from bad weather			0.516		
Pro-consumption					
Q16_2: I intend to purchase foods produced using intensive production systems				0.804	
Q16_1: I purchase foods produced using intensive production systems				0.785	
Q16_3: I would consider purchasing foods produced by intensive production systems				0.743	
Attitude					
Q7_2: bad/ good					0.649
Q7_5: unsafe/ safe					0.644
Q7_1: unpleasant/pleasant					0.622
Q7_3: worthless/valuable					0.621
Q7_6: unethical/ ethical					0.619
Q7_4: useless/ useful					0.455
Cronbach's alpha	0.944	0.962	0.846	0.894	0.878

Table 6.10 EFA results for the pigs survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.946 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5886)=71867.560$, $p=0.000$), indicating that there was sufficient correlation in the data to proceed with factor analysis.

**These factors had no items with factor loadings greater than 0.4 therefore Cronbach's alpha values were not calculated*

General remarks based on EFA

The results of the EFA reflect those of the descriptive statistics, in relation to the types of concerns, risks and benefits held and the type of interventions preferred. Similar results were obtained across each of the three animal types indicating the reliability of the scale items in measuring their respective constructs. As per the descriptive statistics, average scores were around three for most factors indicating some degree of neutrality.

Of the two factors for perceived benefits generated for all three animal types, only one factor had an average score which corresponded to the respondents agreeing to proposed benefits, whilst the other average score corresponded to being disagreed with the proposed benefits. These disagreed with benefits correspond to the perceived risk factors created, in that the items are not perceived as benefits and are in fact risks. The mean scores for the other perceived risk factors (personal risks and non-risks) again correspond to neither agree nor disagree (average score 3). Few benefits were perceived but those that corresponded to both human and animal benefits, and the items that scored highly in the descriptive statistics, namely cheaper and more available animal products, and greater protection from bad weather and predators.

Mean scores for the attitudes factor were negative for each of the three animal types. Behavioural intention was also consistent across the animal types. Pro-consumption behaviour was disagreed with whereas anti-intensive product consumption was neutral. This highlights that respondents can appreciate the benefits of intensive animal production systems. Whilst they may not be agreed with, or have had favourable attitudes towards the proposed benefits, they still can appreciate product availability and affordable products that they offer.

More proactive and natural intervention treatments were preferred, with anything to do with antibiotics or treatment rejected. This correspondes to the antibiotic resistance and medicine concerns which grouped together into factors. Although appropriate nutrition is essential to the well-being and welfare of the animal, respondents were also not in favour of light or feed-based interventions. This could be due to these being perceived as unnatural, but also this may be because the descriptions provided in the survey were not very descriptive. Participants could have been unclear as to what exactly was meant by these e.g. an increase or decrease in the amount of feed or light provided.

Most stakeholders were not trusted to provide information, with supply chain stakeholders typically viewed as least trusted. This could be due to their perceived potential vested interests, e.g. profit as well as animal health and welfare. External independent assurance bodies e.g. animal health and consumer organisations, were perceived as more trusted, however the mean scores still equated to neither agree nor disagree for this factor, indicating an uncertainty amongst respondents. This was true for all animal types bar layers where this separate independent assurance factor was not created. This may be due to the certification and assurance systems already widely in placed for layer hens, such as free-range eggs. The differentiation of these stakeholders also highlights the importance of transparency and credibility surrounding information provision, and the need to ensure this in future communications.

6.6.3 Structural equation modelling

Background

Each of the factors included proposed for inclusion in the model (as determined by the hypotheses in section 6.2.8) were included in a CFA, to establish whether satisfactory. As both PEO and self-identity are not determined as separate factors within the EFA, rather as part of the pro and anti-consumption factors for all three surveys, these could not be included as separate items in the model, and the relationship of these on attitude and behaviour could not be tested. The five variables included in each of the models are summarised below in table 6.11 along with a brief description of the construct.

Construct	Description
Pro-consumption	Pro-consumption behavioural intention of products from intensive animal production systems
Attitude	Attitude towards intensive animal production systems
Perceived benefit	Perceived benefits of intensive animal production systems
Perceived risk	Perceived risks of intensive animal production systems
Concern	Perceived concern over intensive animal production systems

Table 6.11 Five variables include in the SEM analysis

The same model (figure 6.1) was tested for each of the three animal types. The SEM was constructed by adding each of the latent variables in the SEM sequentially to test for changes in the model fit parameters, until each variable hypothesised in

figure 6.1 was included. MI were checked at each stage to establish whether correlations between items were needed, and these were made specific to the models for each animal type. MSEM was then conducted on each final model, using country and gender as the comparison grouping variables.

Broilers

Evaluation of the five-factor model for broilers indicated an adequate to good model fit for all goodness of fit statistics ($\chi^2(479) = 1703.700$, *p=0.000*; TLI=0.930; CFI=0.937; SRMR=0.056) with the exception of the RMSEA, which indicated an adequate fit (0.057 (0.054, 0.060) 95% confidence intervals). All items included significantly loaded onto their construct. Overall the model explained 43.8% (R^2=0.438) of the variation in attitude and 29.1% (R^2=0.291) of the variation in behavioural intention.

Table 6.12 shows the standardised direct effects of the model. Attitude had a significant positive effect on pro-consumption behaviour (β =0.727, *p=0.000*), with the perceived benefits of intensive animal production systems also having a significant positive effect on attitude (β =0.468, *p=0.000*). Perceived risks on intensive animal production systems had a significant negative effect on attitude (β =-0.308, *p=0.000*). Concern had a significant positive effect on perceived risk (β =0.439, *p=0.000*) and a nonsignificant negative effect on perceived benefit (β =-0.014, *p=0.602*), and a significant negative effect on attitude (β =0.-0.294, *p=0.000*). The effect of concern on attitude is fully mediated by both perceived risk and perceived benefit, and partially mediated by attitude. In addition, the effect of perceived risk and perceived benefit are partially mediated by attitude. To summarise, hypotheses H1 to H6 are supported by the model, although H5 is not significant.

Direct effect	
Perceived benefit	
Concern	-0.014
Perceived risk	
Concern	0.439***
Attitude	
Perceived risk	-0.308***
Perceived benefit	0.468***
Concern	-0.294***
Intention	
Attitude	0.727***

Table 6.12 Standards regression coefficients for the structural equation model for broilers

Multigroup analysis by MSEM was conducted to establish potential moderating effects of country and table 6.13 summarises the results of the tests across the four models outlined in section 6.5.3. Results of the MSEM show differences between the baseline model and the series of increasingly restricted models, with measurement invariance not being demonstrated for models 2, 3 and 4, due to there being a significant difference between models. This means that the structure of the latent variables cannot be said to be the same across countries, and subsequently the model cannot be compared across countries.

Model	χ^2	df	*P*	$\Delta\chi^2$	CFI	ΔCFI	RMSEA
Model 1	4870.9	2395	-	-	0.883	-	0.081
Model 2	5073.3	2507	<0.001	202.35	0.879	0.004	0.081
Model 3	5395.3	2619	<0.001	321.97	0.869	0.01	0.082
Model 4	5479.8	2639	<0.001	84.52	0.866	0.003	0.083

Table 6.13 Results of the tests for measurement invariance by country for broilers.

Layers

Evaluation of the five-factor model for layers indicated an adequate to good model fit for all goodness of fit statistics ($\chi^2(335) = 1122.421$, *p=0.000*; TLI=0.941; CFI=0.948) except the RMSEA and SRMR, which indicated an adequate fit (0.055 (0.051, 0.058) 95% confidence intervals and SRMR-0.072). All items included significantly loaded onto their construct. Overall the model explained 36.9% (R^2=0.369) of the variation in attitude and 41.7% (R^2=0.417) of the variation in behavioural intention.

Table 6.14 shows the standardised direct effects of the model. Attitude had a large significant positive effect on pro-consumption behaviour (β =1.008, *p=0.000*), with the perceived benefits of intensive animal production systems also having a significant positive effect on attitude (β =0.303, *p=0.000*). Perceived risks on intensive animal production systems had a significant negative effect on attitude (β =-0.291, *p=0.000*). Concern had a significant positive effect on perceived risk (β =0.552, *p=0.000*), a non-significant effect on perceived benefit (β =0.002, *p=0.941*) and a significant negative effect on attitude (β =0.-0.177, *p=0.000*). The effect of concern on attitude is fully mediated by both perceived risk and perceived benefit, and partially mediated by attitude. In addition, the effect of perceived risk and perceived benefit are partially mediated by attitude. To summarise, hypotheses H1 to H4 and H6 are supported by the model, with H5 not being supported, with concern having a slight positive rather than a negative effect on perceived benefit, although this was non-significant.

	Direct effect
Perceived benefit	
Concern	0.002
Perceived risk	
Concern	0.552***
Attitude	
Perceived risk	-0.291***
Perceived benefit	0.303***
Concern	-0.177***
Intention	
Attitude	1.008***

Table 6.14 Standards regression coefficients for the structural equation model for layers

Multigroup analysis by MSEM was conducted to establish potential moderating effects of country and table 6.15 summarises the results of the tests across the four models outlined in section 6.5.3. Results of the MSEM show significant differences between the baseline model and the series of increasingly restricted models, with measurement invariance not being demonstrated for models 2, 3 and 4. This means that the structure of the latent variables cannot be said to be the same across countries, and subsequently the model cannot be compared across countries.

Model	χ^2	df	*P*	$\Delta\chi^2$	CFI	ΔCFI	RMSEA
Model 1	3219.3	1675	-	-	0.905	-	0.076
Model 2	3344.5	1767	0.0122	125.195	0.903	0.002	0.075
Model 3	3626.7	1859	<0.001	282.228	0.892	0.012	0.078
Model 4	3705.8	1879	<0.001	79.096	0.888	0.004	0.078

Table 6.15 Results of the tests for measurement invariance by country for layers

Pigs

Evaluation of the five-factor model for pigs indicated an adequate to good model fit for all goodness of fit statistics ($\chi^2(721)$ =2934.676, *p=0.000*; TLI=0.904; CFI=0.911) bar the RMSEA and SRMR, which indicated an adequate fit (0.063 (0.061, 0.065) 95% confidence intervals; SRMR=0.077). All items included significantly loaded onto their construct. Overall the model explained 34.9% (R^2=0.349) of the variation in attitude and 32.5% (R^2=0.325) of the variation in behavioural intention.

Table 6.16 shows the standardised direct effects of the model. Attitude had a significant positive effect on pro-consumption behaviour (β =0.819, *p=0.000*), with the perceived benefits of intensive animal production systems also having a significant positive effect on attitude (β =0.336, *p=0.000*). Perceived risks on intensive animal production systems had a significant negative effect on attitude (β =-0.168, *p=0.000*). Concern had a significant positive effect on perceived risk (β =0.526, *p=0.000*), a slightly significant negative effect on perceived benefit (β =0.051, *p=0.037*) and a significant negative effect on attitude (β =-0.168, *p=0.000*). The effect of concern on attitude is fully mediated by both perceived risk and perceived benefit, and partially mediated by attitude. In addition, the effect of perceived risk and perceived benefit are partially mediated by attitude. To summaries, hypotheses H1 to H6 are supported by the model.

	Direct effect
Perceived benefit	
Concern	-0.051*
Perceived risk	
Concern	0.526
Attitude	
Perceived risk	-0.277***
Perceived benefit	0.336***
Concern	-0.168***
Intention	
Attitude	0.819***

Table 6.16 Standards regression coefficients for the structural equation model for pigs

Multigroup analysis by MSEM was conducted to establish potential moderating effects of country and table 6.17 summarises the results of the tests across the four models outlined in section 6.5.3. Results of the MSEM show significant differences between the baseline model and the series of increasingly restricted models, with measurement invariance not being demonstrated for models 2, 3 and 4. This means that the structure of the latent variables cannot be said to be the same across countries, and subsequently the model cannot be compared across countries.

Model	χ^2	df	*P*	$\Delta\chi^2$	CFI	ΔCFI	RMSEA
Model 1	7627.5	3605	-	-	0.85	-	0.086
Model 2	7844.5	3745	<0.001	217.06	0.847	0.003	0.085
Model 3	8323.7	3885	<0.001	479.17	0.834	0.013	0.087
Model 4	8427.2	3905	<0.001	103.51	0.831	0.003	0.088

Table 6.17 Results of the tests for measurement invariance by country for pigs

General remarks based on structural equation modelling

Although differences existed between the animal types, several similar trends were observed. Attitude had a large positive and significant effect on pro-consumption behaviour for all animal types (β= 0.727, 1.008 and 0.819 for broilers, layers and pigs respectively), indicating that a positive attitude towards intensive animal production systems leads to a greater intention to purchase products from these systems. This is unsurprising and serves to confirm the face validity of the measures used.

Perceived risk and general concern had consistent negative effects on attitudes across animal types, being largest for broiler chickens. This indicates that general concerns and perceived risks have a greater effect on attitudes to purchase chicken meat, whilst perceived benefits also had the largest effect on attitudes towards broiler chicken consumption. The concern-risk, and the concern-benefit relationships were of a similar size across all three animal types, and indicates a small effect of concern on both perceived risks and benefits.

Tests for measurement invariance indicated that the structure of the model and each factor does not hold across countries (i.e. measurement invariance could not be achieved), implying that the latent variables may be constructed differently across each of the five countries. This is unsurprising as cultural differences between each of the five countries could lead to different prioritisation and consideration of concerns, risks and benefits. Despite this, when examining the model coefficients, and significance of the relationships between countries some similarities and differences could be seen. There was considerable difference in the size of the coefficients across the five countries and across each of the three animal types. The relationships between concern and benefit, concern and risk and concern and attitude were the most likely to vary in significance across the five countries, whereas the relationships between risk and attitude, risk and benefit and attitude and pro-consumption behaviour all remained consistently significant across countries. This emphasises the importance of communicating risk and benefit information in European communications, whilst focusing in on concerns at national policy and communication levels.

6.7 Discussion

6.7.1 Public concern

This research used three separate, but interlinked, surveys to identify public attitudes, concerns, perceived risks and benefits towards intensive broiler chicken, layer hen and pig production systems. Informed by two systematic reviews examining public attitudes towards intensive animal production systems, the relationship between attitudes towards these production systems, as well as the concerns perceived by the public regarding intensive production, production diseases and interventions were examined.

The findings of the three surveys demonstrate that the public associate some benefits to intensive pig and poultry production systems, primarily in relation to the outputs of these systems, such as less expensive and more widely available animal-based products. They did, however, report concerns about these production systems, with average attitudinal scores across all five countries indicating that the majority of the public do not view these production systems favourably, with respondents viewing them more frequently as unpleasant, bad, worthless, useless, unsafe and unethical than the opposites of these. This is in line with the most recent Eurobarometer survey (European Commission, 2016), where 82% of respondents believed that farm animals should be better protected than they currently are in relation to FAW. Given that a key part of sustainability of a systems is its' acceptance (Broom, 2010), steps should be taken to ensure that actions and information provided to the public seeks to achieve this acceptance.

When asked to rate concern about various aspects of intensive animal production, respondents tended to agree that their perceived risks were in relation to animal stress, it being an unnatural production method, and their being increased risk of animal diseases. This was primarily related to prophylactic antibiotic usage, antibiotic resistance, antibiotic residues and food safety. When asked about their concerns in relation to animal health, the same concerns were identified as well as concerns in relation to production diseases in general, and whether minimum welfare standards were being achieved in each of the three production systems. These findings reflect the results of the systematic review of attitudes in chapter 3. They also indicate that the public cannot dissociate the risks to food safety and human health from animal health and wellbeing in animal production systems, with production diseases in particular also perceived to have negative consequences for food safety and quality. Health is a recurrent theme in relation to hazards and perceived risk (Miles and Frewer, 2001), and the findings of this research suggest that both animal and human health are important considerations in relation to the evaluation of intensive animal production systems. These beliefs are likely to have been reinforced by recent epidemic disease outbreaks such as avian influenza (Department of Environment, Food and Rural Affairs, 2017), which have received a mass media coverage. It is likely the public cannot well differentiate between production and epidemic animal diseases within in the pig and poultry production systems.

Although FAW does not seem to be a priority consideration in relation to product choice, the systematic review of public attitudes in chapter 3 indicated that the public associated higher animal welfare with additional product attributes such as product quality (Zingg *et al,* 2013), and this extends to the production systems used to (Broom, 2010). Additional attributes associated with FAW included healthiness and food safety (Harper and Henson, 2001; Broom, 2010). Although the safety implications of higher welfare systems is not guaranteed there is some evidence to suggest that improved animal welfare can, at least in some cases, lead to higher quality products, including safety and quality issues associated with decreased microbial spoilage (World Bank, 2011).

Despite their concerns over FAW and intensive animal production systems, the public may have very little or no understanding of the technicalities of modern farming practices (Harper and Henson, 2001), and are unfamiliar with several topics or norms associated with FAW (te Velde *et al*, 2002; Lassen *et al*, 2006). The results of the survey confirm this lack of public knowledge surrounding production diseases, with most responses when directly questioned on production disease aspects being neutral (averaging neither disagree nor agree), and there being a general unfamiliarity with farming. This is unsurprising given that there is likely little communication surrounding production diseases, and their interventions to the public, with most mainstream media communication instead involving disease epidemics, such as foot and mouth disease (Breakwell, 2003), or more recently avian influenza (Department of Environment, Food and Rural Affairs, 2017). In light of this, the levels of concern surrounding production diseases reported in the survey, and the corresponding perceived risks involving animal disease and food safety, is unsurprising. This is due to individuals being likely to relate part of their concerns to these diseases with the epidemic disease outbreaks with which they are more familiar. Care should therefore be taken when communicating about production diseases to emphasise and differentiate them from the more familiar disease epidemics, and it would be interesting to explore further if and whether the public can distinguish between production and epidemic disease outbreaks. Moreover, the results suggest that the respondents do not feel that the food they consume originates from intensive production systems. This also highlights that the public are not very familiar with current, and indeed emerging production systems.

The use of antibiotics and AMR were repeatedly identified as concerns both in relation to human and animal health, and more generally in relation to intensive animal production systems. Antibiotics, and the use of other veterinary medicines, have obvious benefits to animal health (Perry *et al,* 2013), and the public can acknowledge these benefits, and accepts the use of these in a controlled and responsible manner. However, the prophylactic use on antibiotics, including the use of antibiotics as a growth promoter[8], was identified as a concern, including in relation to AMR. Of course, AMR is not just associated with the use of antimicrobials within animal production systems (You *et al*, 2016), but there is evidence to suggest animal production is a significant contributor towards this (Hudson *et al,* submitted). AMR represents a transboundary risk in the context of public health, in that it does not respect and can easily cross international borders (You *et al*, 2016), making it a global issue. Given the prevalence of AMR globally, including in relation to key strains of antibiotics (Liu *et al,* 2016), it is imperative to address the concerns that the public, and consumers may hold. AMR has also been estimated to be able to result in major economic losses (e.g. Taylor *et al*, 2014), and so represents a threat to human health and has important socio-economic implications.

Global considerations are particularly important when considering AMR, with the illegal usage of antimicrobials occurring within both developed and developing countries e.g. Italy and China (Conti *et al*, 2015; Zhong *et al*, 2017). Three of the top five countries regarding the use of antimicrobials within animal production systems were low or middle-income countries. China (23%), Brazil (9%) and India (3%; van Boeckel *et al*, 2015), with Myanmar (205%), Indonesia (202%), Nigeria (163%), Peru (160%) and Vietnam (157%) are expected to see the biggest increases in the twenty-year period between 2010-2030, indicating a shift towards more intensive production systems within these regions (de Boeckel *et al*, 2015). The need for international standards, and enforcement is therefore required to ensure public trust and safety (both in relation to food and public health), with trade considerations also needing to be considered, especially of animal products from regions were antimicrobial usage is less regulated, to areas where controls are more stringent, such as the EU. In addition, as the areas where intensive animal production is increasing are also areas

[8] It was emphasised in the survey that the use of antibiotics as a growth promoter has been banned in Europe since 2006, yet it was still identified as a concern by respondents.

where little is known about consumer perceptions, it is important to explore public perceptions also in these countries.

6.7.2 Interventions preferred by the public

The most preferred interventions as identified in the study were proactive disease prevention measures, as opposed to reactive disease mitigation strategies. This included interventions involving changes to housing design, increasing the space available for the birds and pigs, and enhanced hygiene and disease prevention measures, as opposed to the preventative use of medicines or vaccination. The use of probiotics[9] and changes to feed composition were also not preferred in poultry, and this could be due to a lack of understanding or clarity as to exactly what these interventions involve e.g. more or less food available. This highlights a need to provide sufficient information when explaining to the public what the different management strategies involve. When ranked according to their acceptability, broilers chickens and laying hens had almost identical ranking of the measures. Measures for pigs had a slightly different ranking. In particular, feed-related measures are ranked substantially higher in terms of acceptability in pigs than in poultry (table 6.7).

The least preferred interventions related to factors identified by respondents as concerns; namely antibiotic usage, vaccination and feed supplementation in poultry. Although the latter two were not a priority concern when asked (i.e. they were not one of the highest ranked concerns), they are not preferred, with respondents much more accepting of the more natural or less invasive strategies. These were chosen in relation to both food safety and humane treatment reasons, again emphasising that the public cannot separate animal wellbeing from human food safety. This further emphasises the need for effective communication and assurance regarding the regulations and enforcement used within the animal product supply chain, which are used to ensure the safety of the animal products produced.

The results of the survey also identified several concerns held by the public in relation to the interventions used within intensive animal production systems, more specifically in relation to reactive interventions that were rated as unacceptable to respondents. This aligns with the findings from the systematic review of attitudes in

[9] A definition of probiotics was provided to respondents but this still does not ensure that they were familiar with what probiotics are and what their use would entail.

chapter 3, in that they were perceived to breach the concepts of good welfare, humane treatment and naturalness. In addition, the interventions that were least preferred were those that could also have implications for public health, such as those associated with food safety or AMR. This relates back to the priority concerns of consumers when making food choices, and the dual perspectives of FAW, in that the benefits of these systems can be viewed from both anthropocentric and zoocentric perspectives. This has implications for communications, with the benefits needing to be tailored to each of these different target audiences

The concerns in relation to prophylactic antibiotic use identified in chapter 3, were supported by findings of the survey, and again raised concerns in relation to FAW in relation to humane treatment and naturalness, but also in relation to human health too. The findings from the survey provide further insights into this, with several concerns being identified in relation to antibiotic usage. The results therefore suggest that antibiotic usage and food safety are inextricably linked in the minds of consumers. It may be that they use this as a heuristic, with any further information regarding these production systems and interventions being processed accordingly (Finucane *et al*, 2000). It is acknowledged that heuristics can lead to biases (Slovic *et al*, 1982), and this appears to be the case in relation to intensive animal production systems and FAW, with intensive systems used by the public as a cue for several perceived negative consequences to FAW and animal health. It is important to acknowledge this within policy, and subsequent communication, as failure to do so could result in decreased stakeholder trust and subsequent increase in concern and perceived risks, as information containing the words intensive may be interpreted negatively.

The findings surrounding the least acceptable interventions also reflect existing research on disease outbreaks, which have identified that the public are concerned about eating potentially contaminated meat, particularly after disease epidemics. Breakwell (2003) conducted focus groups after the UK foot and mouth disease crisis of 2001 and their results suggest that there was no indication that consumers would not consume meat from vaccinated animals, when presented as an alternative to the culling strategy employed. However, research by Scudamore (2007) indicates that the consumers had some reservations towards eating meat from animals vaccinated against foot and mouth disease (Scudamore, 2007), and Zingg and Siegrist (2012), also reporting a reluctance of consumers to consumer meat from animals vaccinated

against a more general disease epidemic. Given the lack of public acceptability surrounding these interventions they should only be used when the more proactive measures are not thought to be effective enough to ensure animal health and wellbeing, or when the more proactive measures are not perhaps thought to be economically viable. Individual issues may be overemphasized in communications regarding different production systems and as consumers tend to link positive and negative attributes to each-other. This may reinforce negative or positive image that a consumer has regarding intensive production systems.

The intervention preferences identified in the survey tie in with findings from a consultation of pig and poultry industry stakeholders (Jones *et al,* 2016), in which a preference for intervention measures such as biosecurity, ventilation, monitoring and air quality was identified. These interventions, along with the interventions identified as most preferred in the survey, represent more proactive measures requiring little interference with the animal. These also emphasised that a range of measures were preferred rather than one single solution (Jones *et al,* 2016). Findings from the survey conducted here would support the use of a multifaceted approach providing that more invasive or medication based treatments were not used. The findings also emphasise the need to highlight that these production systems are focused on animals' physical and psychological wellbeing. This is obviously the case for animal production systems currently, but clearly there is a need to emphasise this to external stakeholders, such as the public, who are not familiar with the practices and standards used within these systems.

Identifying and understanding public attitudes and concerns, including their perceptions of risks and benefits, in relation to intensive farming practices including those surrounding production diseases is important, and will ensure that the processes and interventions align with the values, needs and expectations of society (Asveld *et al*, 2015). Presenting the proactive management measures taken to mitigate production disease occurrence and severity is therefore an important part of ensuring that these, and the associated risk management procedures, align with societal preferences, and highlights the benefits of ongoing societal discussions in building consumer trust through transparency (van Kleef *et al,* 2007). Best practice examples of this that could already be conveyed may include the work already being done by the UK poultry sector to reduce the amount of antimicrobials being used within production systems (Griffiths, 2016), and the continued and sustained efforts

to reduce these. This would highlight the responsible management practices already in place.

The proactive interventions preferred also emphases the key aspects of good FAW as identified in chapter 3, especially in relation to (perceived) naturalness, and the importance of utilising housing based interventions. The repetition of this theme across the perceived risks, lack of benefits, concerns identified and interventions preferred emphasises the need to ensure that production systems are seen to address these concerns, to ensure that societal concerns are *seen* as being addressed.

6.7.3 Responsibility and trust

The findings from the survey reflect the European Commission's stance that "*everyone is responsible"* (European Union, 2012), in that nearly all the stakeholders listed were perceived as responsible, to some extent, for animal health and welfare. Stakeholders at the production end of the animal supply chain were viewed as most responsible for animal welfare e.g. farmers and veterinarians, along with animal health and welfare organisations. Conversely, stakeholders at the other end of the supply chain, including consumers and the public, were consistently viewed as least responsible for ensuring animal health and welfare. This could have implications for policy or market based interventions to improve animal health and welfare, such as higher product prices or taxes, as consumers and citizens may not perceive that it is their role to bear these costs, and this is supported by this being the least preferred mechanism for how the higher costs of WFP and higher welfare production systems should be implemented, with government, food manufacturers, food retailers and farmers all being viewed as stakeholders who should bear the costs of higher welfare systems. This lack of perceived responsibility by citizens and especially consumers is important from a market perspective, as it implies that markets for WFP may be niche. Therefore, failure to get the balance between supply and demand right will have implications for market failure of higher welfare products (*inter alia* Harvey and Hubbard, 2013a; 2013b for a more in-depth discussion). It is these sub-optimal outcomes, along with the private and public good benefits good FAW offers (Lusk and Norwood, 2011; Bennett *et al*, 2012), highlights the need for regulatory and policy actions (McVittie *et al*, 2006). This mixture of benefits also makes FAW particularly challenging from a policy perspective (Bennett *et al*, 2012).

Despite the European Union having some of the most stringent animal health and welfare regulations globally, most groups of stakeholders were not trusted to provide information on these systems, with respondents being distrusting, or unsure of trusting, most stakeholders listed in the survey. Organizations *independent* of the animal production process were viewed as more trusted by respondents (but still not trusted) to provide information. These were animal health, welfare and consumer organisations, quality assurance schemes, and governing bodies. This indicates that it is important to have independent third-party stakeholders and systems in place to provide assurance to both consumers and the wider public as to how the food they consume is being produced, and the integrity of the standards used to guarantee this, especially as trust is a credence product attribute. Transparency of how this independent assurance is guaranteed, and communication of this, along with the subsequent results of the evaluations, is also important for helping to maintain public trust, with communication of industry good practice and compliance essential for demonstrating trust and goodwill.

These findings also have implications for the market based solutions offered as a means of ensuring the standards of WFP, such as certification schemes and associated labelling. Although different labelling mechanisms and assurance schemes offer guarantees, Lassoused and Hobbs (2015) found that brands were not enough to enhance consumer confidence in food safety alone, and findings from the consumer survey would seem to support this with the highest level of trust in stakeholders for information provision being those external to the food chain. External accreditation and assurance would therefore act as a guarantee and means of traceability for consumers, enabling them to have confidence in the product choices which they are making. This implies that co-ordinated communications from the whole food system are needed to improve public confidence, and that trust in the food supply. An accreditation scheme could not therefore not be implemented without agreement and involvement from all stakeholders.

The findings from the research presented here reflect several of the mediating factors identified in section 6.3.4, namely in relation to naturalness, the perceived level of control individuals have over the concerns raised, the unfamiliarity with the topic and the lack of consumer trust in stakeholders involved. In addition, the only experience or knowledge respondents are likely to have with animal disease is disease epidemics reported by the media, rather than production diseases, which may

increase the perceived risks and concerns. Actions to ensure that all supply chain actors are perceived as trustworthy is therefore vital in ensuring that perceived risks and concerns are reduced. Mechanisms for improving trust in the food industry include taking into consideration the identified concerns and the adoption of the more natural intervention measures, plus greater co-ordination and co-operation between all supply chain members. These mediating factors should therefore be taken into consideration by stakeholders, including policy makers, with policy interventions being designed to address public trust in the whole food system, rather than individual elements (Lassoused and Hobbs, 2015). Communication directly addressing the perceived concerns, risks and benefits are also important for improving trust. The identification and acknowledgement of public perceptions and attitudes associated with food related risks should therefore be taken into consideration so that communications can be tailored accordingly (de Jonge *et al*, 2008). This should also enable public scepticism in relation to certain issues to be addressed (Frewer and Salter, 2002) and will ultimately act to foster and improve public trust and confidence in stakeholders along the supply chain, and in the safety of food (Frewer *et al*, 2004).

6.7.4 Communication

It has been widely reported that the public lack information about animal production and more intensive animal production systems in particular (Duffy *et al*, 2005), and it would appear that this unfamiliarity and lack of knowledge has not changed in recent years. This unfamiliarity extends to holding several misconceptions about intensive animal production systems, including the slower treatment of diseases. There is either not currently enough information readily available, or (more likely) current messages seem to be not reaching their intended targets. Indeed, Duffy *et al* (2005) discuss whether, in fact, the public are not the intended audience for most industry messages about food production. Rather these messages are aimed at other stakeholders, such as the government and other decision makers. This lack of knowledge, together with potential misconceptions held by the public in relation to animal production in general and intensive animal production in particular, indicates disconnection of modern agriculture from its consumers, with the consequence that animal products of the food chain are far removed from the original animals from which these products were developed. This also ties in with findings in relation to behavioural intention with the consumer survey results indicating that respondents to

not perceive themselves as already purchasing products from intensive production systems, or as responsible for ensuring animal health and welfare. These two questions, as well as those regarding who should be financially responsible for bearing the costs of measures to reduce production diseases, partly suggest that the public do not always think logically, but rather focus on their private incentives or information gaps. For instance, although increased taxes was the least preferred mechanisms for all countries to fund additional measures to reduce production diseases, subsidies and public funding for the measures were widely accepted, indicating they perceive responsibility to lie elsewhere. However, this may imply raising additional funds, for example using taxation.

Given the lack of familiarity respondents reported in relation to intensive animal production systems, more therefore needs to be done to ensure communications are reaching the public, as well as other stakeholders involved in the supply chain. It is unlikely that increased transparency in the regulatory process itself will improve trust (Frewer, 2004), rather should be examining what factors are considered to be best practice by the public (van Kleef *et al,* 2007). This ties in with the more proactive approach to risk management (van Kleef *et al,* 2007), with it being perceived as better to focus more on current practice rather than looking back onto events that have been managed well (White and Eiser, 2005). This also advocates a continual strive for improvement, rather than complacency, promoting dissemination of information about the proactive approach taken by regulatory agencies (van Kleef *et al,* 2007), which again acts to increase public trust in stakeholders including policy makers. Involvement with the more trusted independent assurance systems is also likely to promote the improvement of trust through communication. Therefore, communication should focus on which factors are being addressed and proactively managed, and what steps are being done to protect against potential risks (van Kleef *et al,* 2007)

Existing communication has predominantly been in relation to disease epidemics or crisis therefore has been more reactive in nature. Given the wider associations or higher welfare, with product quality and safety, adopting a more proactive stance, including the incorporation of two-way communication is therefore an important change in how stakeholders are communicating with the public, and more research should be undertaken to investigate mechanisms for achieving this.

Whilst providing information to the public is likely to improve trust it is also important to acknowledge that several dissonance strategies were adopted by consumers to enable them to continue with animal product consumption, including not wanting to think about where the products had come from and convincing themselves that the control of welfare is out of their hands. This latter point also aligns with the lack of perceived responsibility of the public and consumers for animal health and welfare. It would be useful to conduct more research to establish the right balance of information to convey to the public and interested stakeholders, including the medium and volume of information preferred.

The SEM indicated that information surrounding risks, benefits and concerns influences attitudes, and subsequently pro-consumption behaviour of products from intensive animal production systems, with the perceived risks identified in the survey having a slightly smaller effect on attitude than the perceived benefits. This is the opposite of findings from the risk-benefit literature with the perceived risks of a given hazard known to outweigh the perceived benefits offered (Ajzen, 1991), and these should be taken into consideration to develop more effective risk-benfit communication strategies (Fife-Schaw and Rowe, 1996). This also suggests that the benefits of intensive animal production systems should be communicated, in particular in relation to the affordability and availability of the products on offer. Communicating information surrounding intensive animal production, more specifically information to address the perceived concerns and risks, would therefore appear to be a way to improve attitudes towards intensive animal production systems. The SEM demonstrated that concern has a positive effect on both perceived risks and perceived benefits. Although this latter result does initially seem surprising, given that the perceived benefits included in the factor are in relation to the cost-effectiveness, price of animal products and protection from predators and climatic conditions, then it is logical that the restrictions applied to intensive animal production systems will lead to these perceived benefits.

As FAW and food safety are applicable along the food value chain, the involvement by several different stakeholders with communication activities is important for consumer trust, assuming they provide the same messaging, especially as results of the survey highlighted that all listed stakeholders (bar consumers and the public) were responsible for the animals' health and welfare.

6.7.5 Between animal type and country differences

Similar results were obtained for each of the three-animal types from the analysis, although slight differences in the degree to which some of the attitudinal, trust and responsibility items were established. This could be due to the amount of press attention given to the three animal types included in the survey, and the level of consumption of each of the three products. More research should therefore be conducted to establish whether these similarities hold for animals in other intensive or slightly more extensive production systems, such as beef cattle and dairy cows, and what differences in perceptions and attitudes are held by the public too.

Analysis of the survey, including the SEM, indicated that there were differences between the five different countries in terms of the concerns, risks and benefits of intensive animal production systems. Even within the EU, different countries have different socio-cultural contexts, which are well known to affect perceptions of risks and benefits (Frewer and Salter, 2002). The differences established by the SEM indicate that national governments may have to further consider what is and is not acceptable at a country level, to ensure that communications are tailored accordingly. This also includes establishing the specific risks, benefits and concerns of intensive animal production systems within each country.

The results support the the importance of communicating risk and benefit information in European communications, whilst focusing on concerns at national policy and communication levels. The finding that risk information needs to be customised across EU nations is not new (van Kleef *et al,* 2007), and highlights the importance of ensuring that national policy makers have in adopting and translating EU policy into country specific legislation and practices. It also reflects the different ways in which EU policy has been incorporated into national legislation, with known differences in welfare standards already known to exist (Spoolder *et al,* 2011). Given the wider implications of decreased trust, and the associations that consumers hold between welfare practices and other product attributes such as food safety and quality (Harper and Henson, 2001; chapter 3), it is essential to address these concerns at a country level, highlighting the steps being undertaken or that have been taken to address these.

The results suggest that there are some differences between the countries and production systems in how acceptable various interventions are accepted. In addition, countries tended to have differing view on how likely the interventions were

thought to be adopted, the Germans tending to be the most pessimistic regarding the adoption. Despite the diversity in perceptions across Europe there are still several general points that can be taken from the survey and the SEM, as discussed in the previous subsections of the discussion. These include the positive relationship between attitude and behaviour, and the relationships between perceived risks, perceived benefits and attitude, and can be acknowledged and adopted into more *de minimis* standards and practices.

6.8 Limitations

A limitation of the online survey methodology used is that it may disadvantage certain population groups from participating in the survey. This is reflected in the results presented in Appendix S whereby the older age categories across each of the five countries included within the analysis are less than national averages. In some countries the proportion of respondents with a university degree is fairly high and there is also some variation between the three samples in the socio-demographic parameters of the samples. Although underrepresented groups could have been targeted by other means, such as by face-to-face, or by telephone interviewing, this was not feasible due to the resources of the project. Despite this age group being underrepresented, the findings presented here are still of value, with the perceived risks, benefits and concerns likely to be perceived by the older age groups too.

In preparation for the analysis, responses obtained in an ordinal scale (Likert scale) were transformed to an index ranging from one to five. The index described the overall situation on each question fairly well. However, this approach also assumed that the scale between each category was linear. An option to this would have been to represent frequencies for all questions and categories of response.

As with all EFA and SEM analysis, there is a need to acknowledge that there could be multiple equivalent factor and model solutions that exist and this could well be the case with the information provided within this research. In other disciplines, such as ecology, model averaging is used to reduce the uncertainty surrounding model selection, and this is something that could be explored with future research, including additional analysis to this data set. Measurement invariance was not achieved in the MSEM across countries. Further analysis could be conducted to explore these differences further. Despite this limitation, the model constructed was based on theoretical and evidence-based decisions, and has reasonable goodness of fit

measures. In addition, the findings from the model supported by the descriptive analysis of the results and have been interpreted more generally, to enable any uncertainty to be taken into consideration.

6.9 Summary of recommendations

6.9.1 Consumer preferred interventions

- Natural and proactive interventions were preferred which primarily involved changes to housing, housing-related management and hygiene practices
- The use of more reactive and treatment-based interventions were viewed as less acceptable. These should not be used unless necessary. Reassurance about food safety and human health should be provided when these are used
- The use of interventions needs to be justified to the consumers as they are not well aware of modern production practices.
- Although not the most preferred intervention, providing farmers with a price premium that encourages enhanced animal health can be part of the solution. This may provide some room for market-based animal health schemes.

6.9.2 Communication

- Stakeholders need to be more proactive in terms of the information they are providing to the public. Measures to improve this could include the use of company websites to convey information to those who wish to proactively seek it out, and press releases of more important information, such as good practice stories.
- The public are heterogeneous. A proportion of consumers do not have a clear view on preferred interventions. However, future consumers and non-consumers do not necessarily have largely differing views regarding the acceptability of interventions. However, they may require different ways of communication.
- Greater supply chain co-ordination and co-operation should be used to ensure that all stakeholders are working together to support each other and convey the same message to the public. This greater co-operation may help to improve public trust.
- Independent assurance is important and stakeholders should be identified who could carry out this role. This assurance could be conveyed on product

packaging e.g. labelling, but also more widely on company and retailer websites.

- Case studies/ practice changes that would create public good will should be identified and communicated to highlight how the industry is responding to societal concerns.

6.10 Summary

This chapter looked to explore European public attitudes towards intensive animal production systems and interventions targeted at preventing and treating production diseases in intensive pig and poultry systems. Results of the survey of five European countries highlighted that the public have concerns over intensive production systems, including in relation to the FAW, naturalness and the use of AMR. The most preferred interventions across all three animal types surveyed were those that can be viewed as most proactive, namely housing and hygiene measures, with the least preferred interventions relating to the main concerns and risks identified, namely medicine based interventions that raised both humane animal care and food safety concerns. Results of the survey also highlight the influence of the identified concerns, perceived risks and benefits on attitudes and subsequent behavioural intention, and the importance of including these in subsequent communications with the public.

Chapter 7 will draw the key findings from the entirety of the thesis, disussing the main theoretical, policy-based and methodological implications of the research undertaken and discussing recommendations for future research.

Chapter 7. General Discussion

7.1 Introduction

The sustainable intensification of animal production systems is increasing in many parts of the world as a consequence of increased demand for foods derived from animals. As such, it can be argued that sustainable intensification contributes to improved food security (Compassion in World Farming and World Society for the Protection of Animals, 2012; High Level Panel of Experts on Food Security and Nutrition, 2016). At the same time, increased intensification in animal production systems may result in increased susceptibility to, and associated greater impacts from, production diseases (Steinfeld, 2004). Increased incidence of animal disease can negatively impact on FAW, and, in addition, may have negative economic impacts on primary producers and other actors in the supply chain (Niemi *et al,* 2015). Animal production, and intensive animal production in particular, is a sensitive topic in the eyes of the public, raising concerns in relation to both animal health and (chapter 6). Given the above, it is also important to assess whether interventions used to treat production diseases are acceptable or unacceptable. This chapter draws together the findings from the two systematic reviews, assessment of publication bias and the consumer survey, discussing the results in the context of their wider theoretical, policy and methodological implications. In addition, the limitations of evidence synthesis are discussed, and the need for primary data collection also considered, along with methodological and theoretical implications of the research, and together with the recognition of research gaps and corresponding suggestions for future research activities.

7.2 Implications of the research

Table 7.1 contains an overview of the action points and recommendations arising from this thesis including recommendations for future research, and potential barriers and facilitators to achieving these. These have been grouped into three categories, theory, policy and methods, and each will be discussed in more detail in the corresponding subsequent sections.

Key finding	Chapter(s)	Rationale	Recommendation
Theory			
Variation in attitudes, and how attitude relates to behavioural intention	3, 4 and 6	Attitudes varied both within and between countries, and did necessarily translate into behaviour. Research was typically focused in affluent countries in the global North.	Future research should look to further explore variation in the data and how this relates to the attitude-behaviour relationship, including examining potential moderators of the data. More research should be conducted within less affluent countries located in the global south where intensive animal production is increasing. This research may also be relevant to understanding differential application of export standards.
Attitudinal uncertainty	3 and 6	Attitudinal uncertainty, was identified in relation to FAW and production diseases was identified.	Further exploration of this uncertainty in relation to attitude and how this relates to behaviour should be undertaken. This includes investigating whether attitudinal ambivalence is present. The effect of communications surrounding interventions and intensive production systems in relation to this uncertainty should also be considered.
Communication	3 and 6	Concern, perceived risks and benefits were all shown to influence attitudes and subsequently behaviour.	Communication should focus on consumer concerns as well as actual risk estimates.
Prioritisation of product attributes	3 and 6	FAW was not a priority concern for most individuals, with food safety, price and quality all being of higher importance. These attributes were however, linked to FAW, with higher welfare products viewed as safer and higher quality.	Given the associations between FAW, food safety and human health, care should be taken to address public concerns and perceived risks held by consumers in these systems.
Policy			
A combination of policy and market-based solutions are needed	3,4 and 6	Given the diversity of preferences and attitudes neither legislative nor market based solutions alone will address all the public concerns or preferences.	Legislation should be used to set *de minimis* standards of welfare with regulated market-based solutions offering more WFP.

		Given the importance of socio-demographic variables in predicting WTP, segmentation can occur based on preferences for WFP.	Given the ability to segment the market, producers should be able to tailor their products and communication accordingly.
More proactive disease mitigation strategies should be implemented	6	More proactive intervention strategies were preferred by most consumers, based on strategies to change housing and improve hygiene. This ties in with the key aspects of FAW, naturalness and humane treatment.	Disease prevention measures should focus on hygiene and housing strategies, such as changes to stocking density, with medication based interventions only used as a last resort.
Attitudes should be monitored to ensure acceptable *de minimis* standards	3, 4 and 6	Attitudes are likely to change over time, including in relation to the alternative production systems available at the time of questioning.	More proactive measures should be introduced to engage the public in conversations surrounding FAW to enable concerns to be monitored. Standardised mechanisms and measures should be used to do this to enable attitudes to be tracked over time and compared across regions.
Communication and transparency of production practices is important for ensuring trust	3 and 6	The public, including consumers, are unfamiliar with modern farming practices, and subsequently misconceptions exist. Availability and ease of identification of higher welfare products were all identified as issues by consumers? Messages come from a variety of sources and so stakeholders should be proactive in their communication.	All stakeholders should be more proactive in displaying information on FAW and production systems, appearing to be more transparent in the processes and procedures used.
Supply chain co-operation and co-ordination	6	Multiple stakeholders were viewed as being responsible for animal health and welfare, including farmers, animal breeding companies and slaughterhouses.	Communication to the public and consumers by all stakeholders within the supply chain should be consistent, to demonstrate collective responsibility. Support from external, independent organisations, may be needed to achieve this.
Trade	3, 4 and 6	Globally, different *de minimis* standards of production exist and this has implications for European imports and exports, and the level of consumer concern.	Care should be taken to protect European products from cheaper imports, whilst also ensuring that production systems in developing countries are supported to improve production systems. Within this, sufficient procedures should

			be in place to ensure the traceability and subsequent authenticity to consumers, and this should be communicated accordingly. More research is needed to understand the ethical considerations across different cultures, and transboundary risks such as AMR.
AMR	3, 4 and 6	AMR and the use of antimicrobials were identified as a concern, and the public were WTP to avoid products from animals.	Antimicrobials should be used responsibly in animal production, and this should be a global effort. Future research should look to address the possibilities and consequences of antimicrobial free production, and how the use can be restricted to effective disease treatment. Best practice within the industry should be communicated to demonstrate the leading role being played by European stakeholders.
Methods			
Lack of best practice in systematic review in the consumer sciences	3, 4 and 5	There is no single set of best practice guidelines for systematic review in social science, with several different sets of guidance in existence.	A more centralised point of advice on good practice should be established and this should be consulted by researchers prior to a review starting.
High risk of bias was reported in several studies in both reviews	3 and 4	Many studies did not report sufficient information to enable quality assessments to be made.	More information on study design should be included in publications, including incorporating this into journal guidelines, or being made available as supplementary material. Publication of primary data should also be encouraged providing confidentiality of sensitive information is assured.
Publication bias is a problem in economics research	4 and 5	Findings from the WTP review indicated that publication bias was present in the data. When adjusted for the average WTP decreased.	This should be tested for as part of a quality of evidence assessment. Study pre-registration should also be encouraged
Benefits of conducting quantitative and qualitative reviews	3, 4, 5 and 6	Results of the qualitative and quantitative reviews helped to explain each other and brought an additional element to the findings.	Future systematic reviews of the literature should include both a qualitative and a quantitative component.

Table 7.1 Summary of recommendations made throughout the thesis

7.3 Theoretical implications

7.3.1 Attitude-behaviour gap

Every day, consumers potentially make different decisions regarding food they purchase and consume, potentially subconsciously as a trade-off between a number of different attributes and factors (Ueland *et al,* 2012). At the same time, other factors may influence consumer food choices in relation to animal products, and in fact be a higher priority. Attitudes and preferences towards different foods are complex (Shephard and Sparks, 1994; Bellisle, 2006), and are influenced by different factors including, potentially, a sensory component, an affective component, a cognitive component, a behavioural component (Knox, 2000 in Costell *et al,* 2010), and habit (Grunert, 2005), depending on the context of the decision. In addition, the distinction between citizens and consumers is well acknowledged in the literature (Harper and Henson, 2001; Grunert, 2006), and individuals may have different attitudes and behaviours depending on whether they are acting in their role as a citizen or a consumer (section 3.5.3), reporting a high level of concern about modern production systems in their role as citizens yet having other priorities when it comes to purchasing animal-based products. It is therefore, unsurprising that the level of concern identified from the two reviews, and reported in the consumer survey, does not match up to consumers indicated behavioural intention.

Another reason for the observed attitude-behaviour gap may be insufficient attitude activation, either through having weak attitudes in the first instance or by these being insufficiently activated (Fazio *et al,* 1986) at the point of purchase. The latter could be due to not being able to identify higher welfare products, either through lack of choice, or insufficient product labelling, both of which were identified as barriers to purchase in chapter 3. In order to *tap the potential* of these higher welfare systems (Grunert, 2006), adopting a transparent and consistent labelling scheme to aid in identification would be beneficial, as could displaying production information at the point of purchase. The attitude-behaviour gap observed in both reviews and the consumer survey could also be due to several factors, including the citizen-consumer duality (as discussed in chapter 3), and it not being a typical point of thought, especially in relation to production diseases. The citizen-consumer duality also emphasises that more research should be done to better understand the situations whereby individuals act in these different roles.

In addition to the subconscious barriers to purchasing higher welfare products, several conscious barriers to purchasing higher welfare products have also been proposed (Harper and Henson, 2001), such as lack of information, perceived influence and costs and that consumers may not actually view themselves as responsible for FAW and health (Grunert, 2006). There is also a growing disconnection between animal products and the animals that produce them i.e. the public are becoming further distanced from more modern or industrial animal production (Spooner *et al,* 2014). Several of these barriers identified in chapter 3 may also help to further explain why the attitude-behaviour gap exists. First, one potential explanation of this might be that whilst individuals may be motivated to purchase WFP, they may not necessarily have the means to do so with WFP perceived as comparatively expensive compared to more intensively produced products. This lack of ability of individuals to express their preferences could evoke cognitive dissonance amongst consumers, if they are unable to express their preferred choices. Boogaard *et al* (2011) also report that whilst the public indicate that they are concerned, they also acknowledge that their current behaviours are supporting the current production systems in place, with this again also likely evoke cognitive dissonance. Given the negative cognitive and affective implications that this may have on individuals, they are likely to adopt one of two mechanisms to deal with this (Ong *et al,* 2017); either confronting the considerations and changing their intentions to purchase to purchase intensively produced products, or more likely, having a confirmatory bias that enables them to continue with animal product consumption. This latter approach ties in with findings from chapter 3, and the coping mechanisms used to continue with animal product consumption.

7.3.2 Attitudinal uncertainty

There is also evidence to suggest an increasing attitudinal uncertainty, or weak strength of attitude, towards modern farming by consumers (Boogaard *et al*, 2006), and increased disassociation between production and consumption in terms of consumer attitudes (Harper and Henson, 2001), with animal-based food products far removed from the animals that they originate from. This could be due to attudinal ambivalence, although this was not explicitly measured in this research. Attitudinal-ambivalence has already been demonstrated in relation to meat consumption in a study by Povey *et al* (2001), with the attitude-ambivalence interaction being the strongest predictor intention to eat meat. This attitudinal ambivalence also ties in with

the dissonance reducing strategies identified in chapter 3, including not wanting to think about how the animal products they are consuming have been produced to reduce feelings of guilt (Plous, 2013).

Another means to consider the attitude-behaviour gap would be to study moral self-regulatory processes, such as moral disengagement and meat attachment (Graça e*t al,* 2016), which may prevent individuals from fully expressing their preferences as they may not wish to think about the ethical and moral implications of their dietary practices to enable them to continue with meat consumption, again similar to the dissonance reducing strategies identified in chapter 3, also known as the meat paradox (Loughnan *et al*, 2014). This can apply at the point of purchase and consumption. It should be noted that given that there is a clear market for higher welfare products, albeit a niche one, these dissonance reducing strategies, including moral disengagement, do not occur for all individuals. Therefore, future research should focus on developing a greater understanding of the attitudinal processes underlying individuals that do and do not have cognitive dissonance, to enable more effective communications to be developed.

Utilising these different approaches to understand the dissonance reducing activities, including more information on the disengagement mechanisms used to enable self-serving behaviours (Bandura, 1999), such as meat consumption, will provide a greater understanding individual decision making processes, which subsequently could be used to create more targeted communications (i.e. by created different segments) in relation to addressing concerns and perceived risks to reduce dissonance in the first instance, and also to change behaviour i.e. reduction of meat consumption for more sustainable diets. As a reluctance to change diets in relation to meat consumptions has already been identified in relation to environmental impacts (MacDiarmid *et al,* 2016), understanding behavioural intention in more detail in relation to FAW may provide further insights into any barriers and facilitators to changing behaviour, with a reduction in meat consumption thought to be an important part of a sustainable diet (Food and Agriculture Organization of the United Nations, 2010).

7.3.3 Systematic variations in attitudes

Several theoretical implications of the research can be considered that enable a greater understanding of attitude formation and behavioural intention in relation to

FAW and production diseases as described above. These can subsequently be used to design and implement better policy and market based solutions, in addition to ensuring that communications from all stakeholders are designed to be as relevant and as effective as possible.

This research has demonstrated considerable variations in public perceptions and behaviours in relation to intensive animal production systems and FAW, with a range of preferences expressed both when questioned about FAW and when asked to indicate their behavioural intention, either through expressing their WTP or when results of the surveys were analysed. These variations highlight that the TPB does not fully predict behavioural intention in this instance, with it is also important to acknowledge that attitude only predicted a small amount of behavioural intention in the context indicating that the TPB does have limitations when it comes to predicting public behaviours in relation to FAW. This lack of predictive power for the model also indicates that it may well be beneficial to view this through attitudes to FAW, and production diseases, through several different perspectives and frameworks, to help explain some of the attitudinal variation, and also why the attitudes held by individuals in relation to FAW and intensive animal production systems do not always translate into behaviour. Within this is the need to consider the theory in a much broader context, including across a range of different eating and purchasing situations, including in relation to the attitudinal ambivalence and moral self-regulation lenses.

Vranken *et al* (2014) identify that several economic and social instruments are required to change meat consumption levels. As consumption of meat is a highly routinized practice attachment (Graça e*t al,* 2016), undertaking more qualitative research to understand the mechanisms behind this is important and would enable interventions to change behaviour, to be tailored to address the core underlying motivations identified (Graça e*t al,* 2016). As animal based products play a central role in more Westernised diets, and is becoming increasingly important in diets of those in developing countries, research should be undertaken across a range of countries to understand any similar or differentiating cultural factors and values held which have often been overlooked in existing research (Mcdiarmid *et al,* 2016). For example, local traditional farming practices in developing regions may be very different to more modern methods of farming in Westernised regions, and would be

insightful to study and compare perceptions of these against more intensive methods which may become more common in these regions in the future.

Despite the variation in attitudes observed there are several more general themes and concerns raised by both the systematic reviews and the survey and these should be encompassed within policy, as discusses in section 7.4. The variability in attitudes and behavioural intention observed throughout the research also supports the use of a portfolio policy response and market-based solutions to ensure the most optimal strategy for meeting societal preferences going forward, with legislation and regulation used to achieve *de minimis* and market-based options used to offer higher welfare products. Future research should also be conducted to better understand attitudes and why this variability exists in the first instance, including by qualitative means in order to gain a better understanding of consumption behaviours. Different theoretical perspectives could also be incorporated to build up a more holistic view about how individuals practices and socio-cultural contexts shape their attitudes towards animal production systems, the management practices used within these, and in relation to whether attitudinal ambivalence can be detected.

7.4 Policy implications

7.4.1 Process of translation of evidence into policy

Several findings in relation to policy were obtained from the reviews and consumer survey and as highlighted in table 7.1. Consideration also needs to be given to the process of the translation of the evidence obtained here into policy, and subsequently then into policy practice, and within this there is a need to ensure that public perceptions are also taken into consideration to ensure acceptable *de minimis* FAW and intervention standards are in place that align with the values, needs and expectations of society (Asveld *et al*, 2015). Failure to consider societal attitudes and concerns is thought to threaten the legitimacy of the associated regulatory frameworks and regulatory agencies (Frewer *et al,* 2004).

Whilst this may be more straightforward at national policy level, where societal concerns can be surveyed and incorporated into national policy, this process becomes more complex at a supra-national level, such as within the EU, or as part of WTO standards. Results of the survey indicate variation both within and between the five European Counties selected and this has implications for supra-national legislation, especially globally where preferences may become more diverse, or may

be unknown. This has implications for ensuring that *de minimis* standards are acceptable, especially from a trade perspective (see section 7.4.2) enabling freedom of choice for consumers and ensuring that producers are also not priced out of the market by higher standards that would not be cost-effective to implement. It also further emphasises the role national policy has to play in ensuring acceptable practices are in place for its citizens, including the setting of *de minimis* standards, labelling, education and communication.

There is also the consideration that the introduction of *de minimis* welfare standards at a level that would price both consumers and producers out of the market may not be a bad thing, with reduced consumption of animal products, in particular meat, believed to have beneficial effects on human health (World Health Organization, 2009), and also beneficial effects on sustainability due to reduced emissions and pressure on resources such as water and grain, used for feed (Bruinsma, 2003; Steinfeld, 2004). However, given the lack of support for changing dietary practices based on sustainability (MacDiarmid *et al,* 2016), and given only a small decline in meat consumption, primarily for health reasons in more Westernised countries, this is unlikely to widely supported. Therefore, care needs to be taken to ensure that when price increases do occur as a result of any changes to FAW standards or diseases intervention measures, are kept within a reasonable price boundary.

Considerations of how best to incorporate the evidence presented into policy are also important as is the need to consider FAW as a policy objective in relation to other policy objectives such as food security and the sustainable intensification of production (Steinfeld, 2004; Foresight, 2011; Godfray and Garnett, 2014), with any changes to production systems looking to address these will have implications for FAW. Given the interlinkages that intensive animal production systems have with policy objectives aside of FAW, it is important to bear these in mind when considering legislation changes, including in relation to food safety, healthiness and quality concerns (Harper and Henson, 2001), especially as the results of the survey (chapter 6) indicated that these are inextricably linked.

There is a need to ensure that FAW standards and regulations are continually meeting public preferences, and as these are likely to continue to change (Mann, 2005) and be of great public concern (Mason, 2016), with the evaluation of production systems dependent on the alternatives available at the time, indicating that their acceptability, may change as time progresses (Bennett *et al,* 2012). Thus,

what was acceptable previously or is acceptable now may become unacceptable in the future (Brambell Report, 1965) i.e. the sustainability and acceptability of an animal production system needs to be considered over space and time (Broom, 2014). For example, within Europe there are currently several alternatives to intensive animal production systems available to consumers, such as organic, free-range, and higher welfare labelled produce (e.g. Freedom Foods in the UK), all of which have different implications for animal experience, and are becoming more widely publicised. Producers of these systems are generally more proactive in terms of communicating the benefits that these systems offer, especially compared to stakeholders involved in more intensive animal production systems, reflecting the higher concern and motivation their customers are likely to have to find out more information about their products.

Thus, it is important to continually assess public attitudes to FAW, intensive production systems and related interventions designed to address production diseases have changed over time, to establish potential criteria that may facilitate or hinder the adoption of subsequent interventions and innovations. It is also thought that awareness of the alternative production systems may affect public perception of any existing practices. It is therefore important to ensure that more formalised links between legislation and public perceptions, attitudes and priorities, as long as not detrimental to FAW[10], should be developed to foster more acceptable *de minimis* standards, that have continually taken societal concerns into consideration. Although it is not always feasible to achieve this on a continuous basis, mechanisms to foster two-way communication, and for the public to voice their concerns in a medium and format that stakeholders can access, could be done on a more regular basis by utilising forms of online participation, such as digital and social media. Having a transparent and readily accessible means of doing so is also important from the perspective of the public, meaning that the public can also proactively seek out information to allay and voice their concerns.

Given the subjectivity of FAW assessment, a combination of both legislative and market based options would appear to offer the most viable, flexible and responsive

[10] It is feasible to think that consumers may want cheaper food products, which could lead to negative FAW and health implications given the systems they are likely to be produced in. The use of these systems is also likely to have negative environmental impacts. Ensuring FAW and health from the perspective of the animal is important, and the use of standards below what is objectively deemed as acceptable should not be used despite the cheaper products they offer.

means of addressing societal concerns and needs, offering a means those with the highest concern a means to express their preferences above the minimum legislative standards implemented (and without having to restrict their diets), whilst also addressing concerns of non-purchasers and ensuring that the freedom of choice for individuals is preserved, with overly stringent FAW legislation having the potential to diminish market freedom (Mann, 2005).

Whilst market players with private (and higher) welfare standards can respond and adapt to these needs and concerns (Buller, 2010), regulation can address any aspects of animal production that the market cannot or will not address, such as areas that the market cannot gain any degree of competitive advantage (Buller, 2010), or where it is in the wider public benefit to ensure that regulations are in place. For example, it is in the public interest to ban the use of certain antimicrobials within animal production, and potentially restrict their use further, given the transboundary risk that AMR poses. Market based solutions may not be able to account for this, given the changes in costs and processes that may occur, meaning that additional support such as subsidies may need to be put in place.

Central to the use of market based solutions is being able to identify, and importantly anticipate, these concerns and needs in the first instance, and subsequently being able to link the supply up with the demand to ensure that those who would like to be able to purchase WFP are able to do so (McVittie *et al,* 2006). Communication is central to this, and ties in with several barriers have been suggested including labelling may not help to fully solve issues. Greater transparency is therefore important in showing how production standards between products are different, and how decisions over what concerns have been incorporated into *de minimis* standards have been made, and what exactly they involve, so as to enable informed choice

7.4.2 Trade considerations

European directives are devised to provide a level playing field within the European Union to sustain economic activity that drives the treatment of welfare (Blandford *et al,* 2002; European Union, 2012), and as such is included within European trade agreements within the EU. Member states incorporate these directives into legislation at a national level ensuring that their own legislation meets the minimum standards laid out (European Union, 2016), with some national governments choosing exceed the minimum standards set for the EU such as the UK, Sweden

There are, however, concerns over about international trade and the effect that different *de minimis* standards of welfare have on imports and exports and Norway (Bock and van Huik, 2007; Spoolder *et al,* 2011). Non-European countries have also raised their standards to protect their export markets to Europe, such as the introduction of the Animal Welfare Act in New Zealand in 1999 for meat and livestock (Blandford *et al,* 2002). Thus FAW is playing an increasingly important role in international trade and policy (Bayvel, 2004 in Croney *et al,* 2015). For example, developing countries are increasing, and are looking to further increase, their exports of animal based products, especially meat (Alexandratos and Bruinsma, 2012). For example, Brazil is now the largest exporter of meat (Alexandratos *et al*, 2006). Whilst this offers economic development opportunities to low and middle income countries, it is acknowledged that animal welfare conditions vary across countries and production systems (High Level Panel of Experts on Food Security and Nutrition, 2016). This disparity in welfare conditions in these countries and the more established export markets could limit trade opportunities, or create public concern if imported into different markets. For example, in some instances the cost of compliance with high FAW stands could reduce profitability and mean producers are non- competitive resulting in a loss of market share to cheaper, lower standard imports in regions where FAW standards are lowest compared to EU legislation (Collins and Wall, 2004; Lusk and Norwood, 2011). Conversely, if welfare standards are increased, and restrictions are put on the interventions used either to enable them to meet public preferences or broader public health concerns e.g. AMR, this will have implications for trade, especially for developing nations who wish to export their products where their standards may not even meet the European standards currently in place. It is also worth considering the potential public health implications of this, including from an AMR perspective, especially as the regions which could still benefit from increasing their animal product consumption are also the regions where an increase in production is not occurring (Alexandratos *et al*, 2006) e.g. sub-Saharan Africa. In regions where intensive animal production is increasing, such as South-East Asia and South America, the introduction of higher standards may also have the impact of reducing or preventing the use of important antimicrobials, and more environmentally friendly production measures.

Legislation is also needs to ensure that European producers are protected from imports from outside the European Economic Area (McGlone, 2001) which may not

have been produced to as high a welfare standard and so could be sold at a much lower price. This would also apply to European regions with higher than *de minimis* standards of welfare in their national legislations, where lower priced animal products from other European countries could be imported. If policy cannot protect producers from this trade issue, then products should be regulated so that they are labelled and communicated accordingly, so that consumers can make informed purchase decisions. In addition, the recent *Brexit* vote by the UK has implications for ensuring that European minimum standards are maintained to enable trade between European countries to continue but also that consumers are protected from lower welfare imports, given that the UK may not necessarily be bound by European trading regulations, and associated product standards. The importance of animal health and production diseases within this especially for intensive animal production systems which generate concerns. Respecting and protecting UK consumer preferences is therefore important within these trade negotiations and regulations. For example, the use of growth promoters was a concern for UK respondents (and respondents across all countries surveyed), therefore widening of the import market for the UK to allow animal products from countries where this is still permitted, such as the USA, could have negative consequences for public trust in government. Looking to develop a centralised evidence-base from which to draw *de minimis* standards from, including consumer perceptions in addition to more objective animal science based evidence, may help to reduce the gap in regulation between countries. Future research should therefore consider whether this is feasible, and should look to incorporate cross-country comparisons of multi-stakeholder attitudes and perceptions within this, including the public.

From a production disease perspective, proper management has implications for trade, and importance of welfare and the effect on product prices (e.g. milk industry; Food and Agriculture Organisation of the United Nations, 2011). For example, there are trade disputes between Europe and the US due to the ban on growth promoters (Steinfeld, 2004). Therefore, the adoption or restriction of different interventions that are acceptable in one region, may not be acceptable in others which could affect existing trade regulations.

This disparity in global FAW standards emphasises a need for a set of global minimum standards, with the acknowledgement that the emphasis on improving welfare standards may need to be occurring outside of Europe, rather than improving

them further within Europe. This has been acknowledged in the recent implementation of the International Organization for Standardization (ISO/DTS/34700) for supply chains and animal welfare management, directed at countries for which FAW in not defined in national legislation, and endorses the adoption of OIE welfare standards (High Level Panel of Experts on Food Security and Nutrition, 2016; World Organization for Animal Health, 2016). In addition, if the intensification of production is going to continue globally, then care needs to be taken to protect small to medium sized farmers in developing countries within these standards, where small scale farming is still more prevalent (Steinfeld, 2004).

It is also worth considering that Africa and Asia, the two regions where consumption is rising, and is predicted to rise the most, were also the two regions with the fewest studies in relation to public attitudes to FAW. Although this may be due to the language restrictions of the search results (i.e. only studies published in English were included), it could also be due to a lack of primary research in these regions in the first instance. It would seem pertinent to explore public attitudes within these countries, due to the different production systems used within these countries, and the shift towards intensive production that they are also experiencing, which may or may not be culturally acceptable to consumers within these regions given traditional means of production. In addition, due to the different climatic conditions, and subsequent disease challenges posed in these regions, research also needs to explore which production diseases interventions are most applicable and acceptable in these countries.

It is also worth considering that underpinning the assessments of good welfare, and subsequent policy decisions, are ethical judgements as to how farm animals should be treated (Johansson-Stenman, 2006; Broom, 2014), which are likely to vary considerably between and across countries and cultures, and may be influenced by opinion leaders within both of these. It is clear from the findings that, whilst there is a range of opinions on what is and is not acceptable, there are several common concerns across the regions that are the priorities. This includes the association between FAW, animal and human health and food safety. This also includes concerns over AMR, antimicrobial usage and naturalness (see chapters 3 and 6).

Considerations of a global ethical code of conduct, and whether the same *de minimis* and ethical standards will be relevant across the globe are therefore important. Given the current lack of research into areas outside of Europe, North America and

Australasia, it cannot be assumed that the same minimum standards will hold elsewhere, although there are likely to be some common factors. This also raises the question of whether Western ethics should be forced onto other societies through international standards.

7.5 Methodological recommendations

7.5.1 The benefit of evidence based methods

The research presented in this thesis demonstrates the benefit of using systematic review methodology prior to primary data collection, to identify research gaps and highlight points of interest to explore further, assuming primary research has been conducted in the research area under consideration to justify this approach. Both potentially help with the primary research design process and enable more directed and useful research to be conducted. This thesis has highlighted several methodological topics for further discussion, with the need to develop best practice within the field of social science, and the benefit of conducting parallel quantitative and qualitative systematic reviews being discussed further in the subsequent two sections.

7.5.2 Best practice in evidence based methods

The exact way in which systematic reviews should be conducted within the social sciences is still open to debate and numerous systematic approaches exist as highlighted in chapter 3, with a centralised guidance organisation and documentation lacking as compared to medicine (and the Cochrane Collaboration) and social science aspects (the Campbell Collaboration). By adopting a rigorous and transparent approach, and subsequently by ensuring good standards in the review protocol and review itself, the review results can be viewed as reliable enough to be used in a meaningful and useful way (Koricheva *et al*, 2013), to inform interested stakeholders or guide future research (Cooper and Hedges, 1994). In addition to meeting the criteria outlined in table 3.1, it is essential that current research synthesis practice, such as meta-analysis and systematic review, develop to be reflective of the diverse nature of the science discipline in question.

The application of systematic review and meta-analysis within social science, is not as straightforward as with other disciplines, with the methods and subsequently data obtained during social science research being far less structured compared to that within medicine (Davis *et al,* 2014), and normally incorporating both qualitative and

quantitative data. This results in a greater emphasis to examine heterogeneity within the data rather than to focus on the homogeneity of the responses obtained (Davis *et al,* 204), to enable the causal processes underlying the phenomenon of interest to be understood (Koricheva *et al*, 2013), which is essential in investigating topics such as attitudes.

Increasingly the more established guidance documents seek to incorporate qualitative information into the synthesis, reflecting the initial aim research synthesis of incorporating all available information. The nature of the qualitative systematic reviews and meta-analysis, and mixed-methods reviews has created much debate in the field of evidence based methods. Publications have been designed to help with this (Pettigrew and Roberts, 2008). However, they remain focused on healthcare settings, and greater work needs to be done in ensuring that existing guidance both within and from other disciplines is adapted for use within social science (Davis *et al,* 2014). In addition, researchers in different areas also have different views as to what counts as good quality, especially when there is a diverse array of studies and study designs that would be eligible for inclusion within a review, resulting in established critical appraisal documents not reflecting the nature of the studies likely to be included within a social science review.

Reflecting the infancy of the field (Gough *et al*, 2012), the development of more widely applicable and robust methods of synthesising this type of research, which meet the same rigorous standards as applied elsewhere, is therefore an important challenge (EPPI-Centre, 2009). The research presented here has attempted to touch upon some of these challenges, specifically transparent and structured protocols, critical appraisal and strength of evidence assessment, including the assessment of publication bias. The tools constructed and devised for use within this research are by no means a *gold standard,* but represent a considered approach at attempting to tackle several these issues, and demonstrate that systematic review and evidence synthesis within social science can be conducted rigorously, reliably and to a high standard.

Future research should seek to explore means of encouraging researchers within the social science domain to explore; pre-registration of research, including both primary research and research synthesis on platforms such as the centre for Open Science; the use of protocols that adhere to established standards such as PRISMA; assessment of study quality by use of critical appraisal and the assessment of

publication bias where relevant; and the exploration of both quantitative and qualitative research, the benefit of which is discussed in the following sub-section, and is of particular importance within social science research.

7.5.3 The benefit of conducting parallel reviews

Due to the inherent nature of the field, social science based disciplines pose the challenge of synthesising several epistemologically different research methods, underlined by different paradigms, theories and concepts (Gough, 2015), not to mention the additional problem of methodological diversity (Sandelowski *et al*, 2006), with often a combination of these, i.e. a mixed-methods approach, often used to address a specific research question. Therefore, the use of solely quantitative or qualitative evidence synthesis is unlikely to be suitable for addressing most research questions utilising systematic review methodology within the social science domain. In addition, a good WTP study should now also include a qualitative component to help explain the behaviour and WTP demonstrated by participants. Therefore, when conducting evidence-synthesis of the WTP literature, a meta-analysis alone will be insufficient in taking into consideration all the available information, and will fail to consider the context and rationale underpinning decision making in these contexts.

Evidence synthesis within the field therefore requires an approach reflective of the mixed-methods used within social science (Harden, 2010), and more suited to the complex nature of the research questions posed and approaches taken (Dixon-Woods *et al*, 2005). This will facilitate a more inclusive approach to evidence synthesis enabling more appropriate conclusions to be drawn and, and will ensure that results are more representative of the findings (Dixon-Woods *et al,* 2005).

Mixed-methods evidence synthesis offers an approach to enable social science research questions to be answered more relevantly (Harden, 2010), and may aid in maximising the interpretation of, and provision of more contextualised, research findings (Harden, 2010; Pearson *et al*, 2015). Evidence synthesis of mixed-methods research can take several approaches (Sandelowski *et al*, 2006; 2012; Pearson *et al,* 2015). Firstly, an integrated approach to evidence synthesis can be taken whereby qualitative and quantitative studies are integrated within the same analysis if data is similar enough to be included within the same synthesis questions are similar enough to be analysed together and assumed that address the same research questions. In addition, a segregated analysis could be undertaken whereby qualitative and

quantitative research are separated into two research streams which are analysed in parallel before being brought together into one combined analysis. Lastly, a Bayesian or transformative approach can be taken whereby one of the qualitative or quantitative data sets are pseudo-coded (transformed) into the other, to enable aggregation of findings using either meta-analysis or a form of narrative synthesis (Sandelowski *et al*, 2012). For a more in-depth discussion of mixed-methods reviews see *inter alia* Sandelowski *et al* (2006) or Pearson *et al* (2015).

Although methods development has been done to improve the robustness and transferability of evidence synthesis methods within consumer behaviour, and of mixed-methods reviews (Harden, 2010), and mixed-methods research, little attention has been paid to the potential benefits of conducting parallel qualitative and quantitative systematic reviews within social science, with the benefits of running parallel or complementary qualitative and quantitative systematic reviews rarely being discussed. This approach would be much more reflective of the inherent nature of the social science discipline. Although calls have been made previously to further use and explore mixed-methods reviews in a systematic process akin to that of meta-analysis or meta-ethnography (Pearson *et al*, 2015), these methods are still not commonly utilised, or have little awareness surrounding them.

The two reviews conducted within this thesis highlight the benefit of parallel review conduction, enabling the triangulation of results, in the sense that the results of one review could be checked to see whether the results of both reviews tell a coherent narrative of what the public think of farm animal welfare. Further insight into the results of the meta-analysis were also obtained from the qualitative synthesis, with several perceived barriers to the purchase of higher welfare products identified. These results were useful for helping to explain the results of the meta-analysis, in terms of the discrepancy between reported and actual WTP. In addition, they helped to explain some of the heterogeneity detected in the meta-analysis, and the underlying motivations underlying public behaviours, helping to generate a cohesive narrative surrounding the public and farm animal welfare.

Given the importance and interest in systematic review by the research community and other stakeholders, including policy makers, it would therefore seem worthwhile to explore the practicalities of conducting parallel reviews in future research, since this helped to maximise the results of the two reviews and aided in their ability to inform policy and practice (Pearson *et al,* 2015). The incorporation of quantitative and

qualitative evidence synthesis methods into a review enables both the quantitative assessment of consumer behavioural intention (in this case, what the public are willing-to-pay), as well as a greater understanding of attitudes surrounding this behaviour, and a greater comprehension of the rational underpinning this behaviour. The qualitative research acted to provide both mediating or moderating variables for the quantitative variables addressed (Sandelowski *et al,* 2006). This in-depth and holistic understanding would not have been possible form conducting only one of the reviews alone. This also enabled a more holistic range of research questions, to be answered, including what, why and for whom, which is not always possible to assess from one type of synthesis alone (Harden, 2010). In addition, the synthesis of results in two complementary information streams, represented a form of data triangulation, as per with primary data collection methods (Jick, 1979), with the results of one review acting to corroborate the findings of the other. These segregated analyses also have the ability to confirm, refute or complement the research findings of each other (Pearson *et al,* 2015; Sandelowski *et al,* 2006), which can act as a means of validating the conclusions of a review (depending on the outcomes), and can enable an inference concerning the robustness of the data available (Jick, 1979).

It should be noted that, whilst on paper conducting mixed-method, or separate complementary reviews appears to be a good idea, in practice this is likely to be a time consuming and resource intensive activity, both in terms of time and moneys. Facilitating this would therefore require both investment and commitment from researchers. Several considerations also need to be taken into consideration including the nature of the research topic and the questions being asked by the review (Heyvaert *et al,* 2011), to ensure that this approach to evidence synthesis is feasible. However, despite these constraints, future research should look to conduct complementary qualitative and quantitative reviews to aid in the overall utility of results (Sandelowski *et al,* 2006) including the interpretation, understanding of results, including the triangulation of available data.

7.5.4 Considerations of WTP

From a policy perspective it is important to consider the economics of FAW (Lusk and Norwood, 2011) as it will provide an understanding of the consequences of different proposed policy options, and within this there is a need to understand the different factors that influence public preferences for improved FAW in order to generate effective policy solutions (Lusk and Norwood, 2012). The findings of the results here

present preferences for public preferred interventions that should be included in further economic analysis to assess their economic viability. In addition to this, the environmental impacts of the interventions should also be considered, with the interventions most preferred.

The findings from this research also have the implication that WTP studies may not be the best indication of behavioural intention in context of FAW, with common criticisms of WTP in relation to FAW including whether the premiums identified just reflect individuals own utility or is it focused on the animal, and do individuals respond in their roles of citizens or consumer (Johansson- Stenman, 2006). In addition, the price premiums and values identified are not necessarily reflective of how WFP are priced in the market. This relates to considerations of how continuous the good in question is, as this will affect whether any price increases will be incremental or step wise. In the case of FAW step changes are likely to occur, which will likely to result in a large increase in WTP as demonstrated in store by the large price differences between free-range and standard chicken. This means that a small WTP will not translate into purchasing behaviour as most changes to welfare will lead to a large increase in price in the current market format. Therefore, in the current market environment, only those who are WTP and can WTP a large price premium are able to purchase higher welfare products (and act in accordance with their values, attitudes and preferences). It therefore needs to be considered how do you cater for those who have concerns and have expressed a small WTP, especially when the small WTP is due to an inability to pay more. Potential mechanisms for achieving this should therefore be considered, such as whether it is economically viable to produce and differentiate between products of different standards, perhaps by use of a welfare score, as suggested by Kehlbacher *et al* (2012).

7.6 Summary

This research aimed to explore the public attitudes towards FAW, in particular relation to intensive animal production systems and the proactive and reactive measures used within these to address production disease. To ensure the acceptability of animal production systems going forward, and maintain public trust in stakeholders across the food chain, public perceptions of these systems, including the interventions utilised to both prevent and treat them need to be addressed. Findings indicate that the public are concerned about more intensive production

systems, with these thought to breach the core concepts of FAW; humane treatment and naturalness. Acceptability of the interventions were also based on these concerns with more proactive interventions utilising housing and hygiene strategies being preferred. The public appear concerned about the use of medicine based interventions, including in relation to food safety, human and health and AMR. Stakeholders including policymakers, should consider these concerns in future policy recommendations, with combination of market and policy based solutions needed to ensure that the range of preferences exhibited are met. Whilst legislation will ensure that these interventions will deliver safe food the results highlight the need for effective communication of the risks and benefits.

Chapter 8. References

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Appendix A: Attitudes systematic review protocol

A protocol for a systematic review into consumers' attitudes, beliefs and perceived ethical obligations towards farm animal welfare.

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Abstract

This article outlines a protocol for a systematic review into consumer attitudes, beliefs and perceived ethical obligations towards farm animal welfare, utilising both the Theory of Reasoned Action and the Theory of Planned Behaviour. A number of secondary objectives will also be explored in relation to the heterogeneity within the data relating to a number of variables known to vary within existing data including; animal species, welfare measures, socio-demographic and socio-economic characteristics.

The protocol outlines the rationale, objectives, inclusion criteria, search strategy and screening processes for the meta-analysis, and the plans for data extraction, risk of bias and data synthesis.

Protocol

Background

The publics ethical concerns have increased over recent years (Shaw, Shui & Clarke, 2000), with issues such as farm animal welfare becoming of increased interest to citizens and consumers (Bennett, Anderson & Blaney, 2002). The most recent Eurobarometer survey (European Commission, 2007) highlighted the European public's concern over farm animal welfare issues with the issue receiving an average rating of 7.8 out of 10 in terms of importance to them. This has implications for ensuring that welfare standards in production systems meet the publics' expectations, that interventions to reduce production diseases are socially acceptable, and the corresponding implications of how farm animal production systems are regulated and supported to enable this.

Research in the domain has demonstrated that consumers are willing to pay (WTP) for a range of products that meet improved (i.e. exceed the minimum) standards of farm animal welfare (Napolitano *et al,* 2008; Carlsson, Frykblom & Lagerkvist¸2007; Bennett, 1996), providing evidence of niche markets for animal welfare products (Wathes *et al*, 2013). Heterogeneity within this has been explored in previous reviews (Lagerkvist & Hess, 2011) in relation to socio-demographic and socio-economic characteristics in addition to different aspects of welfare and different animal species, yet additional underlying variables that could further explain differences in behavioural intention have been neglected.

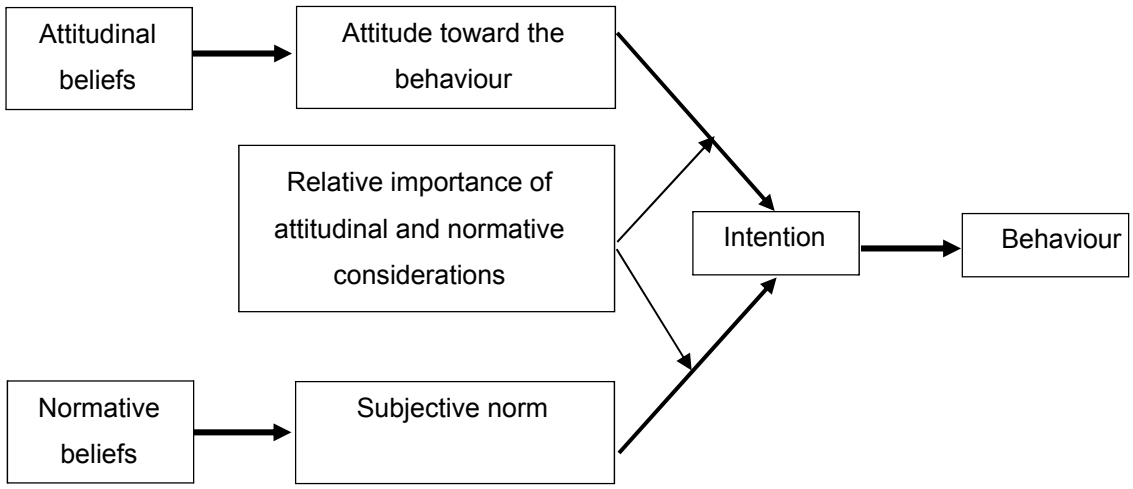
It is important to recognise these influences on behavioural intention, such as attitudes, beliefs and perceptions and explore how and why these vary in relation to farm animal welfare, so as to gain a greater understanding of behaviour.

A number of models exist that attempt to explain the link between attitude and behaviour (Shepherd, 1999), with the Theory of Reasoned Action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (TPB; Ajzen 1991) being two of the most popular (figures 1 and 2 respectively). The TRA purports how volitional behaviour arises from behavioural intention, which is in turn influenced by an individual's attitude towards the behaviour, and their perceived social pressures (subjective norm) of performing the given behaviour, providing that they are all measured within the same context. The TPB further extends this to account for behaviours not fully under volitional control, by incorporating a third construct, perceived behavioural intention.

Each of the three constructs are a function of their corresponding salient beliefs (figure 1 and table 1; Ajzen, 1991; Fishbein & Ajzen, 1975), therefore it is important to gain an understanding of these so as to better comprehend the constructs influencing behavioural intention. Additional variables, such as emotion and attitudes towards objects or persons, are considered external to both models, and so influence behavioural intention via the impact that they have on beliefs (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

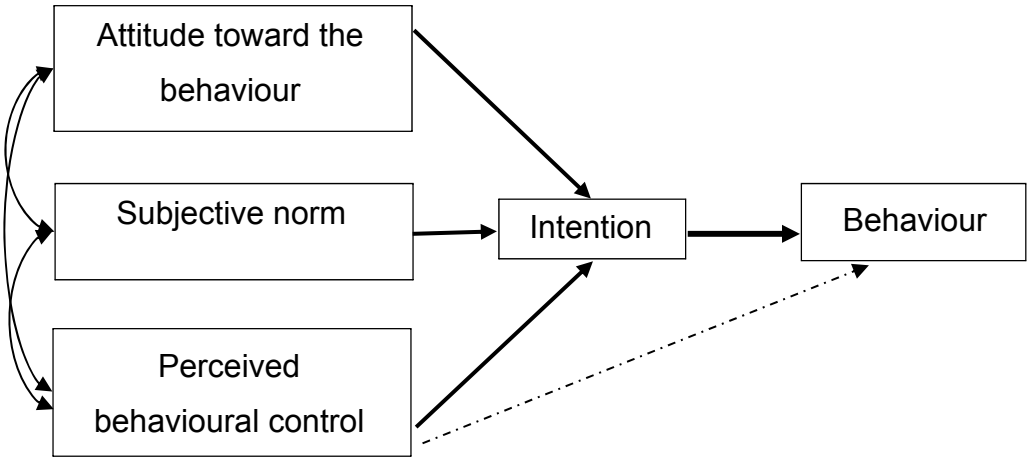
A summary of all three constructs and their associated beliefs can be found in table 1.

Figure 1: The Theory of Reasoned Action



Source: Fishbein & Ajzen (1975)

Figure 2: The Theory of Planned Behaviour



Source: Ajzen & Fishbein (1980)

Table 1: Constructs and associated beliefs associated with the Theory of Reasoned Action and the Theory of Planned Behaviour

Construct (model)	**Description**	**Associated Beliefs**
Attitude (TRA & TPB)	Individuals concerns regarding the overall evaluations of the behaviour as being positive or negative. In general, the more favourable the evaluation of the behaviour, the more likely an individual is to perform it.	Behavioural beliefs which are concerned with the likely outcomes of the behaviour.
Subjective norm (TRA & TPB)	Individuals concerns regarding the perceptions of the general social pressure about whether to engage in or not engage in a specified behaviour.	Normative beliefs which are concerned with the social pressure from specific others to perform the specified behaviour.
Perceived behavioural control (TPB only)	Individuals concerns in relation to how hard or how easy the specified behaviour is to perform. This construct reflects past experience and anticipation of obstacles, and normally involves the consideration of perceived barriers.	Control beliefs which are concerned with the power certain factors have to facilitate or inhibit the behaviour in question.

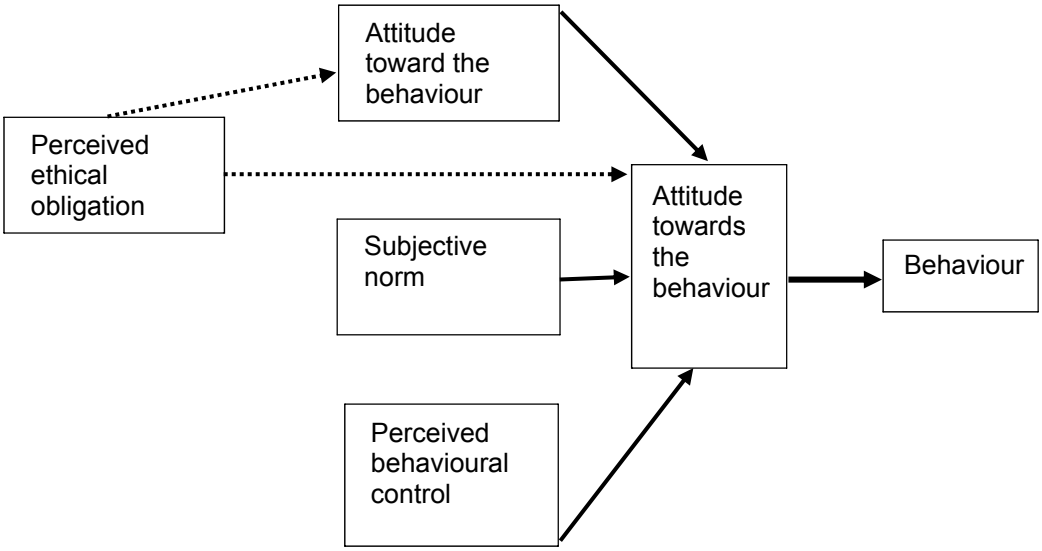
Adapted from Ajzen (1991)

Despite their apparent success of predicting behavioural intention, including in the food domain, it is acknowledged that additional constructs could be added to both the TRA and TPB to capture additional variance in intention (Connor & Armitage, 1998: Ajzen, 1991).

Of particular relevance to behaviours that do not just have self-interest motives, such as farm animal welfare, are constructs that take into account wider interests (Connor & Armitage, 1998). These broader interests include ethical concerns, which may be important motivational factors in behavioural intentions (Shaw & Shui, 2002). Perceived ethical obligation (PEO) is one such construct that seeks to do this, and allows for the inclusion of personal beliefs of what is right and wrong in relation to other beings, in this case animals (Shaw, Shui & Clarke, 2000).

A number of studies have incorporated PEO into both the TRA and TPB in relation to food choice (Shaw & Shui, 2002; Sparks & Shepherd, 2002; Sparks, Shepherd & Frewer, 1995), with the additional ethical construct being a significant independent predictor of behavioural intention both directly, or as an influence on attitude (figure 3). Therefore by incorporating this construct into the models it is expected that a greater percentage of intention will be explained in relation to farm animal welfare.

Figure 3: Hypothesised Theory of Planned Behaviour



Adapted from Shaw & Shui (2002).

As both the TRA and TPB have common components, it is important to gather information on these to establish the effect that each one has, so as to see if different outcomes in relation to behavioural intention are established in relation to the two theories, particularly with the incorporation of PEO. There is also a need to establish how variable or consistent each construct is in relation to behavioural intention. This will highlight whether more studies are required to explain the proposed models or whether they fail to have any predictive power.

It is important to explore the heterogeneity within the retrieved data, in relation to a multitude of different factors including socio-economic and socio-demographic characteristics which have been shown to elicit differences in WTP (Lagerkvist & Hess, 2011), and are important segmentation variables. Additionally, the difference in behavioural intention between consumers and citizens also needs to be established as this is believed to be an important factor in behavioural dissonance (Toma *et al*, 2011; Verbeke, 2009).

Different farm animal welfare aspects have also been shown to account for heterogeneity in the data (Lagerkvist & Hess, 2011) and it is important to explore these to see which aspects are of more concern to consumers.

Despite the importance of the area, there is no current synthesis of studies highlighting the public's attitudes towards animal welfare and the subsequent affects this has on behavioural intention, including any ethical considerations which may be incorporated into these decisions processes. Therefore this review seeks to establish the public's attitudes, perceived behavioural control, subjective norm and PEO in relation to farm animal welfare production systems, and their corresponding beliefs. Additionally factors that may explain heterogeneity in the data will be explored which will enable a better understanding of the variation in the public's behavioural intentions towards farm animal welfare.

As previous reviews have focused on the economic value consumers place on animal welfare, this review will focus on the underlying attitudes and beliefs underlying this, which are essential in tailoring products and policy going forward. The findings of the review will aid producers in the identification of potentially profitable niche marketing opportunities by highlighting how and why animal welfare adds value for consumers, enabling them to produce and market their products accordingly. This will enable livestock producers to make the best use of their resources to create the highest quality products for their intended target markets.

Additionally, policy makers will benefit from greater insights into the public's attitudes thus enabling them to construct the most appropriate procedures and interventions to ensure that minimum farm animal welfare standards, and interventions to improve these, are acceptable to the public. Finally, the findings of the review will be used to make recommendations for future research into this domain, including whether the TRA and/or TPB is an appropriate model of behavioural intention towards farm animal welfare.

Objectives

Primary objectives

As outlined in section 3.1, there is a need to identify, critically assess and summarise the public's attitudes and behavioural intentions towards farm animal welfare. This will be determined by the primary outcomes, which relate to the constructs of behavioural intention in the TRA, TPB and the addition of PEO and are as follows:

1. What are the global public's attitudes towards farm animal welfare?
2. What is the public's perceived behavioural control towards farm animal welfare?
3. What is the public's subjective norm towards farm animal welfare?
4. Do the public have a perceived ethical obligation towards farm animal welfare?
5. What are the sizes of effect and how large and consistent are they in relation to the TRA and TPB?

Secondary objectives

A number of secondary outcomes will also be examined and will be invaluable in helping to explain the primary outcome of the study. These relate to the beliefs outlined in both the TRA and TPB, and those concerned with PEO. Additional factors that may explain heterogeneity in the data will also be explored and are outlined as follows:

6. What are the public's beliefs in relation to farm animal welfare?
7. Do socio-demographic affect attitudes and beliefs in relation to farm animal welfare?

8. Do socio-economic factors affect attitudes and beliefs in relation to farm animal welfare?
9. Do different aspects of animal welfare affect attitudes and beliefs in relation to farm animal welfare?
10. Is there a difference in attitudes between consumers and citizens?

Interpretation of effect of magnitude

It is expected that as perceived ethical obligation increases, attitudes will also become more favourable towards farm animal welfare, which will in turn create more favourable behavioural intentions.

Additionally it is expected that the subjective norm in relation to farm animal welfare will have increased over time, as social pressures have increased for consumers to purchase welfare friendly products.

A range of attitudes and subsequently behavioural intentions will exist, with this heterogeneity in the returned data depending on several factors including age, gender, nationality and animal species as discussed in the secondary objectives.

However, beyond these broad generalisations it is unclear how large the effects are in relation to each other and the potential effect modifiers.

Criteria for considering studies for the review

Types of study to be included

Empirical studies of both a quantitative and qualitative design that measure consumer attitudes, preferences, perceptions, beliefs and perceived ethical obligations towards products produced to a specified animal welfare standard are to be included in the review. This includes, but is not limited to: quantitative and qualitative surveys, focus groups and interviews.

Any studies that have a focus on ethics or morality in relation to farm animal welfare will also be included, provided they meet the other eligibility criteria outlined in table 1. Only studies written in English will be included.

Types of participants

The study population for the review will be consumers of animal products, and wider citizens in the EU (table 1). Studies focusing on specific subgroups of the population and non-EU citizens will be included but variation in population characteristics will be considered in relation to the overall strength of evidence.

Types of outcome measures

The outcomes measured relate to the primary outcomes of the review, with a focus on the constructs that underlie consumer and citizens behavioural intentions towards farm animal welfare; attitudes, subjective norm, behavioural intention and PEO (table

1). Specifically these will relate to categorical responses, frequency and interval scales, with the latter being especially important in the measurement of attitudes in relation to both the TRA and TPB and is normally presented in Likert format.

Secondary outcomes will be measured as mean ± standard deviation, confidence intervals, or as the percentage of participants who meet a certain criteria, with beliefs also likely to be measured using interval scales.

Table 1: Eligibility criteria

Study design	Empirical (qualitative and quantitative), English, Attitudes, perceptions, preferences, beliefs, ethical considerations, moral obligation, morality
Population	Consumers and/ or citizens
Outcome	Attitudes, preferences, beliefs, ethical obligation, societal norms

Search strategy for the identification of studies

Search strategy

A number of subject specific electronic databases will be searched; Scopus, AgEcon Search and ISC Web of Knowledge, and will include all studies published over the past 15 years so as to include the most up to date information. Google Scholar will also be searched as a source of grey literature.

In order to further reduce publication bias two further sources of grey literature will be examined. Firstly key authors in the field will be consulted to check for any unpublished findings and additional sources of information (Higgins & Green, 2011), and secondly reference lists of included studies will be checked for any further references not returned from the database searches.

Search terms will be refined after several trial searches to ensure the most successful search strategies are used. Face validity of the searches will be addressed by checking returned searches for key authors and articles.

Search strategies will be tailored for each database searched, with the specific search strategies to be reported in an Appendix in the final review. The core list of search terms for the review can be found in table 2. All search terms will be included in the topic, keyword, title and abstract sections of each individual database searched and used in conjunction with the Boolean operator AND as highlighted.

Where search sensitivity is low species related terms will be used to increase specificity, as highlighted in italics in table 2.

Table 2: Keywords considered for search

Type of Study and Outcome	Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer
AND	
Animal Species[1]	farm animal OR production animal *pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef*
AND	
Animal Welfare	Animal welfare OR health OR disease OR welfare OR production disease

[1]Where search sensitivity is low species related terms will be used to increase specificity

Search screening

EndNote libraries will be constructed, with the principle researcher removing all duplicates before the results are sifted according to exclusion criteria in table 1. An overview of the search process will be included in a PRISMA flow chart (Moher *et al*, 2009) for ease of reference.

The search results will then be filtered in a two stage process as outlined below. Decisions of whether to include and exclude the articles will be noted in the EndNote entry for each result.

1) **Title and abstract search:** In addition to the full title the abstract of these studies will also be read by the primary researcher so as to minimise the risk of error (Higgins & Green, 2011). A second reviewer will then review at least 10% of the studies. Any differences between the two researchers will be resolved through discussion. Again if there is any doubt at this stage then the study will be included for stage two. If abstracts are not available at this stage then they will be included for stage two.
2) **Full text search:** the full text of all included studies will be read and assessed for relevance by the primary researcher. A second researcher will then review at least 10% of the studies. Any differences in decisions related to study eligibility will be discussed by the review authors.

Details of excluded studies will be provided at the full text stage only, listing the primary reason for exclusion in relation to the hierarchy of exclusion. Details of excluded studies at stages one can be obtained by contacting the corresponding author.

Methods of the review

Inclusion criteria

Studies obtained from the search will be selected based on the eligibility criteria outlined in table 1, to ensure only relevant materials are included. Studies will not be included if they fail to meet any of the criteria listed.

Assessment of risk of bias

The validity and the impact of bias will be addressed by use of a critical appraisal document that examines a number of quality criteria which have the potential to impact on the results of the study. Critical assessment will consider the construct validity, internal and external validity and reliability of included studies, as described by Yin (2009).

The quality appraisal tool (under development) will use elements of the Critical Appraisal Skills Programme checklists for both qualitative and quantitative research (CASP, 2013a; 2013b), the RATS qualitative research guidelines (Biomed Central, 2014; Clark, 2003). It will also be developed to ensure that it meets the guidance outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011), Campbell Collaboration (2001) guidelines and the Centre for Reviews and Disseminations (2009) advice, to provide a document not based in a healthcare context.

No studies will be excluded based on the quality assessment tool, but the findings will be taken into account during the evidence synthesis. Quality appraisal will inform the overall assessment of strength of evidence and may inform sensitivity analysis. Any differences in decisions related to study quality will be discussed by the review authors.

Data management and extraction

Data will be extracted from the included studies using a data extraction form. This will be finalised as the nature of the data becomes apparent in relation to the relevant contribution of qualitative and quantitative data. The finalised data extraction form will be trialled by two independent researchers on five key papers known to be identified in the search process, to check that all relevant information is extracted. A template of the final form will be attached to the final review.

All data will be extracted by the primary researcher, with a subset of at least 10% of the included studies checked by a second researcher independently, again to check for potential errors. Where information is missing efforts will be made to contact the authors to obtain further details (Higgins & Green, 2011).

Data synthesis

Firstly descriptive results of the review will be presented, detailing the study characteristics and findings. This will be followed by a narrative analysis of the extracted information which will follow ESRC Narrative Synthesis guidance (Popay *et al*, 2006), and will explore the variations and relationships in the data. Additionally

any changes in behavioural intention overtime will be reported. Qualitative and quantitative data will then be analysed in separate streams as outlined below.

Qualitative studies will be exported into Nvivo and coded according to both the primary and secondary objectives. Data will then be explored using a thematic approach so as to link any information containing shared attitudes and views (Thomas & Harden, 2008; Braun & Clarke, 2006).

Subsequently, if a sufficient number of studies are obtained then a random effects meta-analysis and meta-regressions will be conducted (further details to be provided at a later date). Simulation procedures will be used to derive variances for weighting based on the sample sizes of the studies. AIC will be used to minimise over fitting when exploring heterogeneity (Koricheva, Gurevitch & Mengersen, 2013). Sensitivity analyses will be conducted to explore the risk of bias where appropriate. Similarly, funnel plots and tests of funnel plot asymmetry will be used to assess potential publication bias despite their known limitations.

Qualitative and quantitative synthesis activities will be used to explore individual constructs and beliefs associated with the TRA and TPB. Subsequent evidence contextualisations will assess the strength of evidence in relation to each model.

The adaptive grade framework (Meader *et al*, 2013) will be used to assess the strength of evidence, and again will be adapted to reflect the non-healthcare setting of the review (c.f. Barański *et al*, 2014). Quantitative and qualitative will then be drawn together and the implications of the review will be discussed in relation to the context of the objectives and wider policy and production implications.

Acknowledgements

The author would like to thank the advisory group for consultation of the protocol and associated quality appraisal documents.

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Supplementary Information

Feedback

Feedback on the protocol from the advisory team was obtained and gratefully received.

Plans for updating the protocol

Section 5.4 relating to data synthesis will be confirmed after critical appraisal, but prior to the extraction of outcomes, once the nature of the data has become apparent. Data finalisation of the critical appraisal tool will also be reported.

About the Article

Anticipated contributions of authors

Protocol development: BC, GS, LP, LF
Run search: BC
Identification relevant titles and abstracts: BC
Identification relevant studies: BC
Obtain relevant studies: BC
Data extraction: BC
Quality appraisal: BC, GS
Data analysis and interpretation: BC, GS, LP, LF
Draft review: BC, GS, LP, LF

Advisory group

The advisory group consisted of Richard Bennett, Richard Tranter, Philip Jones (University of Reading), Jarkko Niemi and Latvala Terhi (MTT Agrifood Research Finland).

Declarations of interest

Gavin Stewart is an associate editor of Peer J. Lynn Frewer has previous publications relating to animal welfare and the Theory of Planned Behaviour.

Sources of support

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Preliminary timeframe

Protocol development: October - November 2014
Database searching: December 2014
Data sifting: December 2014 – January 2015
Data extraction: January – February 2015
Quality appraisal: February- March 2015
Data analysis: March –May 2015
Key conclusions: May 2015

Appendix B: List of trial and final search terms

Scopus

Include 'life sciences' and 'social sciences and humanities' only
Use of AND, OR and NOT functions are indicated in bold
Article title, abstract and keyword search
Search all years

Search 1

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal OR production animal **AND** animal welfare OR health OR disease OR welfare OR production disease

Search date: 05/01/2015
Results returned: 673 results returned, 3 key authors included

Search 2

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal OR production animal **AND** Animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being

Search date: 05/01/2015
Results returned: 86 results returned, 4 key authors included

Search 3

Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer **AND** pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl **OR** turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy **AND** (animal welfare) OR (production disease)

Search date: 05/01/2015
Results returned: 7,707 results returned, 3 key authors included

Search 4

Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer **AND** ((farm animal) OR (production animal) OR pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl **OR** turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR

turkey OR goose OR meat OR dairy OR beef) **AND NOT** chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever) **AND** (animal welfare) OR (production disease)

Search date: 05/01/2015
Results returned: 290,360 results returned, 1 key author included

Search 5

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR (production animal) **AND** (animal welfare) OR (production disease)

Search date: 12/01/2015
Results returned: 10,616 results returned, 1 key paper and 8 key authors included

Search 6

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 12/01/2015
Results returned: 16,171 results returned, 4 key papers and 7 key papers included

Search 7 (search terms used)

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal **AND** welfare

Search date: 12/01/2015
Results returned: 1,203 results returned, 5 key papers and 9 key authors included

Search 8

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **OR** welfare OR (production disease)

Search date: 12/01/2015
Results returned: 551,974 results returned, 4 key papers and 8 key authors included
ISI Web of Knowledge

Search all databases
Search for topic
Use of AND, OR and NOT functions are indicated in bold
First 150 results searched key papers

Searched 1995-2015
Search 1

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal OR production animal **AND** animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 16, 999 results returned, 2 key authors included

Search 2

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) **AND** (farm animal OR production animal) **AND** (Animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being)

Search date: 06/01/2014
Results returned: 17, 099 results returned, 2 key authors included

Search 3

(Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer) **AND** (pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) **AND** (animal welfare OR production disease)

Search date: 06/01/2014
Results returned: 3,706 results returned, 4 key authors included

Search 4

Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer **AND** (farm animal) OR (production animal) OR pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND **NOT** chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever) **AND** (animal welfare) OR (production disease)

Search date: 06/01/2015
Results returned: 7,345 results returned, 4 key authors included

Search 5

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR (production animal) **AND** (animal welfare) OR (production disease)

Search date: 08/01/2015
Results returned: 12,025 results returned, 3 key authors included

Search 6

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 08/01/2015
Results returned: 20,313 results returned, 6 key authors included

Search 7

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal **AND** welfare

Search date: 08/01/2015
Results returned: 1,959 results returned, 5 key authors included

Search 8

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **OR** welfare OR (production disease)

Search date: 08/01/2015
Results returned: 360, 795 results returned

Search 9

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR (production animal) **AND** welfare OR (production disease)

Search date: 08/01/2015 *social science papers only*
Results returned: 1,607 results returned, 1 key paper and 5 key authors included

Search 10

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 08/01/2015
Results returned: 4,214 results returned, 1 key paper and 7 key authors included

Search 11

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 08/01/2015 *excludes all bar veterinary sciences, agriculture, zoology, food science & technology, behavioural sciences, business economics, psychology, social sciences other topics, sociology, social issues*
Results returned: 2,868 results returned, 3 key authors included

Search 12 (search terms used)

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 08/01/2015 *excludes all bar veterinary sciences, agriculture, zoology, food science & technology, behavioural sciences, business economics, psychology, social sciences other topics, sociology, social issues AND social science only*
Results returned: 595 results returned, 3 key papers and 6 key authors included
AgEcon

Search 'anywhere in record'
Search the entire database
Use of AND, OR and NOT functions are indicated in bold
No date restrictions
Search 1

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) **AND** (farm animal OR production animal) **AND** (Animal welfare OR health OR disease OR welfare OR production disease)

Search date: 05/01/2015
Results returned: 29 results returned, no key papers or author included

Search 2

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) **AND** (farm animal OR production animal) **AND** (Animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being)

Search date: 05/01/2015
Results returned: 2 results returned, no key authors or papers included

Search 3

(Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer) **AND** (pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) **AND** (Animal welfare OR health OR disease OR welfare OR production disease)

Search date: 05/01/2015
Results returned: 58 results returned, no key authors or papers included

Search 4

Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer **AND** (farm animal) OR (production animal) OR pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND **NOT** (chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever)) **AND** (animal welfare) OR (production disease)

Search date: 12/01/2015
Results returned: 269 results returned, 2 key papers and 3 key authors included

Search 5

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR (production animal) **AND** (animal welfare) OR (production disease)

Search date: 12/01/2015
Results returned: 215 results returned, 1 key paper and 2 key authors included

Search 6

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 12/01/2015
Results returned: 230 results returned, 2 key papers and 3 key authors returned

Search7

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** farm animal **AND** welfare

Search date: 12/01/2015
Results returned: 76 results returned, 1 key paper and 2 key authors included

Search 8 (final search terms used)

Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer **AND** (farm animal) OR animal **AND** welfare OR (production disease)

Search date: 12/01/2015
Results returned: 230 results returned, 2 key papers and 3 key authors included
Google Scholar

Exclude patents and citations
Sort by relevance
First 150 results searched for key papers
Searched 1995-2015
Search 1

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal OR production animal) AND (Animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2015
Results returned: 19,700 results returned, 1 key author and 1 key paper included

Search 2

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal OR production animal) AND (Animal welfare OR health OR disease OR wellbeing well-being)

Search date: 06/01/2014
Results returned: 18,200 results returned, 1 key paper and 4 key authors included

Search 3

(Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer) AND (pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND (Animal welfare OR health OR disease OR welfare OR production disease)

Search date: 12/01/2015
Results returned: 36,400 results returned, 1 key author returned

Search 4

(Attitude*OR perception* OR belief* OR valu* OR intention*OR behav*OR purchas*OR ethic*OR pref*OR moral*OR consumer) AND (farm animal) OR (production animal) OR pig* OR swine* OR sow* OR hog* OR poultry OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle* OR bovine* OR cow* OR beef OR horse* OR fish* OR ovine* OR sheep* OR caprin* OR lamb* OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND NOT chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever) AND (animal welfare) OR (production disease)

Search date: 12/01/2015
Results returned: 59, 500 results returned, 3 key papers and 3 key authors included

Search 5

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal) OR (production animal) AND (animal welfare) OR (production disease)

Search date: 12/01/2015
Results returned: 19,900 results returned, 1 key paper and 2 key authors

Search 6

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal) OR animal AND welfare OR (production disease)

Search date: 12/01/2015
Results returned: 19,300 results returned, 2 key authors returned

Search 7 (search used)

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND farm animal AND welfare

Search date: 12/01/2015
Results returned: 19,800 results returned, 3 key papers and 4 key authors included

Search 8

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer)AND (farm animal) OR animal OR welfare OR (production disease)

Search date: 12/01/2015
Results returned: 20,700 results returned, 1 key author included

Search 9

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND farm animal AND welfare OR disease

Search date: 12/01/2015
Results returned: 19,400 results returned, 3 key papers and 2 key authors included

Search 10

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal) AND welfare

Search date: 12/01/2015
Results returned: 19,700 results returned, 3 key papers and 2 key authors included

Search 11

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal OR production animal) AND welfare

Search date: 12/01/2015
Results returned: 20,100 results returned, 4 key papers and 3 key authors included

Search 12

(Attitude* OR perception* OR belief* OR valu* OR intention* OR behav* OR purchas* OR ethic* OR pref* OR moral* OR consumer) AND (farm animal OR production animal) AND (welfare OR production disease)

Search date: 12/01/2015
Results returned: 20,600 results returned, 1 key author included

Appendix C: Studies included in the attitudes review and excluded at the full text stage

Studies included in the attitudes review

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Appendix D: Attitudes review summary of included studies

Paper	Year of data collection	Country	Sample size	Method	Animal	Publication type	Peer reviewed
Bennett *et al* (2015)	2011	UK	193	Contingent valuation	Layer hens	Journal article	Yes
Bennett *et al* (2012)	NA	UK	Around 300	Choice experiment	General	Journal article	Yes
Bennett & Blaney (2003)	1996	UK	591	Contingent valuation	Layer hens	Journal article	Yes
Bennett & Blaney (2002)	NA	UK	164	Contingent valuation	Pigs	Journal article	Yes
Bennett *et al* (2002)	1998	UK	120	Contingent valuation	General	Journal article	Yes
Bennett & Larson (1996)	NA	USA	137	Contingent valuation	Calves, layer hens	Journal article	Yes
Bernard de Cock Buning (2013)	2010	Netherlands	21	Focus groups	Pigs	Journal article	Yes
Boogaard *et al* (2011a)	2007	Netherlands	1178	Survey	Dairy cows	Journal article	Yes
Boogaard *et al* (2011b)	2009 - 2010	Netherlands, Denmark	18, 8	Citizens Panel	Pigs	Journal article	Yes
Boogaard *et al* (2006)	2003	Netherlands	1074	Survey	General	Journal article	Yes
Christensen *et al* (2006)	2005	Denmark	2301	Choice experiment	Broiler Chickens	Report	No
Clonan *et al* (2010)	2008-2009	UK	842	Survey	General	Conference paper	No
de Barcellos *et al* (2010)	2008	Brazil	475	Survey	Pigs	Journal article	Yes
de Jonge & van Trijp (2013)	2012	Netherlands	209	Conjoint analysis	Broiler chickens	Journal article	Yes
Deemer & Lobao (2011)	2007	USA	1500, 1677	Survey	General	Journal article	Yes
Delizie *et al* (2006)	2005	Belgium	450	Survey	Broiler chickens	Journal article	Yes
Ellis *et al* (2009)	2007	UK	363	Survey	Dairy cows	Journal article	Yes
Eurobarometer (2007)	2006	Europe	29152	Survey	General	Report	No
Eurobarometer (2005)	2005	Europe	24708	Survey	General	Report	No
Fearne & Lavelle (1996)	1995	UK	747	Survey	Broiler chickens	Journal article	Yes
Frewer *et al* (2005)	NA	Netherlands	1000	Survey	Pigs and fish	Journal article	Yes
Hall & Sandilands (2007)	2005	UK	16	Cognitive mapping, Q methodology	Broiler Chickens	Journal article	Yes
Harper & Henson (2001)	NA	UK, Ireland, Italy, France & Germany	NA	Interviews, Focus groups, Survey	General	Project report	No
Harper & Henson (1999a)	NA	UK, Ireland, Italy, France & Germany	NA	Focus group	General	Project report	No
Harper & Henson (1999b)	NA	UK, Ireland, Italy, France & Germany	300	Interviews	General	Project report	No
Heid & Hamm (2013)	2009	Germany	89	Vickory auction,	Pigs	Journal article	Yes

				Focus group			
Heleski & Zanella (2006)	NA	USA	58, 29	Survey	Layer hens, pigs, dairy cows	Journal article	Yes
Heng *et al* (2013)	2012	USA	924	Choice experiment	Layer hens	Journal article	Yes
Honkanen & Olsen (2009)	2006	Spain	450	Survey	Fish	Journal article	Yes
Kallas *et al* (2013)	NA	Spain, UK, France, Italy, Netherlands, Germany	825	Pre and post surveys, sensory test	Pigs	Journal article	Yes
Kehlbacher *et al* (2012)	2009	UK	278	Contingent valuation	General	Journal article	Yes
Kendall *et al* (2006)	2002	USA	4030	Survey	General	Journal article	Yes
Kjaernes & Lavik (2007)	2005	France, Italy, Netherlands, Sweden, Norway, Hungary, UK	1500 each country	Survey	General	Project report	No
Krystallis *et al* (2009)	2008	Belgium, Denmark, Poland, Germany	1931	Survey	Pigs	Journal article	Yes
Lassen *et al* (2006)	2001	Denmark	NA	Focus group	Pigs	Journal article	Yes
Loveridge (2013)	1994, 2008	New Zealand	1400, 1243	Survey	General	Journal article	Yes
Lu (2013)	NA	Canada	2056	Choice experiment	Layer hens	Thesis	No
Lusk *et al* (2007)	2007	USA	1019	Survey	General	Working paper	No
Makdisi & Maggraf (2011)	2007	Germany	300	Contingent valuation	Broiler Chickens	Conference paper	No
Maria (2006)	2003	Spain	3978	Survey	General	Journal article	Yes
McCarthy *et al* (2004)	NA	Ireland	300	Survey	Pigs, Broiler chickens	Journal article	Yes
McCarthy *et al* (2003)	NA	Ireland	300	Survey	Beef cows	Journal article	Yes
McEachern *et al* (2007)	2001	UK	353	Survey	General	Journal article	Yes
McKendree *et al* (2014)	2012	USA	798	Survey	Pigs	Journal article	Yes
Meuwissen *et al* (2007)	2001	Netherlands	1199	Survey	Pigs	Journal article	Yes
Miele & Evans (2011)	Multiple	France, Italy, Netherlands, Sweden, Norway, Hungary, UK - UK, Italy, Norway	NA; 10-12 per group	Focus group, Citizens juries	General	Journal article	Yes
Moran & McVittie (2008)	2005	UK	318	Contingent valuation	Broiler chickens	Journal article	Yes

Ngapo *et al* (2003)	2001	France, England, Sweden, Denmark	24, 34, 19, 21	Focus group	Pigs	Journal article	Yes
Nocella *et al* (2012)	2005	France, Germany, Italy, Spain, UK	1294	Choice experiment	General	Journal article	Yes
Peneva (2011)	NA	Bulgaria	NA	Survey	General	Journal article	Yes
Phan-Huy & Badertscher (2003)	1996, 1993-1996	Switzerland	645, 502	Survey	General	Journal article	Yes
Phillips & McCulloch (2005)	NA	Multiple Countries	445	Survey	General	Journal article	Yes
Rauch & Sharp (2005)	2004	USA	Around 1960	Survey	General	Report	No
Schnettler *et al* (2008)	2006	Chile	384	Survey	General	Journal article	Yes
Schröder & McEachern (2004)	2000	UK	30	Interviews	General	Journal article	Yes
Sepulveda *et al* (2011)	2008	Spain	371	Survey	Lamb	Journal article	Yes
Sharp & Tucker (2005)	2002	USA	4013	Survey	Chickens, general	Journal article	Yes
Solgaard & Yang (2011)	2009	Denmark	1000	Contingent valuation	Fish	Journal article	Yes
Spooner *et al* (2014)	NA	Canada	24	Interviews	General	Journal article	Yes
Tawse (2010)	NA	UK	173	Survey	Pigs	Journal article	Yes
Taylor & Signal (2009)	2005	Australia	1224	Survey	General	Journal article	Yes
te Velde *et al* (2002)	NA	Netherlands	15	Interviews	General	Journal article	Yes
Toma *et al* (2011)	2005	UK	654	Survey	Chicken	Journal article	Yes
Tonsor & Wolf (2009)	2008	USA	768	Contingent valuation	Pigs	Journal article	Yes
Tuyttens *et al* (2010)	2006	Belgium	459	Survey	General	Journal article	Yes
Uzea (2009)	2008	Canada	541	Choice experiment	Pigs	Thesis	No
van Bierendonck *et al* (2013)	2009	Belgium	1018	Survey	Pigs	Journal article	Yes
Vanhonacker & Verbeke (2009)	2007	Belgium	469	Survey	Layer hens and broiler chickens	Journal article	Yes
Vanhonacker *et al* (2010)	2000-2002, 2006	Belgium	521; 29	Survey, Focus groups	General	Journal article	Yes
Vanhonacker *et al* (2009)	2008	Belgium	225	Survey	Pigs	Journal article	Yes
Vecchio & Annunziata (2012)	2008-2009	Italy	300	Survey	Layer hens	Journal article	Yes

Verbeke *et al* (2010)	2008, NA	Germany, Spain, France , UK -Belgium, Germany, Poland, Greece, Denmark	65; 492, 479, 480, 506, 480	Focus groups, Conjoint choice survey	Beef cows	Journal article	Yes
Verbeke *et al* (2005)	NA	Belgium	32; 50	Focus groups, Interviews	General	Journal article	Yes
Verbeke & Viane (1999)	1998	Belgium	303	Survey	Chickens , pigs, beef cows	Journal article	Yes
Vermeulen & Bienabe (2010)	2009	South Africa	420	Survey	Chicken	Conference paper	No
Videras (2006)	NA	USA	NA	Modelling	Pigs	Journal article	Yes
Viegas (2013)	2009	Portugal	35; 613	Focus groups, Choice experiment	Beef cows	Thesis	No
Vinnari *et al* (2011)	2010	Finland	1893	Survey	General	Journal article	Yes
You *et al* (2014)	2011	China	6006	Survey	Pigs, chickens	Journal article	Yes
Zander & Hamm (2010)	NA	Austria, Germany, Italy, Switzerland, UK	240, 240, 233, 239, 240	Information display matrix	Dairy cows	Journal article	Yes

Appendix E: Qualitative and quantitative critical appraisal documents for the attitudes systematic review

Quantitative critical appraisal tool

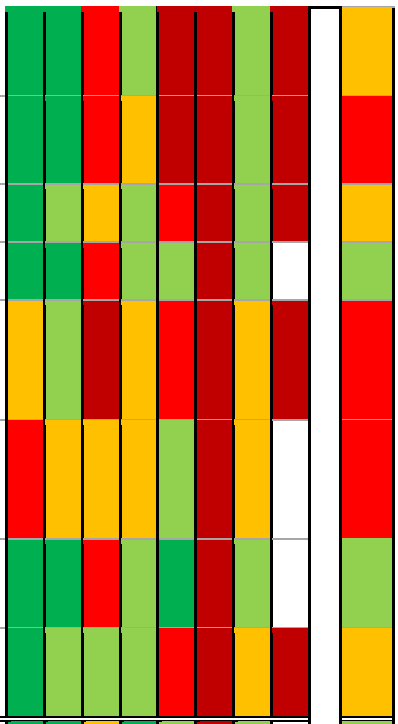
	Y	N	?	Comments
Was there a clear statement of the aims of the research?				
Is the relevance highlighted?				
Are PICO elements clear?				
Was the research design appropriate to address the aims of the research?				
Is there discussion or justification of the right method to use?				
Was the recruitment strategy appropriate to the aims of the research?				
Was it clear how participants were recruited?				
Was a rationale provided for participant selection?				
Is the population representative?				
Was there a justification of the sample size?				
Has the response rate been reported?				
Have participant characteristics been described?				
Was the data collected in a way that addressed the research issue?				
Is it clear how data was collected?				
Has the research been contextualised (is all relevant information about the subjects and the setting provided?				
Did the instrument directly measure the outcome of interest?				
Was a valid and reliable instrument used?				
Was the data analysis sufficiently rigorous?				
Was the analysis appropriate for the aims and methods of the study?				
Has reference been made to accepted procedures for analysis?				
Have steps been taken to guard against selective use of the data?				
Is sufficient data presented to support the findings?				
Have limitations been acknowledged?				
Have ethical issues been taken into consideration?				
Have issues of confidentiality been discussed?				
Was the research explained to participants?				
Has approval been sought from an ethics committee?				
Is there a clear statement of findings?				
Is there adequate discussion of the argument for and against the researchers' findings?				
Are results presented for all measures?				
Has the author identified potential cofounding factors?				
Are findings discussed in relation to the original research question, aims and objectives?				
Are the findings generalizable?				
Other				

Qualitative critical appraisal tool

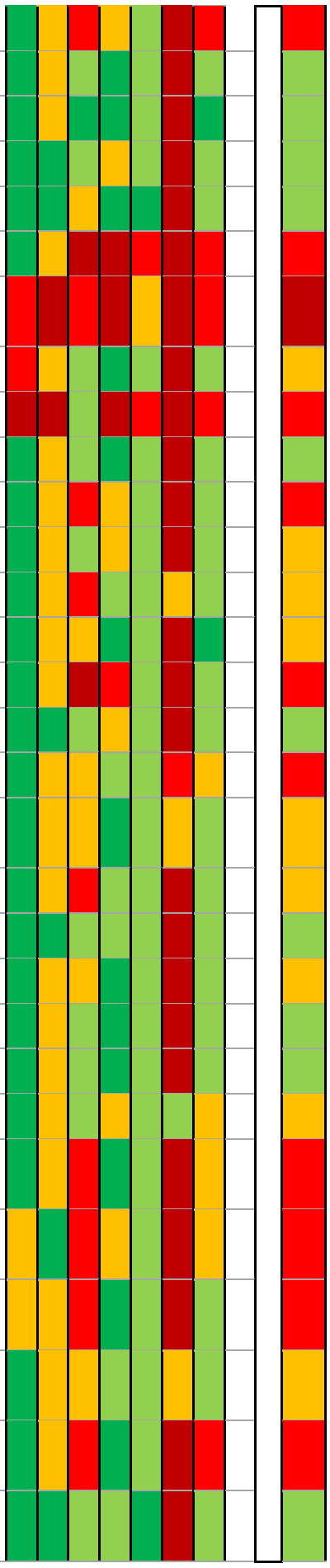
	Y	N	?	Comments
Was there a clear statement of the aims of the research?				
Is the relevance highlighted?				
Was the research design appropriate to address the aims of the research?				
Is there discussion or justification of the right method to use?				
Would a quantitative approach have addressed the issue better?				
Does the research seek to explore and understand processes, structures or subjective experiences or meanings?				
Was the recruitment strategy appropriate to the aims of the research?				
Was it clear how participants were recruited?				
Was a rationale provided for participant selection?				
Was there a justification of the sample size and has saturation been discussed?				
Have participant characteristics been described?				
Was the data collected in a way that addressed the research issue?				
Is it clear how data was collected?				
Has the research been contextualised (is all relevant information about the subjects and the setting provided?				
Has the researcher made the methods explicit?				
Is the form of the data clear?				
Was the data analysis sufficiently rigorous?				
Was the analysis appropriate for the aims and methods of the study?				
Has reference been made to accepted procedures for analysis?				
Has reliability been considered?				
Have steps been taken to guard against selective use of the data?				
Is there adequate discussion of how themes, concepts etc. were derived?				
Have limitations been acknowledged?				
Have ethical issues been taken into consideration?				
Have issues of confidentiality been discussed?				
Was the research explained to participants?				
Has approval been sought from an ethics committee?				
Is there a clear statement of findings?				
Is there adequate discussion of the argument for and against the researchers' findings?				
Are findings discussed in relation to the original research question, aims and objectives?				
Is sufficient original evidence provided to satisfy the reader of the relationship between the evidence and the conclusions?				
Are the findings generalizable?				
Are the authors sure about their study findings?				
Has the role of the researcher been addressed?				
Has the relationship between the researcher and participants been discussed?				
Has the researcher examined their own role and bias in the analysis process?				
Other				

Appendix F: Critical appraisal assessment of included studies

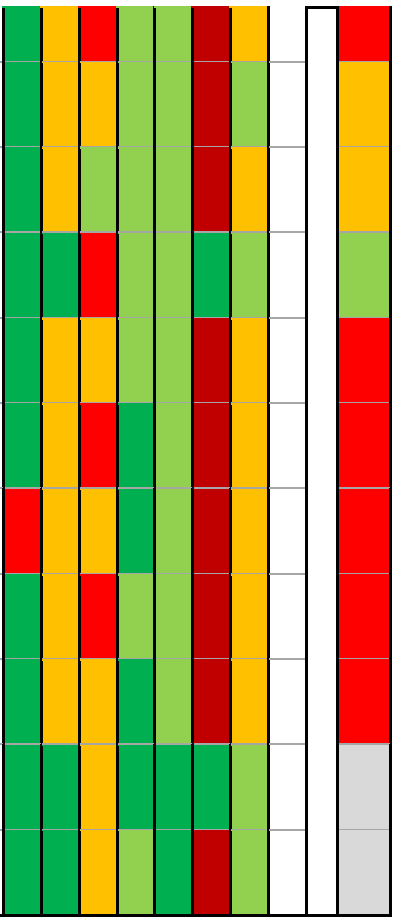
	Study ID	Paper	Method	1	2	3	4	5	6	7	8		Overall
Qualitative	1	Boogaard *et al* (2011)	Citizens Panel										
	2	Bernard and de Cock Buning (2013)	Focus Group										
	3	Harper & Henson (1999)	Focus Group										
	4	Lassen *et al* (2006)	Focus Group										
	6	Ngapo *et al* (2003)	Focus Group										
	9	Harper & Henson (2001)	Interviews										
	12	Schroder & McEachern (2004)	Interviews										
	13	Spooner *et al* (2014)	Interviews										
	14	te Velde *et al* (2002)	Interviews										
Mixed Methods	7	Verbeke *et al* (2005)	Focus Group, Interviews										
	7	Verbeke et al (2005)	Focus Group, Interviews										
	16	Hall and Sandilands (2007)	Cognitive mapping										
	16	Hall and Sandilands (2007)	Q methodology										
	17	Harper & Henson (2001)	Interviews, Focus Groups, Survey, Focus Groups, Workshop										
	17	Harper & Henson (2001)	Interviews, Focus Groups, Survey, Focus Groups, Workshop										
	17	Harper & Henson (2001)	Interviews, Focus Groups, Survey										
	18	Heid & Hamm (2013)	Vickory auction, focus group										
	18	Heid & Hamm (2013)	Vickory auction, focus group										
	19	Kallas *et al* (2013)	Pre and post surveys, sensory test, WTP - CV										
	19	Kallas *et al* (2013)	Pre and post surveys, sensory test, WTP - CV										

	21	Miele & Evans (2011)	Focus Group, citizens juries	
	21	Miele & Evans (2011)	Focus Group, citizens juries	
	24	Vanhonacker *et al* (2010)	Survey, focus group	
	24	Vanhonacker *et al* (2010)	Survey, focus group	
	25	Verbeke et al (2010)	Focus groups, survey - conjoint choice	
	25	Verbeke et al (2010)	Focus groups, survey - conjoint choice	
	26	Viegas (2013)	Focus groups, choice experiment	
	26	Viegas (2013)	Focus groups, choice experiment	
Quantitative	8	Zander & Hamm (2010)	Information display matrix	
	15	Videras (2006)	Modelling	
	20	McEachern *et al* (2007)	Survey	
	29	Boogaard *et al* (2011)	Survey	
	30	Boogaard *et al* (2006)	Survey	
	31	Clonan *et al* (2010)	Survey	
	32	de Barcellos *et al* (2010)	Survey	
	33	Deemer & Lobao (2011)	Survey	
	34	Delizie *et al* (2006)	Survey	
	35	Ellis *et al* (2009)	Survey	
	36	Eurobarometer (2005)	Survey	
	37	Eurobarometer (2007)	Survey	
	38	Fearne & Lavelle (1996)	Survey	
	39	Frewer *et al* (2005)	Survey	
	41	Heleski & Zanella (2006)	Survey	
	42	Honkanen & Olsen (2009)	Survey	
	44	Kendall *et al* (2006)	Survey	
	45	Kjaernes & Lavik (2007)	Survey	
	46	Krystallis *et al* (2009)	Survey	
	47	Loveridge (2013)	Survey	
	48	Lusk *et al* (2007)	Survey	

	49	Maria (2006)	Survey
	50	McCarthy *et al* (2003)	Survey
	51	McCarthy *et al* (2004)	Survey
	52	McKendree *et al* (2014)	Survey
	53	Meuwissen *et al* (2007)	WTP
	54	Peneva (2011)	Survey
	55	Phan-Huy & Badertscher (2003)	Survey
	59	Phillips & McCulloch (2005)	Survey
	61	Rauch & Sharp (2005)	Survey
	62	Schnettler *et al* (2008)	Survey
	63	Sepulveda *et al* (2011)	Survey
	64	Sharp & Tucker (2005)	Survey
	66	Tawse (2010)	Survey
	67	Taylor & Signal (2009)	Survey
	68	Toma *et al* (2011)	Survey
	69	Tuyttens *et al* (2010)	Survey
	70	van Bierendonck *et al* (2013)	Survey
	71	Vanhonacker & Verbeke (2009)	Survey
	74	Vanhonacker *et al* (2009)	Survey
	76	Vecchio & Annunziata (2012)	Survey
	78	Verbeke & Viane (1999)	Survey
	79	Vermeulen & Bienabe (2010)	Survey
	80	Vinnari *et al* (2011)	Survey
	81	You *et al* (2014)	Survey
	82	Bennett *et al* (2002)	WTP - contingent valuation
	83	Bennett *et al* (2012)	WTP - choice experiment
	84	Bennett & Larson (1996)	WTP -contingent valuation
	85	Bennett & Blaney (2003)	WTP - contingent valuation
	86	Bennett & Blaney (2002)	WTP - contingent valuation
	87	Christensen *et al* (2006)	WTP - choice experiment



88	de Jonge & van Trijp(2013)	Survey	
90	Heng *et al* (2013)	WTP - choice experiment	
91	Kehlbacher *et al* (2012)	WTP - contingent valuation	
92	Lu (2013)	WTP - choice experiment	
93	Makdisi & Maggraf (2011)	WTP - contingent valuation	
94	Moran & McVittie (2008)	WTP - contingent valuation	
95	Nocella *et al* (2012)	WTP - choice experiment	
96	Solgaard & Yang (2011)	WTP - contingent valuation	
97	Tonsor & Wolf (2009)	WTP - contingent valuation	
98	Uzea (2009)	WTP - choice experiment	
99	Bennett *et al* (2015) TBC	WTP - contingent valuation	



Key

Risk of Bias					
Very High	High	Moderate	Low	Very Low	Not Applicable

Appendix G: The strength of evidence for all included studies (summary GRADE assessment)

GRADE Criteria	Assessment	Explanation
Risk of Bias	Moderate	Only 27.7% of studies were rated as good, 28.9% as moderate and 43.3% as poor or very poor on critical assessment. Risk of bias was higher for qualitative studies, followed by mixed methods studies, with their being a higher proportion of quantitative studies with a low risk of bias. However, this could be due to their only being 9 qualitative and 9 mixed methods studies, and 62 quantitative studies.
Inconsistency	Moderate	For the majority of themes the evidence was consistent across the review e.g. overall attitudes, concerns, knowledge and the concept of welfare. However, the evidence was more conflicting across some themes, such as trust, responsibility, zoocentric vs. anthropocentric orientation and labelling, therefore there is moderate inconsistency across the review.
Indirectness	Low	The majority of the studies examined public attitudes, with only 7 (8.75%) just focusing on student populations, with only 26 studies (32.5%) not having animal welfare as the sole focus. Almost three quarters of studies (74%) were conducted in Europe, which was the main focus of the investigation.
Imprecision	High	For the qualitative studies, 85.5% stated how sure they were of the results, with just over half (57.2%) having generalizable results, due to how they selected participants. For the quantitative studies, just under a third (30.4%) explicitly mentioned identifying any co-founding factors, with only 33.3% of studies having generalizable findings (with 11.6% being unclear).
Publication Bias	Undetected	There appeared to be no difference in study outcomes between peer reviewed and non-peer reviewed literature. There was only a slight difference in the risk of bias assessment between the peer reviewed and non-peer reviewed literature too, with them having a similar proportion of good studies (27.8%), but more poor studies (55.6% compared to 38.8% peer reviewed).
Overall	Moderate	Based on evaluation of the above 5 categories, a moderate strength of evidence is found for attitudes towards animal welfare.

Appendix H: Supporting quotes for each theme

Theme (subtheme)	Source	Study Type	Associated Quotes
Concept of Welfare			
Definition Welfare	Spooner et al (2014)	Interviews	"When asked to describe what the term "farm animal welfare" conveyed to them, most participants made reference to morals or ethics and the humane rearing of animals over the course of their entire lives"
	Lusk et al (2007)	Surveys	"Overall, the public appears split between whether scientific measures or moral considerations should determine animal well- being. This result provides indication that a significant portion of the population is willing to trust scientific measures of animal happiness. However, it also suggests that a large fraction of people (39%) will be unconvinced by scientific reasoning about the well-being of animals in different production systems"
Naturalness	Spooner et al (2014)	Interviews	"Participants overwhelmingly related animal welfare to access to natural environments and the ability to express natural behaviour. Frequent references were made to animals "just being outside", "having their feet on turf, not just concrete", "grazing out" and "being able to get outside and breathe fresh air and feel daylight". Most regarded natural living as being consistent with animals' natural predispositions …Participants emphasized natural social behaviour with phrases including "it's their natural instinct to want to socialize in groups", "to have others of their kinds around", "contact between mothers and young" and to "display their normal, behavioural traits.""
	Verbeke et al (2005)	Mixed Methods	"Apart from the freshness of the meat they attach great importance to the way the meat is produced. These respondents report to want "natural" meat. For some this means produced without hormones, while for others meat has to originate from free-range animals. These respondents reason that naturally produced meat is healthier"
Humane Treatment			

Animal Health	Spooner et al (2014)	Interviews	“Participants made relatively few references to health and statements that were made were often qualified. In particular, although participants related animal health to animal welfare, they did not support efforts to protect animal health at the expense of access to natural environments”
	Frewer et al (2005)	Survey	“Factor 1 was comprised of items relating to the living environment of the animal, and factor 2 of items relating to the health of the animal. The results suggest that consumers think about animal welfare in terms of two broad categories related to their health and living environment, but do not think about welfare issues at a more detailed level”
Treatment	Ngapo et al (2004)	Focus Groups	“The French participants discussed the preventative usage of antibiotics both positively (comparing it to vaccination for humans) and negatively (destroying the ability of pigs to cope with diseases). The method of administration was also a problem, syringes being considered both acceptable and unacceptable, but was unacceptable when added to feedstuffs”
	Boogaard et al (2011)	Citizens Panel	“In order to maintain healthy animals, respondents appreciated treatment of ill animals with medicines, vaccinations, and the controlled use of penicillin and antibiotics. “Disease cannot be totally avoided. [I appreciated that] ill animals are isolated and treated. Medicine use is recorded””
Animal Type	European Commission (2005)	Survey	“Across the European Union, we observe a distinct perception of welfare and protection for each species of farmed animal. While a majority of respondents (66%) have a positive opinion of the welfare and protection of dairy cows, only 45% regard the welfare of pigs in the same light, and only 32% that of laying hens. Regarding the latter, 22% of respondents have a very negative opinion of their welfare”
	Vecchio & Annunziata (2012)	Surveys	“The conditions of laying hens are appraised to need the highest improvement in terms of welfare/protection (30%), followed by dairy cows (26%), broilers (24%), and pigs and calves (20%) “
Animal Wellbeing	Lassen et al (2006)	Focus Groups	“The pigs raised in these industrial production systems were generally characterised as unhappy and suffering. Concerns expressed included physical harm, violation of animal integrity and reduced

			autonomy … It was a widely felt that modern production technology has deprived the pigs of their ability to follow natural instincts and thus eroded their integrity”
	Te Velde et al (2002)	Interviews	“Consumers’ definitions of animal welfare are broader: they presume that, beside physical well-being, a certain kind of mental well-being is very important as well; animals have to feel good”
Behaviour	Miele et al (2011)	Mixed Methods	“Secondly, focus group-participants consistently pointed to the importance of providing natural environments for farm animals. Whilst certain elements of this naturalistic view appeared to show nostalgia for some idealised version of past farming practices (where farm animals are imagined as living happily in green fields, meadows and mountains), other elements reflected a more nuanced appreciation of the advantages and disadvantages of outdoor living, the importance of allowing animals to perform natural/instinctual behaviours, and the benefits of having animals that are ‘fit for their environments’”
	Viegas (2013)	Mixed Methods	“Intensive production was considered to be harmful for animal welfare, and issues like diminished space for movement and inability to fulfil natural behaviour were mentioned”
Castration	Kallas et al (2013)	Mixed Methods	“Regarding the question related to ‘relative importance of the different aspects (O) for pig welfare, results showed that, amongst the animal welfare aspects included in the survey, the ‘do not castrate’ aspect received the lowest value in all six countries (Table 5). Even though pig castration received the lowest score in relation to the other pig welfare features, it is important to remark that it was rated above the central point of the Likert scale used, which may indicate certain relative importance. In any case, this result could be at least partly explained by the fact that consumers were not aware of the fact that male pigs are castrated without any anaesthetic and analgesic treatments”
Cleanliness	Boogaard et al (2011)	Citizens Panel	“n general, clean and tidy sheds, pigs and farm yards were appreciated, just as clean air and water supply: “clean and nice everywhere — seems well organized” (DK22-c). Dirty and dusty sheds, dirty troughs, flies, a messy and untidy farm yard, and dirty pigs raised concerns (SCI). “Many pens and troughs were extremely dirty. Up to a point that it is not even acceptable for pigs anymore, which are not averse to a bit of dirt” (NL13-o). Respondents associated hygienic and clean farming practices

			with better conditions for the animals and low risks of disease spreading to animals and humans, whereas dirt was associated with unhygienic food production and animal diseases"
Feed	Sepúlveda et al (2011)	Survey	"As in the case of the production region, animal feeding was rated more highly by consumers than by producers … More specifically, both consumers and producers coincided in giving animal feeding the highest rating as a quality aspect at farm level"
	Ngapo et al (2004)	Focus Groups	"The feed given to the animals was discussed, largely by the men, especially in comparison to animal-based feeds and mad cow disease. The Danish participants thought that intensively reared animals are fed both concentrates, which are perhaps from genetically modified materials, and growth enhancers. The French groups did not trust the labels concerning animal feeds"
Housing System	Hall & Sandilands (2007)	Mixed Methods	"Finally, respondents were asked if they could list any issues that they were particularly concerned about, related to how farmed chickens are treated. The most common issues were 'battery rearing' and 'crowded conditions'"
	Boogaard et al (2011)	Citizens Panel	"All 26 respondents mentioned issues surrounding the housing systems, such as stocking rate (SCA 5.1), freedom to move (SCA 5.2), outside access (SCA 5.3), distraction material (SCA 5.4), straw (SCA 5.5), climate (SCA 5.6), ventilation (SCA 5.7), daylight (SCA 5.8) and atmosphere in the shed (SCA 5.9)"
Husbandry	Kjærnes & Lavik (2007)	Survey	"Large proportions say that when buying beef, they give emphasis to animal welfare factors such as treatment of the animal, slaughtering methods and outdoor access. The treatment of the animal is generally considered the most important factor, with the average proportion being 66 per cent"
	Miele et al (2011)	Mixed Methods	"Firstly, focus group participants believed that low intensity farming systems could provide better animal welfare than high intensity industrialised systems that rely on confined housing. This was due to concerns about space, freedom, the difficulty of farmers fulfilling their roles as animal carers in 'industrial' contexts"
Advantages Modernity	Boogaard et al (2011)	Citizens Panel	"Automation and mechanisation (SCA 2.2) were mentioned by half of Dutch (9) and half of Danish (4) respondents. Most respondents evaluated developments like automatic feeding system, climate

			control system, ventilation system and computer registration of the animals positively as long as these contributed to higher efficiency, increased animal health and welfare”
	Spooner et al (2014)	Interviews	“While participants clearly favoured small-scale production, some did allude to animal welfare benefits from modern technological or intensive production methods: 106: Maybe a lot of animals don't need to be free-range to have a good life … They could live very well within a barn if it's set up right…. Some wouldn't agree with me on that. They'd say, “No, they all have to be free range.“ But physically you couldn't do that. 204: I think that the technology makes things worse for them. But, on the other hand, maybe the technology, if used in a different way … could ease the suffering. Maybe … [it could] … ensure that their surroundings are clean and … that they're properly fed, and… at the right temperature”
Disadvantages Modernity	Bernard & de Cock Buning (2013)	Focus Groups	“Industrial efficiency was depicted with long rows of cramped pens and the presence of grids on the floor. In their presentations, urban-citizens spoke of the separation of sow and piglet and the re-insemination shortly after birth, docking of the tail and clipping of teeth, and the choice of unhealthy food spiked with medicines and aiming at rapid growth”
	Boogaard et al (2011)	Survey	“We measured the respondents’ appreciation of modernity by using a ‘‘modernity-index.’’3 The modernity index was the sum of seven items and had a scale running from 0 to 7; with higher scores indicating a greater desire for modernity within dairy farming and an average score of zero implying a desire for a completely natural and traditional dairy farm. Although the average score was not zero, it was still relatively low (2.15) and this suggests that respondents prefer a relatively traditional and natural type of dairy farm”
Slaughter	Spooner et al (2014)	Interviews	“Participants frequently and spontaneously expressed specific welfare concerns over animal slaughter”
	Kjærnes & Lavik (2007)	Survey	“Turning now to methods of transportation and slaughtering, we see that, in most countries, a majority is worried about welfare conditions in these situations (Table 4.1). When merging the proportions of the two most critical answer categories (1 and 2), we find that more than 40 per cent are worried for

			both issues in all countries. The exceptions are Norway and Sweden, were the ratings are much lower. In all countries, the conditions for farm animal transportation cause more worry than the methods used at the abattoirs"
Transport	Boogaard et al (2011)	Citizens Panel	"There were little comments on animal transport (SCA 4.6), only one Dutch and two Danish respondents mentioned this issue. Their main concern was the long transport time for export (SCI). However, animal transport was not visible during the farm visits. Despite the small amount of comments, animal transport should therefore not be interpreted as a non-issue"
	McEachern et al (2007)	Survey	"Regarding specific aspects of livestock production, respondents' top welfare concerns for cattle and sheep, pigs and poultry respectively were transport (77 per cent and 76 per cent respectively), housing and health equally with 69 per cent; and health (71 per cent)"
Production Diseases			
	Boogaard et al (2011)	Citizens Panel	"Respondents associated hygienic and clean farming practices with better conditions for the animals and low risks of disease spreading to animals and humans, whereas dirt was associated with unhygienic food production and animal diseases. "Everywhere there are spider webs and dust. People worry about the spread of animal diseases, while the hygiene level looks poor""
	Hall & Sandilands (2007)	Mixed Methods	"They also made some links between what was good (or bad) for the chicken and what was good (or bad) for the consumer. Hence, disease in chickens was also considered to be bad for the consumer, and overall chicken welfare was considered to be good for the consumer. Clearly this group was thinking about the issues 'beyond the chicken shed'"
Attitudes Towards Welfare Overall			
Positive	You et al (2014)	Survey	"To find out public attitude to factory rearing in China, four choices are given for respondents to select: factory rearing is ''a very good way of production'', ''a scientific way of production'', ''a way limiting the freedom of pigs and domestic fowls'', or ''a cruel way of production''. Among the 5,705 respondents,

			1,228 of them (21.5%) select ‘‘a very good way of production’’; 1,970 of them (34.5%) believe it is a scientific way; 1,357 people (23.8%) think this way limits the freedom of pigs and domestic fowls; 1,150 respondents (20.2%) dismiss this as a cruel way”
	Boogaard et al (2011)	Survey	“The overall average result (4.82) implied that respondents were more pleased than displeased with contemporary dairy farming …In general, the more familiarity and contact people had with farming, the more satisfied they were with contemporary dairy farming”
Negative	Miele et al (2011)	Mixed Methods	“Firstly, focus group participants believed that low intensity farming systems could provide better animal welfare than high intensity industrialised systems that rely on confined housing. This was due to concerns about space, freedom, the difficulty of farmers fulfilling their roles as animal carers in ‘industrial’ contexts”
	Bennett et al (2003)	Willingness to Pay	“Eighty-six percent of respondents were ‘very concerned’ or ‘somewhat concerned’ that farm animals may suffer or be mistreated (41 and 45%, respectively), whilst only 1% stated that they were ‘not at all concerned’”
Mixed	Ngapo et al (2004)	Focus Groups	“Some participants felt that there had been no change, and more particularly, no degradation, in production systems in the last 30 years. These participants also dis- cussed that some good intensive farms exist, and conversely some bad extensive farms, dependent on the individual farmer”
	Ellis et al (2009)	Survey	“Fifty percent of respondents gave dairy welfare a positive rating of good or excellent, 22% gave a negative rating (poor or very poor) and 28% stated that they didn’t know”
Public Characteristics			
Age	Maria (2006)	Survey	“Similarly, young and middle aged people had a more animal- centred opinion than older people … Women were significantly ($p<0.05$) more critical than men and young people were more critical than the middle aged or elderly”
	Boogaard et al (2011)	Survey	“Finally, people over 65 years old were significantly more satisfied with contemporary dairy farming (5.12) than those between 18 and 44 years of age (4.80–4.85) … Socio-demographic variables, and particularly age, were a significant influence on responses to these questions. People older than 65

			differed from the other age- categories in finding modernity in animal farming acceptable (4.37), and those between 25 and 34 years old considered the same developments the most unacceptable (3.68)”
Children	Tuttyens et al (2011)	Survey	“Respondents with children tended to give higher scores to most criteria as compared to respondents without children, although the difference was significant only for criteria 1, 3–5 and 8–10”
	Vanhonacker et al (2010)	Survey	“Households with children gave relatively less priority to animal welfare (p\0.05) than those without children … Households without children more strongly expressed the lack of available information (p = 0.003) and were a little more in favour of the need for stricter welfare monitoring (p = 0.036)”
Education	Tuttyens et al (2011)	Survey	“Education level did not associate with the scores, except for criterion 11: respondents with a lower level of education allocated more importance to ‘human–animal relations’ than respondents with a higher level of education”
	Sharp & Tucker (2005)	Survey	“Age and education were positively related to familiarity, while women were much less likely to be familiar with the issues … Education, residence in southwest Ohio, and residence in a suburb were negatively related to livestock welfare concern”
Familiarity	Bernard & de Cock Buning (2013)	Focus Groups	“At the start of the focus group session, most of the 21 urban-citizens stated that they had no actual experience or affinity with husbandry practices. Three had visited a farm once or a few times but not an intensive pig husbandry site”
	Boogaard et al (2001)	Survey	“People with working experience in the agricultural sector were more satisfied (5.05) with dairy farming than people with no agricultural working experience (4.83). People who had visited a farm in the last 2 years were also more positive (5.02) than those who had not recently visited a farm (4.86)”
Gender	European Commussion (2005)	Survey	“Once again women are more likely than men to display an interest in animal welfare and conditions. A larger proportion of them think that agricultural policy in their country accords too little importance to animal welfare and protection (58% as compared with 52% of men)”

	Vanhonacker et al (2010)	Mixed Methods	"Opinions did not differ strongly between socio-demographic groups. Females were slightly more in favour of stricter welfare monitoring (p = 0.026), the need for product label relating to welfare standards (p = 0.023) and showed more the willingness-to-pay for higher welfare products (p = 0.004)"
Pet Ownership	McKendree et al (2014)	Survey	"Dog and/or cat owners were found to be statistically different from those who did not own a cat or dog regarding concern for the welfare of livestock animals used in food production (Table 5). Dog and/or cat owners were statistically more concerned about the welfare of livestock animals in food production in both domestic and international markets than those who did not own a cat or dog. Dog and/or cat owners also statistically more often reported having a primary source for animal welfare than those who did not own these species"
	Boogaard et al (2006)	Survey	"Pet owners had a less positive image of farmers than respondents without a pet … Respondents without a pet value human life more than animal life, compared to pet owners … Respondents without a pet agreed more strongly that humans are allowed to use animals for consumption than pet owners"
Political Affiliation	European Commission (2005)	Survey	"Centre (33%) and in particular left (27%) sympathisers on the political spectrum are most critical of the protection and welfare of laying hens, with barely or less than one third of them having a positive opinion on this subject"
	McKendree et al (2014)	Survey	"T hose who were not concerned about the welfare of domestic food animals statistically more frequently self-reported as Republican"
Religion	Deemer & Lobao (2011)	Survey	"Catholics, those with no religious preference, those from other (non-evangelical) religions, and mainline Protestants are all more concerned about animal agriculture than evangelical Protestants. As found for dominion orientation, church attendance is related to less concern with animal agriculture while spiritual reflection upon animals is related to more concern"
	Boogaard et al (2011)	Survey	"Religious people were slightly more satisfied (5.00) with dairy farming than non-religious people (4.88)"

Rural vs. Urban	Kendall et al (2006)	Survey	"Having grown up on a farm has the strongest effect, followed by having grown up in the country, a small town, and the suburbs. People who grew up on a farm are least concerned about animal well-being. Those who grew up in other nonurban settings are less concerned about animal treatment compared to those who grew up in the city. Respondents who talk with farm people more frequently are also less concerned about animal treatment. Neither current residence or having other types of rural experiences are significant"
	Spooner et al (2014)	Interviews	"Our results showed no discernible division of views between urban and rural residents"
Vegetarians	European Commission (2005)	Survey	"The analysis of the cross-tabulations with questions related to animal welfare shows, as we might expect, that interviewees stating that they never eat meat are appreciably more critical about the welfare and protection of laying hens. Only 18% of respondents of this category had a positive view of the welfare of these animals"
	Vanhonacker et al (2010)	Mixed Methods	"There were differences between the vegetarian and non-vegetarian groups in the way that they regarded the relation between animal welfare and other product attributes. The vegetarian groups provided relatively homogenous responses, possibly due to shared values that influence their attitude towards animal welfare"
Socio-economic	Kendall et al (2006)	Survey	"Respondents from both the lower and middle income brackets are more concerned with animal treatment than are those in the upper income bracket"
	Vecchio & Annunziata (2012)	Survey	"Consistent with other studies (Marıa, 2006; Vermeir and Verbeke, 2006; Vanhonacker et al., 2007), consumers with higher levels of education and higher incomes are those with a more favourable attitude towards animal welfare, while consumer groups with more negative attitudes are more likely to have a lower level of income and educational qualification"
Role and Orientation			
Citizens vs. Consumers			

Dissonance	Ngapo et al (2004)	Focus Groups	“In the present study it was also observed that the English urban women adopted an ‘ignorance is bliss’-type attitude and did not want to know where meat comes from in terms of types of production systems (this group had great difficulty responding to this question), taste being of greater importance”
	Spooner et al (2014)	Interviews	“Participants strongly maintained that a factor contributing to poor animal welfare is the disconnection in the minds of consumers between animal products and the animals that produce them. In turn, this resulted in a lack of connection to the treatment of the animals themselves”
Dilemmas	Boogaard et al (2011)	Citizens Panel	“In the present study, people also experienced dilemmas. On the one hand, respondents strongly emphasised the importance of animals' naturalness in pig production, referring to as little human interference as possible. As such, pig production reflects ‘naturality’ referring to “farming's interactions with nature, animals and the soil but also through its dependence on nature” (Boogaard et al., 2010a: p. 34). But on the other hand, respondents appreciated certain aspects of modernity – such as hygienic farming practices, efficiency and high production – because these make pork affordable and represent technological innovations able to contribute to animal welfare, e.g. climate control and sprinkler systems”
	Viegas (2013)	Mixed Methods	“When discussing animal welfare in beef production (Table 21), the focus groups participants considered this to be a rather emotional subject, and acknowledged the contradiction between eating beef and having concerns about cattle welfare”
Guilt	Te Velde et al (2002)	Interviews	“The consumers’ perceptions are just as much related to their interests as those of farmers. In the statements of consumers, we found interests such as: healthy, tasteful, and cheap meat that is easily available (preferably in the supermarket), and a clean conscience. The need for a clean conscience is comparable to the wish for a license to produce. At the core of these needs lies the need for justification and reducing feelings of guilt”

	Harper & Henson (1999)	Focus Groups	"Consumers were keen to alienate the product from its origin in order to allow them guilt-free consumption. A number of participants stated that if they 'thought about it', they would not be able to eat the products"
Zoocentric	Boogaard et al (2011)	Citizens Panel	"Most respondents agreed that pigs may be used for human consumption (SCA 1.3), but they were concerned about the way pigs – as living beings – were treated in the contemporary systems (SCI). "[I feel] sad and disappointed, because actually it is not so much about the animals. But it is all about the production of meat. I wonder mostly why and how humans have become like this, that this is necessary" (NL6)"
	Spooner et al (2014)	Interviews	"Participants appeared to consider animals to have intrinsic value beyond their utilitarian value to humans. In this context, many emphasized reciprocity, stressing the need for mutually beneficial relationships between producers and animals. Participants also cited a moral need to provide animals with good lives in exchange for the sacrifice demanded of them. In short, farm animals were to be recognized as sentient beings deserving of respect and appreciation beyond provision of basic care and comfort"
Anthro-pocentric	Schröder & McEachern (2004)	Interviews	"In the present study, farm animal welfare clearly emerged as an aspect of palatability. There was a general sense that if you chose to eat meat, you were likely to be the source of some cruelty to some animal at some point"
	Te Velde et al (2002)	Interviews	"The values and norms of consumers seem to be based on the same convictions as those of farmers: animals are meant to serve humans ("pigs are less important than people are"), meat is a necessary element of the human diet ("When I have dinner without meat it feels as if I have had not really eaten"), keeping animals and killing them for meat is legitimate ("these cows and pigs exist to produce meat"), and farmers are there to feed the rest of the population ("these people just do their work")"
Behaviour			

Product Consumption	Ngapo et al (2004)	Focus Groups	"Some French and the Danish groups were emotional when talking about intensive rearing conditions, yet all of these groups willingly admitted that their purchasing habits were not influenced by these images"
	Toma et al (2011)	Survey	"Attitudes toward animal welfare significantly impact behaviour in a positive relationship; that is, the stronger the welfare-friendly attitudes, the more frequent the consumption of free-range and organic chicken meat … Socioeconomic group has a significant positive impact on stated behaviour in both models, which shows that more educated people belonging to higher social grades are more likely to consume free-range and organic chicken meat on a frequent basis"
Willingness-to-pay			
Unwilling to Pay	Vanhonacker et al (2009)	Survey	"These findings confirm that reported concern and interest in the issue of animal welfare in general and the welfare for laying hens and broilers more specifically do not translate equally in consumer buying behaviour. The attitude-behaviour inconsistency is mainly situated in the 3 groups with the lowest engagement in pro-welfare behaviour, suggesting a low significance of interest and concern in the buying decision process of higher welfare eggs and chicken meat"
	Yue et al (2014)	Survey	"Shown in the above data, a little more than half of the public are willing to pay more for pork reaching the standards of animal welfare"
Willingness to Pay	Ellis et al (2009)	Survey	"Most respondents (92%) stated they would pay more for milk if good welfare could be guaranteed, with 37% of respondents stating they would pay more than 30% extra if welfare could be guaranteed"
	Lusk et al (2007)	Survey	"Given that consumers understand the trade-off between animal happiness and meat prices, what is their willingness to make this trade-off? The question below shows that consumers generally feel that the well-being of farm animals is more important than low meat prices. This suggests that individuals are willing to accept some increase in meat prices if it is necessary to ensure farm animal well-being"
Characteristics	Christensen et al (2006)	Willingness to Pay	"In the present survey, utility of food safety and animal welfare were not directly affected by income levels. However, the respondents with the highest income level were less price sensitive than the low income groups"

	Boogaard et al (2011)	Survey	"People's knowledge and experiences also played a role, with people who had visited a farm in the past 2 years being more willing to pay extra (5.18) than those who had not visited a farm (5.02) … People over 65 years of age were the most willing to pay extra (5.29) and people between 18 and 24 were the least willing to pay extra (4.98)"
Barriers and Facilitators			
Cost	Schröder & McEachern (2004)	Interviews	"As a teenager, Urban 1 became upset about meat production and turned vegetarian. She took a job at McDonald's when at university, causing her to abandon both her vegetarianism and her self-perception as a caring person. Intends to resume ethical consumption as soon as finances permit"
	Makdisi & Marggraf (2011)	Willingness to Pay	"Nearly 82.3% of the respondents were willing to pay extra for certified FAW products, while the rest (17.7%) objected paying more. The reason behind rejecting paying more in the pilot study was mostly (85%) because consumers could not afford high prices"
Availability	Vanhonacker et al (2010)	Mixed Methods	"High welfare products were generally thought be less widely available (''…the problem for consuming more is the limited availability (G1)…''), carry a higher price and trustworthiness of the label/claim to be questionable"
	Vecchio & Annunziata (2012)	Survey	"Several questions explored consumer purchasing behaviour of animal-friendly foods: interviewees were asked if animal-friendly products were easily available in food stores and to state their buying frequency. On analysing the results in Fig. 2, it emerges that 66% of the respondents consider such products not at all available in normal food stores, while only 7% considers these foods easily available"
Personal Influence	European Commission (2005)	Survey	"The respondents who believe that buying animal welfare friendly products could have a positive impact on the welfare of farm animals, think more often about animal welfare when purchasing meat (49% versus 28% for those who don't)"
	Vanhonacker et al (2010)	Mixed Methods	"Focus groups also thought that consumers were partly responsible. Vegetarians in particular emphasized the effects of contemporary lifestyles (''…mankind has a feeling of superiority, he wants more and more (G2)…only buy what is necessary for a healthy life (G4)…eating no or fewer animal

			products has an impact on mass production (G4)…''). Participants varied in their opinions over this issue: Some thought that consumers can influence the system by buying more animal friendly products, while others did not see how they could have an impact given the lack of direct involvement"
Prioritisation	Hall & Sandilands (2007)	Mixed Methods	"When asked for unprompted factors that influenced their choice when buying chicken meat the most common factors were 'quality/freshness' and 'price', followed by 'appearance' and 'how it is farmed/whether it is organically farmed'. However, when prompted with specific factors those most commonly indicated were 'sell-by date' and 'appearance', followed by 'quality food labelling' and 'price'"
	Lassen et al (2006)	Focus Groups	"By contrast, immaterial qualities – i.e. things connected with the way the food is produced, such as animal welfare and environment – were by and large little discussed during this first period. When the context changed from the everyday to a production context in which pork was framed as an agricultural product, the topics of discussion reversed dramatically"
Association Other Attributes	Miele et al (2011)	Mixed Methods	"Finally, focus group participants' understandings of what counts as good animal welfare were far less circumscribed than scientific understandings and participants inextricably linked issues of animal welfare with issues of environmental sustainability, food quality/taste and human health"
	Bennett et al (2012)	Willingness to Pay	"Eighty-one percent thought that meat from animals with high welfare has better food safety, 78% that it was healthier, 71% that it had better nutritional value and 69% that it tasted better, whilst 79% thought it was also better for the environment"
Labelling			
Negatives	Harper & Henson (1999)	Focus Groups	"Participants in all groups and all countries expressed a very high cynicism about the credibility of labels"
	Viegas (2013)	Mixed Methods	"Negative reactions to labels: Unclear claims, excess information, difficult comprehension, unreliable logos"

Positives	Frewer et al (2005)	Survey	"Respondents were enthusiastic about the use of a labelling system to identify products made using animal friendly production systems"
	Moran & McVittie (2008)	Willingness to Pay	"Animal welfare is of concern to three-quarters of respondents, although knowledge of production systems and the effect of this concern on purchase decisions is lower at around 50%. Indeed, only 38% of respondents look for production information on product labels, whilst 23% agreed that such information was easy to find"
Mediators			
Trust			
Trust	Vanhonacker et al (2010)	Mixed Methods	"Considering the source of the information, participants stressed the importance of objectivity and expertise, with information being scientifically sound (i.e., credible and reliable) and straightforward (i.e., simple and understandable)"
	Christensen et al (2006)	Willingness to Pay	"The respondents state that only information from the government or public authorities is credible, whereas information from the producers/industry divides the population in two – one group trusts them and the other group mistrusts them"
Distrust	Vanhonacker et al (2010)	Mixed Methods	"A third source was related to a general distrust in the beef production chain. This distrust was either related to the production system, the actors and/or the sources of information. Intermediaries, slaughterhouses, meat processing industries and beef packaging companies were generally considered not to be reliable actors or trustworthy sources of information"
	Nocella et al (2012)	Willingness to Pay	"About 80% of respondents considered the improvement of the selected standards to be either "quite important" or "very important." However, the likelihood of stakeholders' compliance with these improvements dis- plays strong uncertainty. Almost half of the respondents believed it unlikely that stakeholders will comply"
Responsibility			

	Schröder & McEachern (2004)	Interviews	"It was found that respondents who tended to delegate responsibility for animal welfare in this way had various motives. The first of these may be defined as frustration, with individuals having tried, unsuccessfully, to make sense of meat advertising, labelling and claims. The second reason for delegating responsibility might be described as resignation, where a consumer feels powerless to effect change, believing that their individual consumption habits will not make any difference to the status of animals within society. Thirdly, many individuals lack any involvement and feel that animal welfare is principally an issue for government and not for consumers"
	Lusk et al (2007)	Survey	"Returning to the question of who bears responsibility for animal welfare, the answer appears to be everyone. Consumers believe their food purchases matter— consumers are responsible …"
External Organisations	European Commission (2007)	Survey	"Three other stakeholders are also seen as having an important role to play, being mentioned by around a quarter of all surveyed. These are veterinarians (26%), national governments16 (25%) and animal protection organisations (24%)"
	Vinnari et al (2013)	Survey	"Also, veterinarians and slaughterhouses were considered highly responsible for animal welfare in Finland. On the other hand, the media, consumers, and non-governmental organizations (NGOs) were actors to whom people attributed only a low responsibility for animal welfare"
Government	Te Velde et al (2002)	Interviews	"Consumers also shift responsibility for animal welfare. They point at the government ("the government should design sufficient and effective laws with respect to animal welfare"), and to retailers ("they should offer meat that is produced in an 'animal friendly' way")"
	Vanhonacker et al (2010)	Mixed Methods	"Government was seen as having an important responsibility, especially in formulating labels, monitoring welfare, and disbursing subsidies. The participants agreed that the responsibility did not lie solely with one actor, but that there is a need for more general awareness and change in mentality"
Legislation	European Commission (2005)	Survey	"When asked about the existence of European legislation to promote the welfare and protection of farmed animals, a majority of European Union citizens (57%) believe that such legislation exists with regard to the transport and the slaughter of farmed animals. However they seem less convinced (44%) of the existence of this type of legislation regarding the conditions under which the animals are

			reared on farms. Finally, nearly one respondent in five (19%) states that they do not know of the existence of any European legislation in these fields"
	You et al (2014)	Survey	"Among 5,772 respondents, 4,712 of them think it is necessary; whereas 1,060 of them don't think so, with the proportion being 81.6% and 18.4% respectively. Judging from this, the necessity of establishing animal welfare laws is widely recognized by the public in China"
Retailers	Clonan et al (2010)	Survey	"The results of our study indicate that there is a strong desire for supermarkets to make sure food is produced responsibly"
	Hall & Sandilands (2007)	Mixed Methods	"They viewed the supermarkets as having a negative effect on broiler chicken welfare, leading to over- crowded sheds, stress, and pressure on farmers' profits"
Farmers	Lassen et al (2006)	Focus Groups	"Many participants refused to blame the individual farmer, but instead pointed to a number of structural factors, mostly of an economic nature, which together force producers to produce pigs in the way they do"
	Spooner et al (2014)	Interviews	"Participants were not unsympathetic to the economic realities of contemporary farm animal production and did not want to hamper individual producers or their families as this would amount to "punishing the wrong people" …Nonetheless, many participants were critical of what they regarded as an excessive focus on profit which, they maintained, had contributed to intensive animal production. For example, participants saw profit and greed as detrimental to animal interests, humanity and kindness"
Knowledge			
Good Knowledge	McEachern et al (2007)	Survey	"Similar to Berry and McEachern's (2005) conclusion that ethical consumption is often accompanied by a greater desire to gain knowledge, the role of knowledge as a precursor to attitudes is significant, as attitudes towards animal welfare (ATT2) and the media (ATT4) formed an antecedent to moral obligation (MO). Moreover, all respondents that purchased "Freedom Food" branded meat were aware of and confident about their knowledge of the underpinning production standards"

	Harper & Henson (2001)	Mixed Methods	"For poultry production, German, Irish, British, Italian and French consumers feel 'somewhat informed'. In the case of beef, German, Irish and French consumers feel 'somewhat informed' about production methods, whilst the British and Italian consumers feel 'somewhat uninformed'"
Poor Knowledge	Lassen et al (2006)	Focus Groups	"…problems during transportation and at the abattoirs were seldom topics arising during the interviews. Ignorance of pig welfare issues arising beyond the farm gate may, of course, reflect better welfare maintenance at these stages in the production chain. However, it is more likely that it is the result of lay people in Denmark being more familiar with farms than the rest of the production chain"
	Te Velde et al (2002)	Interviews	"The vagueness of the norms that the consumers came up with can be ascribed to a lack of concrete knowledge of the circumstances in which meat livestock lives. What they do know is based on fortuities: an incidental visit to a farm, stories they heard or documentaries they saw on television"
More Knowledge	Schröder & McEachern (2004)	Interviews	"All respondents expressed the wish to be properly informed both by the government and by food retailers, the emphasis here being on information rather than prescriptive advice"
	Spooner et al (2014)	Interviews	"Participants occasionally acknowledged that they lacked first-hand knowledge about intensive rearing methods. One participant, for example, "heard how they're kept in cages that are so small that they can't even turn around", but also noted "not that I'm an expert in this." Furthermore, some expressed willingness to acquire more factual information before drawing conclusions, even if that meant overturning longstanding assumptions. For example, one participant emphasized "I need to have a more balanced view"
Sources of Information	Vanhonacker et al (2010)	Mixed Methods	"Other potential information sources mentioned were butchers, farmers, schools, advertising, educational and documentary television programs, leaflets (although these were thought to have a limited impact), and labelling … They preferred a neutral source (e.g., the government instead of animal welfare organizations), recognizing the potential influence of vested interests and their tendency to highlight only one side of the story"

	Ngapo et al (2004)	Focus Groups	“Participants in all countries admitted that their views were dominated by images generated by the media and the reality of the reports was questioned, few had actual first-hand experience or knowledge of the systems”

Appendix I: WTP systematic review protocol

A protocol for a meta-analysis of consumers' and citizens willingness-to-pay for farm animal welfare and disease prevention.

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Abstract

This article outlines a protocol for a meta-analysis into willingness-to-pay (WTP) for farm animal welfare. The analysis seeks to establish the publics' WTP for farm animal welfare and whether there is evidence to support niche markets for products produced to designated, and usually higher, welfare standards. A number of secondary objectives will also be explored in relation to the heterogeneity within the data relating to a number of variables known to vary within existing data including; animal species, welfare measures, socio-demographic and socio-economic characteristics.

The protocol outlines the rationale, objectives, inclusion criteria, search strategy and screening processes for the meta-analysis, and the plans for data extraction, risk of bias and data synthesis.

Introduction

Background

Farm animal welfare is of increasing ethical concern to both European citizens and consumers (European Commission, 2007; Shaw, Shui & Clarke, 2000), relating to either altruistic or utilitarian ethical concerns (Johansson-Stenman, 2006).

Willingness-to-pay (WTP) is a measure of value to an individual (Hanley *et al,* 2011) and is defined as the price premium or maximum price an individual is willing to sacrifice for a good (Breidert, Hahsler & Reutterer, 2006). Typically WTP studies have tried to quantify consumers concerns in relation to the value placed on animal lives, their welfare conditions (Lagerkvist & Hess, 2011) and the higher expected benefits including product quality, that consumers generally associate with improved welfare (Verbeke, 2009).

Numerous studies have aimed to establish the public's WTP for animal products produced to a designated welfare standard, and their findings provide evidence to support a WTP for a variety of different products across a number of different countries (Napolitano *et al,* 2008; Carlsson, Frykblom & Lagerkvist*,* 2007; Bennett, 1996). These findings highlight a niche market for products produced to a designated, and usually higher than minimum standard of production (Wathes *et al*, 2013), where consumers derive value from the improved welfare conditions used.

Many such WTP studies have been synthesised into a meta-analysis by Lagerkvist & Hess (2011) which attempted to address a number of aspects in relation to data heterogeneity including; labelling, law changes, animal species, nationality, WTP method, and participant socio-economic and socio-demographic factors.

The review thereby acknowledges the large number of moderator variables that need to be explored in relation to WTP for farm animal welfare, a number of which have been found to have varying effects of explaining heterogeneity including different animal welfare aspects (Napolitano *et al*, 2008), socio-demographic variables (Bernard & Bernard, 2009; Bennett, 1996) and socio-economic characteristics (Carlsson, Frykblom & Lagerkvist*,* 2007), the latter two being important segmentation variables. There is also evidence that WTP differs between animal species (Cicia &Colantuoni, 2010; Carlsson, Frykblom & Lagerkvist, 2007), which is an important

aspect to explore due to the implications it could have for producers of different animal species.

However, publication bias remains in the meta-analysis with the author's grey literature search being limited to the searching of reference lists and Google searching for key author websites, with the authors acknowledging that their review was not as comprehensive as it could have been. This study aims to take additional steps to limit publication bias by searching different databases, Google Scholar and consulting experts in the field in an attempt to retrieve additional sources of grey literature.

The previous meta-analysis also failed to distinguish between citizens, consumers and those that were vegetarian or non-vegetarian. Although these population characteristics may not be highlighted by all studies, they are potentially important moderator variables of WTP that warrant further exploration, particularly in relation to policy implications concerning the wider acceptability of farm animal welfare standards.

This systematic review will update and extend the work done by Lagerkvist & Hess (2011) to establish consumer WTP for farm animal welfare, incorporating more recent studies to provide producers and policy makers with the best available current information to aid decision making in relation to production systems and legislation. By further exploring heterogeneity in the included data more detailed findings can also be presented to stakeholders that will enable these stakeholders to make more informed decisions.

The findings and recommendations from the review will aid producers with the identification of potentially profitable niche marketing opportunities (Breidert, Hahsler & Reutterer, 2006). Also, far less is known about the value of the benefits accrued from improvements to animal production systems compared to the economic costs incurred as a result of improving the production systems, which are relatively well understood (Bennett *et al*, 2012). Therefore this research will aid in the cost-benefit evaluations of these in relation to the adoption of higher welfare systems (Cicia & Colantuoni, 2010).

Additionally the findings may provide information as to the acceptability of interventions to reduce and prevent production diseases, which form an important part of welfare strategies going forward (PROHEALTH, 2013).

Policy makers will benefit from a greater understanding of the public's positioning in relation to farm animal welfare enabling them to construct the most appropriate procedures to facilitate and monitor the implementation of designated farm animal welfare standards and interventions to prevent production diseases going forward. The findings of the review will also provide recommendations for future research into WTP for farm animal welfare, relating to gaps in the current literature and aspects of heterogeneity that warrant further investigation.

Objectives

Primary objectives

As outlined in section 1.1 there is a need to identify, critically appraise and summarise the public's WTP for farm animal welfare. This will be determined by the primary objectives which aim to establish:

What are the public WTP for production animal welfare?

What are the public WTP for interventions to reduce production diseases?

Is there evidence to support niche markets for products produced to higher animal welfare standards?

Secondary objectives

A number of secondary objectives will also be addressed and will be used to examine the fungibility of the data in relation to the primary objectives. These will help explore heterogeneity in the data and aid in the provision of more in-depth recommendations from the meta-analysis. The secondary outcomes are as follows:

Does animal species affect the public's WTP for farm animal welfare?

Do socio-demographic characteristics such as nationality, age and gender affect the public's WTP for farm animal welfare?

Do socio-economic characteristics such as income, education and occupation affect the public's WTP for farm animal welfare?

Does being vegetarian affect the public's WTP for farm animal welfare?

Is there a difference between consumers and citizens WTP for farm animal welfare?

Do choice set characteristics, such as number of attributes or options affect the public's WTP for farm animal welfare?

Interpretation of the effect of magnitude

A positive WTP is expected from consumers for farm animal welfare ranging from a few pence to several pounds, with the magnitude of their WTP depending on several factors including age, gender and animal species as discussed in the secondary objectives.

It is likely that a proportion of respondents of included studies will exhibit a higher WTP than average. This will provide evidence of niche markets for products produced to higher standards of animal welfare, with socio-economic and socio-demographic variables explaining heterogeneity in the data likely to be important segmentation variables.

Additionally, the proportion of individuals of WTP for farm animal welfare is likely to have increased over time, reflecting and increased media coverage and subsequent retailer response given to animal welfare over recent years

Criteria for considering studies for the review

Types of study to be included

Empirical studies of a quantitative design are to be included in the review, specifically those that examine consumer and citizens WTP for animal welfare and so provide data to address the primary objectives. Both stated and revealed preference measures of WTP will be considered. This includes, but is not limited to; market data, conjoint analysis, auctions, contingent valuation, choice experiments, dichotomous choice studies and existing review articles of WTP for animal welfare, as highlighted in table 1. Only studies written in English will be included.

Types of participants

The study population for the review will be consumers of animal products, and wider citizens of the EU (table 1). Studies focusing on specific subgroups of the population and non-EU citizens will be included but variation in population characteristics will be considered in relation to the overall strength of evidence.

Types of outcome measures

WTP is defined as the maximum amount of money an individual is willing to give up in order to obtain a certain benefit or to avoid a certain factor (Hanley, Shogren & White, 2001), and for the review will be considered as the price premium expressed by participants to purchase products to defined farm animal welfare standards. This price premium will be expressed in Euros, as standardised by the exchange rate at the time of study publication, and as the proportion of participants WTP across specific price thresholds.

Secondary outcomes will be measured as mean ± standard deviation, confidence intervals, or as the percentage of participants who meet a certain criteria e.g. vegetarian.

Table 1: Eligibility criteria

Study design	English, quantitative empirical; conjoint analysis, auction dichotomous choice, contingent valuation, choice experiments, additional methods of willingness to pay and intention to purchase
Population	Consumers and/ or citizens
Outcome	Willingness-to-pay, intention-to-purchase, price premium

Search strategy for the identification of studies

Search strategy

A number of subject specific electronic databases will be searched; Scopus, AgEcon Search and ISI Web of Knowledge, and will include all studies published over the past 15 years. Google Scholar will also be searched as a source of grey literature.

In order to further reduce publication bias two further sources of grey literature will be examined. Firstly key authors in the field will be consulted to check for any unpublished findings and additional sources of information (Higgins & Green, 2011), and secondly reference lists of included studies will be checked for any further references not returned from the database searches.

Search terms will be refined after several trial searches to ensure the most successful search strategies are used. Face validity of the searches will be

addressed by checking returned searches for key authors and articles, including the 24 studies included in the Lagerkvist & Hess (2011) meta-analysis.

Search strategies will be tailored for each database searched, with the specific search strategies to be reported in an Appendix in the final review. The core list of search terms for the review can be found in table 2. All search terms were included in the topic, keyword, title and abstract sections of each individual database searched and used in conjunction with the Boolean operator AND as highlighted.

Where search sensitivity is low species related terms will be used to increase specificity, as highlighted in italics in table 2.

Table 2: Keywords considered for search

Type of Study and Outcome	valu*OR intention*OR behav*OR purchas*OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref*OR economic OR reject* OR consumer
AND	
Animal Species[1]	farm animal OR production animal *pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef*
AND	
Animal Welfare	animal welfare OR health OR disease OR welfare OR production disease

[1] Where search sensitivity is low species related terms will be used to increase specificity

Search screening

EndNote libraries will be constructed, with the principle researcher removing all duplicates before the results are sifted according to the eligibility criteria in table 1. An overview of the search process will be included in a PRISMA flow chart (Moher *et al*, 2009) for ease of reference.

The search results will then be filtered in a two stage process as outlined below. Decisions of whether to include and exclude the articles will be noted in the EndNote entry for each result.

Title and abstract search: In addition to the full title the abstract of these studies will also be read by the primary researcher so as to minimise the risk of error (Higgins & Green, 2011). A second reviewer will then review at least 10% of the studies. Any differences between the two researchers will be resolved through discussion. Again if there is any doubt at this stage then the study will be included for stage two. If abstracts are not available at this stage then they will be included for stage two.

Full text search: the full text of all included studies will be read and assessed for relevance by the primary researcher. A second researcher will then again review at least 10% of the studies. Any differences in decisions related to study eligibility will be discussed by the review authors.

Details of excluded studies will be provided at the full text stage only, listing the primary reason for exclusion in relation to the hierarchy of exclusion. Details of excluded studies at stage one can be obtained by contacting the corresponding author.

Methods of the review

Inclusion criteria

The eligibility of studies will be base on the inclusion criteria in table 1 and the search screening process outlined in section 4.2.

Assessment of risk of bias

The validity and the impact of bias will be addressed by use of a critical appraisal document that will examine a number of quality criteria that has the potential to impact on the results of the study. The document will assess the; construct validity, internal and external validity and reliability of studies, as described by Yin (2009).

The quality appraisal tool (under development) will meet the guidelines in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011), Campbell Collaboration (2001) guidelines and recommendations provided by the Centre for Reviews and Dissemination (2009), to provide a document not based in a healthcare context.

No studies will be excluded based on the quality assessment tool, but the findings will be taken into account during the evidence synthesis. Quality appraisal will inform the overall assessment of strength of evidence and may inform sensitivity analysis.

Any differences in decisions related to study quality will be discussed by the review authors.

Data management and extraction

Data will be extracted from the included studies using a data extraction form to allow for efficient meta-analysis and meta-regression, and will be designed in relation to both the primary and secondary objectives of the study. All WTP data will be extracted and expressed in relation to the base prices provided in the study so as to provide a price premium and values will be converted into Euros, so as to provide a consistent valuation unit. Inflation will be accounted for by the use of the purchasing power parity indices in relation to WTP values, and the consumer price index for income. Information in relation to the following variables will be extracted: participant characteristics, focus (animal type, product and welfare aspects), study methodology and design, outcome measures, results and implications will also be extracted. Additionally sample sizes will be recorded in order to provide weight for the meta-analysis.

Free text fields will be minimised as much as possible, although the option to comment on each section will be provided to ensure that any additional details or researcher comments are taken into consideration. The form will be trialled by two independent researchers on five papers from the Lagerkvist & Hess (2011) meta-analysis, to check that it extracts all relevant information.

All data will be extracted by the primary and a secondary researcher independently, to again check for potential errors. Where information is missing efforts will be made to contact the authors to obtain further details (Higgins & Green, 2011).

Data synthesis

Descriptive results of the review will first be presented, detailing the study characteristics and findings. A cumulative meta-analysis will also be undertaken to establish if any changes in WTP over time are apparent.

Random effects meta-analysis and meta-regressions will be conducted (further details to be provided at a later date). Simulation procedures will be used to derive variances for weighting based on the sample sizes of the studies. AIC will be used to minimise over fitting when exploring heterogeneity (Koricheva, Gurevitch & Mengersen, 2013). Sensitivity analyses will be conducted to explore the risk of bias

where appropriate. Similarly, funnel plots and tests of funnel plot asymmetry will be used to assess potential publication bias despite their known limitations.

If excessive heterogeneity is detected in the data then a narrative synthesis will instead be conducted. Effects will still be generated for comparative reasons with the pooled effect considered meaningless. The narrative analysis of the information extracted which will follow guidance laid out in the ESRC Narrative Synthesis Guidance document (Popay *et al*, 2006), and will explore the variations and commonalities in the data.

The adaptive grade framework (Meader *et al*, 2013) will be used to assess the strength of evidence, and again will be adapted to reflect the non-healthcare setting. Finally the implications of the review will be discussed in relation to the context of the objectives and wider policy and production implications.

Acknowledgements

The author would like to thank the advisory group for consultation of the protocol and associated quality appraisal documents.

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Supplementary Information

Feedback

Feedback on the protocol from the advisory team was obtained and gratefully received.

Plans for updating the protocol

Section 5.4 relating to data synthesis will be confirmed after critical appraisal, but prior to the extraction of outcomes, once the nature of the data has become apparent. Data finalisation of the critical appraisal tool will also be reported

Anticipated contributions of authors

Protocol development: BC, GS
Run search: BC
Identification relevant titles: BC
Identification relevant titles and abstracts: BC
Identification relevant studies: BC
Obtain relevant studies: BC
Data extraction: BC
Quality appraisal: BC, GS
Data analysis and interpretation: BC, GS, LP, LF
Draft review: BC, GS, LP, LF

Advisory group

The advisory group consisted of Richard Bennett, Richard Tranter, Philip Jones (University of Reading), Jarkko Niemi and Latvala Terhi (MTT Agrifood Research Finland).

Declarations of interest

Gavin Stewart is an associate editor of Peer J. Lynn Frewer has previous publications relating to animal welfare and the Theory of Planned Behaviour.

Sources of support

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Preliminary timeframe

Protocol development: October - November 2014
Database searching: December 2014
Data sifting: December 2014 – January 2015
Data extraction: January – February 2015
Quality appraisal: February- March 2015
Data analysis: March –May 2015
Key conclusions: May 2015

Appendix J: Trial and final search terms for the WTP review

Scopus

Include 'life sciences' and 'social sciences and humanities' only
Use of AND, OR and NOT functions are indicated in bold
Article title, abstract and keyword search
Search all years

Search 1

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 16 returned all years, no key papers or authors included

Search 2

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal AND animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being

Search date: 06/01/2014
Results returned: 1 result returned all years, no key papers or authors included

Search 3

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 39 results returned, 1 key paper and 4 key authors included

Search 4

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef AND NOT chickenpox OR

chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) OR (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever) AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 159 results returned,

Search 5

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) OR (production animal) AND (animal welfare) OR (production disease)

Search date: 06/01/2014
Results returned: 13,070 results returned, 8 key papers and 5 key authors included

Search 6

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014
Results returned: 1,851 results returned, 6 key papers and 6 key authors included

Search 7

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014

Results returned: 1,851 results returned, 6 key papers and 6 key authors included

Search 8

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) OR (animal OR (farm animal)) OR welfare OR (production disease)

Search date: 06/01/2014
Results returned: 5,180,616 results returned, 4 key papers and 4 key authors included

Search 9

(willingness to pay) AND (farm animal OR production animal) AND welfare

Search date: 06/01/2014

Results returned: 30 results returned, 5 key papers and 3 key authors returned

Search 10

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) OR (production animal) AND (animal welfare) OR (production disease)

Search date: 06/01/2014
Results returned: 91 results returned, 7 key papers and 6 key authors included

ISI Web of Knowledge

Search all databases
Search for topic
Use of AND, OR and NOT functions are indicated in bold
First 150 results searched key papers
Searched 1995-2015

Search 1

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 19,758 results returned, 4 key papers and 3 key authors included

Search 2

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal AND animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being

Search date: 06/01/2014
Results returned: 19, 826 results returned, 4 key papers and 3 key authors included

Search 3

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 125,555 results returned, 2 key paper and 3 key authors included

Search 4

valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND farm animal OR production animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef NOT chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) OR (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever) AND animal welfare OR health OR disease OR welfare OR production disease

Search date: 06/01/2014
Results returned: 118, 812 results returned, 3 key papers and 3 key authors included

Search 5

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) OR (production animal) AND (animal welfare) OR (production disease)

Search date: 06/01/2014
Results returned: 13,835 results returned, 7 key papers and 4 key authors included

Search 6

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014
Results returned: 2,749 results returned, 6 key papers and 5 key authors returned

Search 7

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014
Results returned: 2,882 results returned, 6 key papers and 5 key authors returned

Search 8

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer

OR demand OR choice) OR (animal OR (farm animal)) OR welfare OR (production disease)

Search date: 06/01/2014
Results returned: 12,386,852

Search 9

(willingness to pay) AND (farm animal OR production animal) AND welfare

Search date: 06/01/2014
Results returned: 102 results returned, 8 key papers and 4 key authors returned

Search 10

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014 *excludes all bar veterinary sciences, agriculture, zoology, food science & technology, behavioural sciences, business economics, psychology, social sciences other topics, sociology*

Results returned: 1,783 results returned, 3 key papers and 3 key authors returned

Search 11

valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer AND (farm animal) AND welfare OR (production disease)

Search date: 06/01/2014 *social science only papers*
Results returned: 565 results returned, 6 key papers and 5 key authors returned

AgEcon

Search 'anywhere in record'
Search the entire database
Use of AND, OR and NOT functions are indicated in bold
No date restrictions (ordered by date, newest first)
Search 1

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014
Results returned: 67 results returned, no key papers or authors included

Search 2

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal) AND (animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being)

Search date: 06/01/2014
Results returned: 4 results returned, no key papers or authors included

Search 3

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014
Results returned: 106 results returned, no key authors or papers included

Search 4

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND NOT (chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district)OR (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever)) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014
Results returned: 62 results returned, no key authors or papers included

Search 5

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND ((farm animal) OR (production animal)) AND ((animal welfare) OR (production disease))

Search date: 08/01/2014
Results returned: 363 results returned, 1 key paper and 1 key author included

Search 6

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal) AND (welfare OR (production disease))

Search date: 08/01/2014
Results returned: 361 results returned, 1 key paper and 2 key authors included

Search 7

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (farm animal) AND (welfare OR (production disease))

Search date: 08/01/2014
Results returned: 146 results returned, 1 key paper and 2 key authors included

Search 8

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) OR (animal OR (farm animal)) OR (welfare OR (production disease))

Search date: 08/01/2014
Results returned: 51, 105 results returned, no key authors or papers in first 300 results

Search 9

(willingness to pay) AND (farm animal OR production animal) AND welfare

Search date: 08/01/2014
Results returned: 13 results returned, 1 key author included

Search 10

(valu* OR purchas* OR (willingness to pay) OR pref* OR consumer OR demand OR choice) AND (animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef)

Search date: 08/01/2014
Results returned: 51, 105 results returned, no key authors or papers in first 300 results

Search 11

((willingness to pay) OR consumer OR demand OR valu* OR pref* OR choice) AND ((farm animal) OR (production animal) OR animal OR welfare)

Search date: 08/01/2014
Results returned: no results returned

Search 12

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef)

Search date: 12/01/2014
Results returned: no search results returned

Google Scholar

Exclude patents and citations
Sort by relevance
First 150 results searched for key papers
Searched 1995-2015

Search 1

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014
Results returned: 19,100 results returned, 5 key papers and 4 key authors included

Search 2

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal) AND (animal welfare OR health OR disease OR welfare OR production disease OR animal wellbeing OR animal well-being)

Search date: 06/01/2014
Results returned: 19,100 results returned all years, 5 key papers and 4 key authors included

Search 3

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR

bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014
Results returned: 16, 500 results returned, 3 key papers and 4 key authors returned

Search 4

(valu* OR intention* OR behav* OR purchas* OR WTP OR willingness to pay OR willingness to buy OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal OR production animal OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) NOT (chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever)) AND (animal welfare OR health OR disease OR welfare OR production disease)

Search date: 06/01/2014

Results returned: 19,300 results returned, 5 key papers and 4 key authors returned

Search 5

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal) OR (production animal) AND (animal welfare) OR (production disease)

Search date: 06/01/2014
Results returned: 19,100 results returned, 2 key papers and 3 key authors included

Search 6

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer) AND (farm animal) AND (welfare OR (production disease))

Search date: 06/01/2014
Results returned: 20,000 results returned, 2 key papers and 3 key authors included

Search 7

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (farm animal) AND (welfare OR (production disease))

Search date: 06/01/2014
Results returned: 20,000 results returned, 2 key papers and 3 key authors included

Search 8

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) OR (animal OR (farm animal)) OR welfare OR (production disease)

Search date: 06/01/2014
Results returned: 20,000 results returned, 2 key papers and 2 key authors included

Search 9

(willingness to pay) AND (farm animal OR production animal) AND welfare

Search date: 06/01/2014

Results returned: 19, 700 results returned, 6 key papers and 4 key authors included

Search 10

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (animal OR (farm animal) OR welfare OR (production disease)

Search date: 08/01/2014
Results returned: 19,900 results returned, 2 key papers and 1 key author

Search 11

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (animal OR (farm animal) OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) NOT (chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever)) OR welfare OR (production disease)

Search date: 08/01/2014
Results returned: 19,700 results returned, 4 key papers and 3 key authors

Search 12

((willingness to pay) OR consumer OR demand OR valu* OR pref* OR choice) AND ((farm animal) OR (production animal) OR animal OR welfare

Search date: 08/01/2014
Results returned: 36,300 results returned, 6 key papers and 4 key authors included

Search 13

(valu* OR intention* OR behav* OR purchas* OR WTP OR (willingness to pay) OR (willingness to buy) OR ITP OR buy OR pref* OR economic OR reject* OR consumer OR demand OR choice) AND (animal OR (farm animal) OR (production animal) OR pig* OR swine* OR sow* OR hog* OR broiler* OR chick* OR fowl OR turkey* OR hen* OR egg* OR meat OR pork OR piglet OR weaner OR poult* OR cattle*OR bovine*OR cow*OR beef OR horse*OR fish*OR ovine*OR sheep*OR caprin*OR lamb*OR mutton OR milk OR goat OR duck* OR turkey OR goose OR meat OR dairy OR beef) NOT (chickenpox OR chickpea OR (egg AND freezing) OR (guinea AND pig) OR (hard AND boiled AND eggs) OR (health AND district) (hen AND harrier) OR (meat AND consumption) OR pigweed OR (pickling AND eggs) OR (swine AND fever)) OR welfare

Search date: 08/01/2014
Results returned: 18,300 results returned, 4 key papers and 4 key authors

Search 14

((willingness to pay) OR consumer OR demand OR valu* OR pref* OR choice) AND ((farm animal) OR (production animal) OR animal OR welfare OR (production disease)

Search date: 08/01/2014
Results returned: 20,200 results returned, 2 key papers and 3 key authors included

Search 15

(willingness to pay) AND (farm animal OR production animal) AND (welfare OR (production disease))

Search date: 12/01/2014
Results returned: 19, 300 results returned, 2 key papers and 2 key authors included

Appendix K: Studies included in the WTP review and excluded at the full text stage

Studies included in the WTP review

- Allender, W.J. & Richards, T.J. (2010). Consumer Impact of Animal Welfare Regulation in the California Poultry Industry, *Journal of Agricultural and Resource Economics*, 35(3), pp. 424-442.
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Appendix L: WTP review summary of included studies

Paper	Year data collection	Number of measures	Country	Sample size	Population	Method	Animal species
Bennett *et al* (2012)	2012	3	UK	300	Citizens	Choice Experiment	Beef cows, pigs, broiler chickens
Bennett & Blaney (2002)	2002	1	UK	164	Students	Contingent Valuation	Pig
Bennett *et al* (2002)	1998	2	UK	119	Students	Contingent Valuation	Animals in general and layer hens
Bennett (1998)	1996	1	UK	591	Citizens	Contingent Valuation	Layer hens
Bennett (1996b)	1996	2	USA	140	Students	Contingent Valuation	Layer hens and calves
Napolitano *et al* (2008)	2008	6	Italy	104	Consumers	Auction	Dairy cows
Moran & McVittie (2008)	2005	1	England	318	Citizens	Contingent Valuation	Broiler chickens
Liljenstolpe (2011)	2002	36	Sweden	1250	Citizens	Choice Experiment	Pig
Burgess & Hutchinson (2005)	2003	5	Northern Ireland	192	Citizens	Contingent Valuation	Layer hens, dairy cows, broiler chickens, pigs
Zanoli *et al* (2012)	2008	4	Italy	145	Consumers	Choice Experiment	Beef cows
Bernard & Bernard (2009)	2005	2	USA	154	Citizens	Auction	Dairy cows
Doherty & Campbell (2014)	2010	6	UK and Republic of Ireland	1173, 400	Citizens	Choice Experiment	Broiler chickens
Elbakidze & Nayga (2012)	2009	8	USA	215	Citizens	Auction	Dairy cows
Lopez-Galan *et al* (2013)	2013	1	Spain	803	Consumers	Choice Experiment	Layer hens
Heid & Hamm (2013)	2009	4	Germany	89	Consumers	Auction	Pig
Grimsrud *et al* (2013)	2010	4	Norway	737	Citizens	Choice Experiment	Salmon
Rolfe (1999)	1997	2	Australia	100, 224	Citizens	Contingent Valuation	Layer hens

Heng *et al* (2013)	2012	4	USA	449	Consumers	Choice Experiment	Layer hens
Uzea *et al* (2011)	2008	20	Canada	541	Consumers	Choice Experiment	Pigs
Loureiro *et al* (2013)	2010	6	Spain	92, 62	Consumers	Auction	Pigs
Olesen *et al* (2010)	2004	1	Norway	84	Consumers	Real choice experiment	Salmon
Lusk & Norwood (2011)	2011	6	USA	126, 134	Citizens	Auction	Layer hens and pigs
Nocella *et al* (2010)	2007	5	France, Germany, Italy, Spain, UK	133, 155, 792, 160, 182	Citizens	Contingent Valuation	General
Lusk *et al* (2007)	2004	2	USA	594	Citizens	Choice Experiment	Pigs
Makdisi & Marggraf (2011)	2007	1	Germany	300	Citizens	Contingent valuation	Broiler chickens
McFadden *et al* (2012)	2012	12	USA	29	Citizens	Contingent Valuation and Conjoint Analysis	Layer hens
Lusk *et al* (2003)	2000	8	France, Germany, UK , USA	93, 45, 109, 566	Citizens	Choice Experiment	Beef cows
Lagerkvist *et al* (2006)	2005	8	Sweden	285	Consumers	Choice Experiment	Pigs
Koistinen *et al* (2013)	2010	28	Finland	1623	Consumers	Choice Experiment	Beef cows
Lusk *et al* (2006)	2004	2	USA	291, 432	Citizens	Conjoint Analysis and Contingent Valuation	Pigs
Connor & Oppenheim (2008)	2007	2	USA	253	Consumers	Contingent Valuation	Beef cows and dairy cows
Bennett & Blaney (2003)	1996	1	UK	446	Citizens	Contingent Valuation	Layer hens
Bennett & Larson (1996)	1996	3	USA	137	Students	Contingent Valuation	Layer hens and calves
Carlsson *et al* (2007a)	2002	2	Sweden	450	Citizens	Choice Experiment	Layer hens
Allender & Richards (2010)	2008	1	USA (California)	993	Consumers	Hedonic Analysis	Layer hens
Carlsson *et al* (2005a)	2003	30	Sweden	710	Citizens	Choice Experiment	Broiler chickens, beef cows, pigs, dairy cows, layer hens

Carlsson *et al* (2007B)	2004	12	Sweden	395, 362	Consumers	Choice Experiment	Broiler chickens and beef cows
Goddard *et al* (2007)	2005	3	Canada (Alberta and Ontario)	292, 248	Citizens	Hedonic Analysis	Layer Hen
Tonsor *et al* (2009a)	2007	10	USA	205	Citizens	Choice Experiment	Pigs
Pozo *et al* (2012)	2012	10	USA	1312	Citizens	Choice Experiment	Pigs
Tonsor *et al* (2009b)	2008	1	USA	768	Citizens	Contingent Valuation	Pigs
Solgaard & Yang (2009)	2009	1	Denmark	1000	Citizens	Contingent Valuation	Fish
Ubilava *et al* (2010)	2004	2	USA	197	Citizens	Choice Experiment	Pigs
Olynk & Ortega (2014)	2011	12	USA	500, 399	Citizens	Choice Experiment	Dairy cows, pigs
Andersen (2011)	2000	2	Denmark	844	Consumers	Choice model	Layer hens
McVittie *et al* (2006)	2005	9	England	336, 318	Citizens	Choice Experiment and Contingent Valuation	Broiler chickens
Lu (2013)	2013	14	Canada	518	Citizens	Choice Experiment	Layer hens
Viagas *et al* (2014)	2013	1	Portugal	613	Consumers	Choice Experiment	Beef cows
Vander Naald *et al* (2011)	2006	2	USA	240	Citizens	Conjoint Analysis	Broiler chickens
Satimanon & Weatherspoon (2010)	2007	1	USA	207	Consumers	Hedonic pricing	Layer hens
Olynk *et al* (2010a)	2008	32	USA	669	Citizens	Choice Experiment	Pigs
Morbak *et al* (2010)	2006	2	Denmark	1322	Consumers	Choice Experiment	Pigs
Chung *et al* (2009)	2007	4	Korea	1000	Consumers	Choice Experiment	Beef cows
Christensen *et al* (2006)	2005	2	Denmark	2301	Consumers	Choice Experiment	Broiler chickens

Appendix M: WTP critical appraisal tool

Considerations				
Type of Study		Standard	Criteria	Risk of Bias*
Revealed Preference Measures	Hedonic	Normal	Linear models, criteria based on previous research	Moderate
		Good	Panel data or scanner data, criteria based on previous research	Low
	Real Choice Experiment	Normal	If two or more of the below are not mentioned	Moderate
		Good	Reminded budget constraints, provided with information,	Low
	Auctions	Normal	Reminded budget constraints, practice in the method beforehand	Moderate
		Good	BDM Lottery/ Vickrey auctions, participants trained/ practiced in the method, made clear that participants have a commitment to buy, reminded budget constraints	Low
Stated Preference Measures	Conjoint Analysis	Normal	If two or more of the below are not mentioned	Moderate
		Good	Opt out provided, reminded budget constraints, prior qualitative research, cheap talk script used	Low
	Choice Experiment	Normal	Cheap talk script not used, non-orthogonal design, prior qualitative research	Moderate
		Good	Use of a cheap talk script, orthogonal/ main effects design, cyclical or full/ fractional factorial design maintaining orthogonality, D-optimal design, prior qualitative research	Low
	Contingent Valuation Methods	Normal	Open-ended choice, if more than two of the below are not mentioned	Moderate
		Good	Single bounded, one and one half bounded, double bounded dichotomous choice, reminded budget constraints, realistic choices, cheap talk script , payment card or payment scale	Low
Modelling Used				
Revealed Preference Measures	Hedonic	Normal	Linear models	Moderate
		Good	Semi log model, log-log models, non-linear models	Low
	Real Choice Experiment	Normal	Multinomial and mixed multinomial logit models, probit model, conditional logit model, descriptive statistics	Moderate
		Good	Random parameter logit (mixed logit model), latent class model, nested logit model, random co-efficient logit model	Low
	Auctions	Normal	Descriptive or multivariate statistics, ordinary least squares	Moderate
		Good	Tobit model, random effects tobit model, log-linear model	Low

Stated Preference Measures	Conjoint Analysis	Normal	Probit model, ordinary least squares, non-linear least squares	Moderate
		Good	Logit model	Low
	Choice Experiment	Normal	Multinomial logit model, conditional logit model	Moderate
		Good	Mixed logit model (random parameter logit, WTP-Space model, random co-efficient logit model, mixed multinomial logit model), latent class model, multinomial probit model	Low
	Contingent Valuation Methods	Poor	Descriptive statistics	High
		Normal	Binary logit model (binomial logit model), probit model	Moderate
		Good	Ordered probit model, tobit model	Low
Directness				
Population	General citizen or consumer	Good	Looking at consumers of specified product(s) or wider citizens in general	Low
	Specific population	Normal	Appropriateness of the sample for the product in question (relevance and representativeness)	Moderate
Represen-tativeness	Quota or stratified sample	Good	The sample used is representative of the chosen population in most aspects, national sales data, clustered sampling technique	Low
		Normal	The sample used is representative of the chosen population in only one aspect, regional sales data	Moderate
	Simple random or systematic sample	Normal	A randomly sample of the chosen population, convenience sample, supermarket sample	Moderate

*Where no information is provided, or it is unclear, the risk of bias will be rated as high for that given aspect

NB) Novel or modified methods will be assessed based on the criteria of similar traditional methods e.g. Calibrated Auction Conjoint Method and Matching Method

Appendix N: Critical appraisal of all WTP studies

Study	Causation						Directness			Overall Risk of Bias
	Type	Rating	Risk of Bias	Model	Rating	Risk of Bias	Population	Representative	Risk of Bias	
Bennett *et al* (2012)	Choice Experiment	Normal	Moderate	Mixed Logit Model	Good	Low	Citizens	Stratified, quota sample contacted randomly	Low	Low
Bennett & Blaney (2002)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Low	Students	Random and convenience	Moderate	Moderate
Bennett *et al* (2002)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Moderate	Students	Unclear how chosen	Moderate	Moderate
Bennett (1998)	Contingent valuation	Normal	Moderate	Descriptive Statistics	Poor	High	Citizens	Random stratified sample by socio-economic characteristics	Low	High
Bennett (1996)	Contingent valuation	Normal	Moderate	Probit Model	Normal	Moderate	Students	Described as *a sample*	Moderate	Moderate
Napolitano *et al* (2008)	Auction	Good	Low	Multivariate Statistics	Normal	Moderate	Consumers	Screening criteria, mostly students	Moderate	Moderate
Moran & McVittie (2008)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Moderate	Citizens	Stratified for age and gender, no sampling method	Moderate	Moderate
Liljenstolpe (2011)	Choice Experiment	Normal	Moderate	Latent Class model	Good	Low	Citizens	Unclear due reporting, sample obtained from database	Moderate	Moderate
Burgess & Hutchinson (2005)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Moderate	Citizens	random sample using electoral register	Low	Moderate

Zanoli *et al* (2012)	Choice Experiment	Good	Low	Multinomial Logit Model, Multiple Variations of Random Parameter Logit Model (inc. WTP-Space Model)	Good	Low	Consumers	Quota sample of beef consumers, and occassional organic purchasers	Moderate	Low
Bernard & Bernard (2009)	Auction	Normal	Moderate	Descriptive Statistics	Normal	Moderate	Citizens	Random sample using ads, local organizations	Moderate	Moderate
Doherty & Campbell (2014)	Choice Experiment	Normal	Moderate	Latent Class Model	Good	Low	Citizens	Representative sample collected by research agency	Low	Low
Elbakidze & Nayga (2012)	Real Choice Experiment	Normal	Moderate	Descriptive Statistics	Normal	Moderate	Citizens	Mostly students, no real information on sampling procedure	Moderate	Moderate
Elbakidze & Nayga (2012)	Auction	Normal	Moderate	Descriptive Statistics	Normal	Moderate	Citizens	Mostly students, no real information on sampling procedure	Moderate	Moderate
Gracia *et al* (2014)	Choice Experiment	Good	Low	Latent Class model	Good	Low	Consumers	Stratified, random sample of consumers	Low	Low
Heid & Hamm (2013)	Auction	Normal	Moderate	Descriptive statistics	Poor	High	Consumers	Quota sample, recruitment strategy unclear	Moderate	High
Grimsrud *et al* (2013)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Citizens	Stratified and random	Low	Low

								sampling to be representative		
Rolfe (1999)	Contingent valuation	Normal	Moderate	Binomial Logit Model	Normal	Moderate	Citizens	A random sample of households	Moderate	Moderate
Heng *et al* (2013)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Consumers	Nationally representitive, stratified sample. Use screening questionnaire	Low	Low
Uzea *et al* (2011)	Choice Experiment	Normal	Moderate	Latent Class Model	Good	Low	Consumers	Representative sample collected by research agency	Low	Low
Loureiro *et al* (2013)	Auction	Normal	Moderate	Random Effects Tobit Model	Good	Low	Consumers	Random stratified procedure by age	Moderate	Moderate
Olesen *et al* (2010)	Real Choice Experiment	Good	Low	Random Parameter Logit Model	Good	Low	Consumers	Participants recruited locally is only information	High	Moderate
Lusk & Norwood (2011)	Auction	Good	Low	Descriptive Statistics	Normal	Moderate	Citizens	Randomly recruited by market research companies	Moderate	Moderate
Nocella *et al* (2010)	Contingent valuation	Good	Low	Binary Logit Model	Normal	Moderate	Citizens	Randomly recruited online	High	High
Lusk *et al* (2007)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Citizens	Random sample matched to be representative	Low	Low
Makdisi & Marggraf (2011)	Contingent valuation	Normal	Moderate	Binomial Logit Model	Normal	Moderate	Citizens	Unclear	High	High
McFadden *et al* (2012)	Contingent valuation	Normal	Moderate	Descriptive Statistics	Poor	High	Citizens	A quota sample	Moderate	High

McFadden et al (2012)	Conjoint analysis	Unclear	High	Non-Linear Least Squares	Normal	Moderate	Citizens	A quota sample	Moderate	High
Lusk *et al* (2003)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Citizens	Representative sample accessed through private companies	Low	Low
Lagerkvist *et al* (2006)	Choice Experiment	Good	Low	Binary Logit Model	Normal	Moderate	Consumers	Random sample of the census registry	Low	Low
Koistinen *et al* (2013)	Choice Experiment	Normal	Moderate	Conditional Logit Model and Latent Class Model	Good	Low	Consumers	Representative of internet users	Moderate	Moderate
Lusk *et al* (2006)	Choice based conjoint analysis	Normal	Moderate	Multinomial Logit Model	Normal	Moderate	Citizens	Participants recruited in a grocery store	Moderate	Moderate
Connor & Oppenheim (2008)	Contingent valuation	Unclear	High	Tobit Model	Good	Low	Consumers	Sample of consumers from outside supermarket	Moderate	High
Bennett & Blaney (2003)	Contingent valuation	Good	Low	Binary Logit Model	Normal	Moderate	Citizens	Random stratified sample by socio-economic characteristics	Low	Low
Bennett & Larson (1996)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Moderate	Students	Convenience sample of students	Moderate	Moderate
Carlsson *et al* (2007b)	Choice Experiment	Good	Low	Random Parameter Logit Model	Good	Low	Citizens	Sample from census date	Moderate	Low

Allender & Richards (2010)	Hedonic Pricing	Good	Low	Random Parameter Logit Model	Good	Low	Consumers	From homescan database	Low	Low
Carlsson *et al* (2005)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Consumers	Random sample from census registry	Low	Low
Carlsson et al (2007a)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Consumers	Random sample from census registry	Low	Low
Goddard *et al* (2007)	Hedonic Pricing	Normal	Moderate	Conditional Logit Model	Normal	Moderate	Consumers	From homescan database	High	High
Goddard *et al* (2007)	Choice Experiment	Unclear	High	Conditional Logit Model	Normal	Low	Citizens	Unclear - a market research agency was used	High	High
Tonsor *et al* (2009a)	Choice Experiment	Good	Low	Random Parameter Model and Latent Class Model	Good	Low	Citizens	Unclear, used a market research agency	Moderate	Low
Pozo *et al* (2012)	Choice Experiment	Good	Low	Multinomial Logit Model and Random Parameter Model	Good	Low	Citizens	Representative sample using market research agency	Low	Low
Tonsor et al (2009)	Contingent valuation	Normal	Moderate	Binary Logit Model	Normal	Moderate	Citizens	Representative sample using panel data	Low	Moderate
Solgaard & Yang (2009)	Contingent valuation	Unclear	High	Binomial Logit Model	Normal	Moderate	Citizens	Representative sample using panel data	Low	High
Ubilava *et al* (2010)	Choice Experiment	Unclear	High	Random Parameter Logit Model	Good	Low	Citizens	Representative sample	Moderate	High

Olynk & Ortega (2014)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Citizens	Representative sample using panel data	Low	Low
Andersen (2011)	Choice Model	Good	Low	Mixed Multinomial Logit Model	Normal	Moderate	Consumers	Retail purchase data	Low	Low
McVittie *et al* (2004)	Choice Experiment	Moderate	Normal	Multinomial Logit Model	Normal	Moderate	Citizens	Stratified sample	Moderate	Moderate
McVittie *et al* (2004)	Contingent valuation	Moderate	Normal	Binary Logit Model	Normal	Moderate	citizens	Stratified sample	Moderate	Moderate
Lu (2013)	Choice Experiment	Moderate	Normal	Conditional Logit Model	Normal	Moderate	Citizens	Unclear	High	High
Viagas *et al* (2014)	Choice Experiment	Good	Low	Random Parameter Logit Model	Good	Low	Consumers	Stratified random sample	Low	Low
Vander Naald *et al* (2011)	Conjoint Analysis	Normal	Moderate	Conditional Logit Model	Normal	Low	Citizens	Chosen from jury register	Moderate	Moderate
Satimanon & Weatherspoon (2010)	Hedonic Analysis	Good	Low	Hedonic Model	Unclear	High	Consumers	Sales data	Low	Moderate
Olynk *et al* (2010a)	Choice Experiment	Normal	Moderate	Random Parameter Logit Model	Good	Low	Citizens	Representative, used a market research agency	Low	Low
Morbak & Norstrom (2009)	Choice Experiment	Good	Low	Random Parameter Logit Model	Good	Low	Consumers	Recruited online through an agency	Moderate	Low
Chung *et al* (2009)	Choice Experiment	Normal	Moderate	Multinomial Logit Model and Mixed Multinomial Logit Model	Normal	Moderate	Consumers	Convenience sample of supermarket shoppers	Moderate	Moderate
Christesen *et al* (2006)	Choice Experiment	Good	Low	Multinomial Probit Model	Good	Moderate	Consumers	Panel data, random quota sample	Low	Low

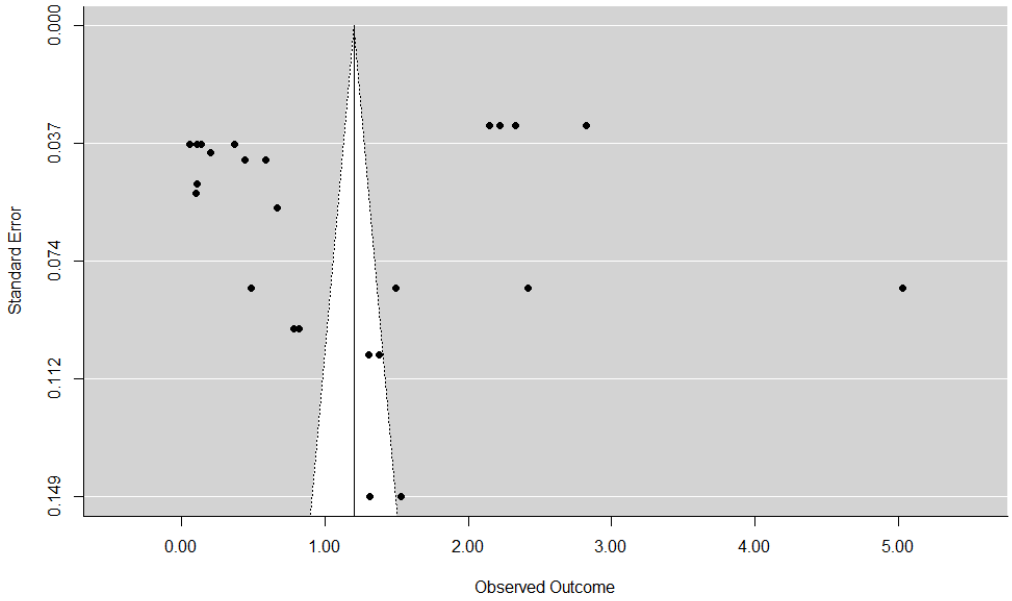
Appendix O: The strength of evidence of all WTP studies

Outcome	No. studies (no. measures)	Risk of Bias	Imprecision	Inconsist-ency	Indirect-ness	Publication Bias	Overall Strength of Evidence	Effect Magnitude (95% CI)	Adjusted WTP
Complete Case Studies	37	Moderate	Moderate	High	Moderate	Strongly Suspected	Low	0.6302 (0.5016, 0.7587)	€ 0.27
Overall (Complete case and imputed value studies)	54	Moderate	Moderate	High	Moderate	Strongly Suspected	Low	0.5709 (0.4599, 0.6819)	€ 0.34
Aggregated (by paper)	54	Moderate	Low	High	Moderate	Strongly Suspected	Low	0.4690 (0.2075, 0.7036)	€ 0.92
Pigs	13(90)	Low	Moderate	High	Moderate	Strongly Suspected	Low	0.2843 (0.1936, 0.3750)	€ 0.54
Layer Hens	10 (47)	Moderate	Moderate	Moderate	Moderate	Strongly Suspected	Moderate	0.7823 (0.3594, 1.2053)	€ 0.09
Broiler Chickens	8 (26)	Moderate	Moderate	High	Low	Strongly Suspected	Low	0.4024 (0.2653, 0.5394)	€ 1.24
Dairy Cows	7 (27)	Moderate	High	High	Moderate	Strongly Suspected	Low	1.2276 (0.7776, 1.4575)	€ 0.50
Beef Cows	7 (24)	Low	High	High	Low	Strongly Suspected	Low	1.022 (0.7294, 1.6750)	€ 5.00
Multiple	2 (6)	High	Moderate	Moderate	Low	Strongly Suspected	Low	0.6547 (0.4206, 0.8888)	€11.20
Calves	1 (1)	Moderate	High		High		Low	4.8344 (4.6526, 5.0162)	€8.69
Fish	3 (6)	Moderate	Low	Moderate	Low	Strongly Suspected	Moderate	0.3712 (-0.0073, 0.7497)	€3.53
UK	7 (27)	Moderate	High	High	Low	Strongly Suspected	Low	0.6479 (0.5113, 0.7845)	€ 1.72
Northern Europe	8 (76)	Moderate	Moderate	Moderate	Low	Strongly Suspected	Moderate	0.1060 (0.0376, 0.1744)	€ 0.41
Western Europe	3 (7)	High	High	Moderate	Low	Strongly Suspected	Low	1.0741 (0.7720, 1.7630)	€ 4.28

Southern Europe	6 (23)	Moderate	High	High	Low	Strongly Suspected	Low	1.4329 (0.9577, 1.9082)	€ 0.68
Asia	1 (4)	Moderate	High		High		Low	2.3820 (2.0842, 2.6799)	€ 5.40
North America	16 (90)	Moderate	High	Moderate	High	Strongly Suspected	Low	0.7515 (0.5026, 1.0004)	€ 0.15
Citizens	26 (187)	Moderate	Moderate	Moderate	Moderate	Strongly Suspected	Moderate	0.5122 (0.3810, 0.6435)	€ 0.33
Consumers	11 (40)	Low	High	High	Moderate	Strongly Suspected	Low	1.1796 (0.8287, 1.5304)	€ 0.25
Age	24 (156)	Moderate	Low	High	Moderate	Undetected	Moderate	-0.0377 (-0.0530, -0.0224)	€ 0.19
Income	19 (123)	Moderate	Low	High	Moderate	Undetected	Moderate	0.0207 (0.0131, 0.0284)	€ 0.11
% Female	26 (157)	Moderate	Low	Moderate	Moderate	Undetected	Moderate	0.0086 (-0.0002, 0.0175)	€ 0.19
% Vegetarian	6 (59)	Low	Low	Moderate	Low	Undetected	High	-0.7024 (-0.9654, -0.4394)	€ 0.25
Education	15 (74)	Moderate	Low	High	Moderate	Strongly Suspected	Low	0.0246 (0.0113, 0.0379)	€ 0.17
Revealed Preference	8 (31)	Moderate	High	High	Moderate	Undetected	Low	1.1935 (0.9077, 1.4793)	€ 0.41
Stated Preferences	29 (196)	Moderate	Moderate	High	Moderate	Strongly Suspected	Low	0.5416 (0.4035, 0.6796)	€ 0.25
Cheap talk script used	9 (83)	Low	Low	Moderate	Low	Strongly Suspected	Moderate	0.3595 (0.2259, 0.4932)	€ 0.11
Cheap talk script not used	20 (113)	Moderate	Moderate	Moderate	Moderate	Strongly Suspected	Low	0.6758 (0.4600, 0.8916)	€ 0.50
Cheap talk script not needed	8 (31)	Moderate	High	High	Moderate	Undetected	Low	1.1935 (0.9077, 1.4793)	€ 0.41

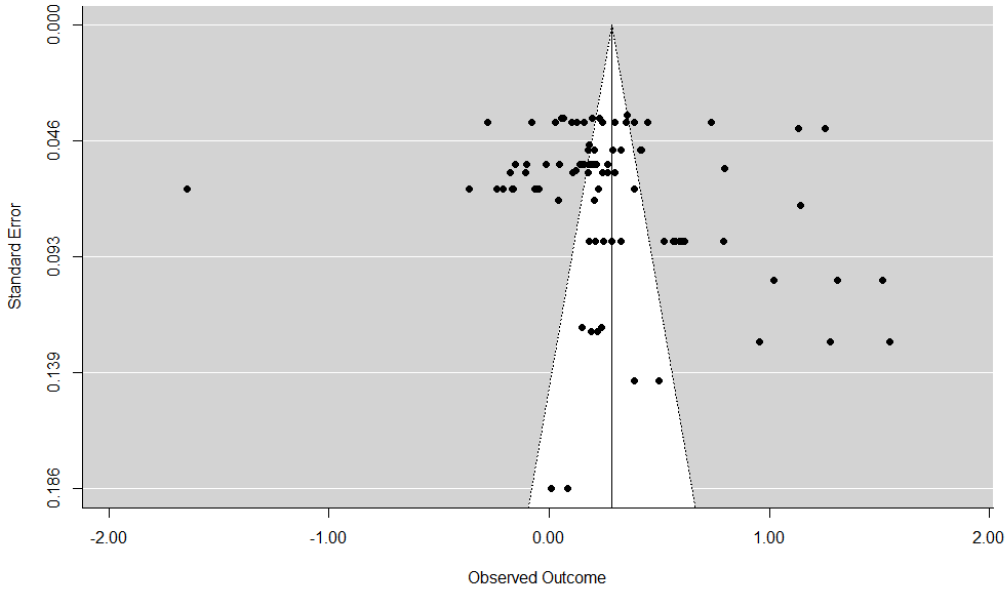
Appendix P: Funnel plots from the sub-group analysis

Animals

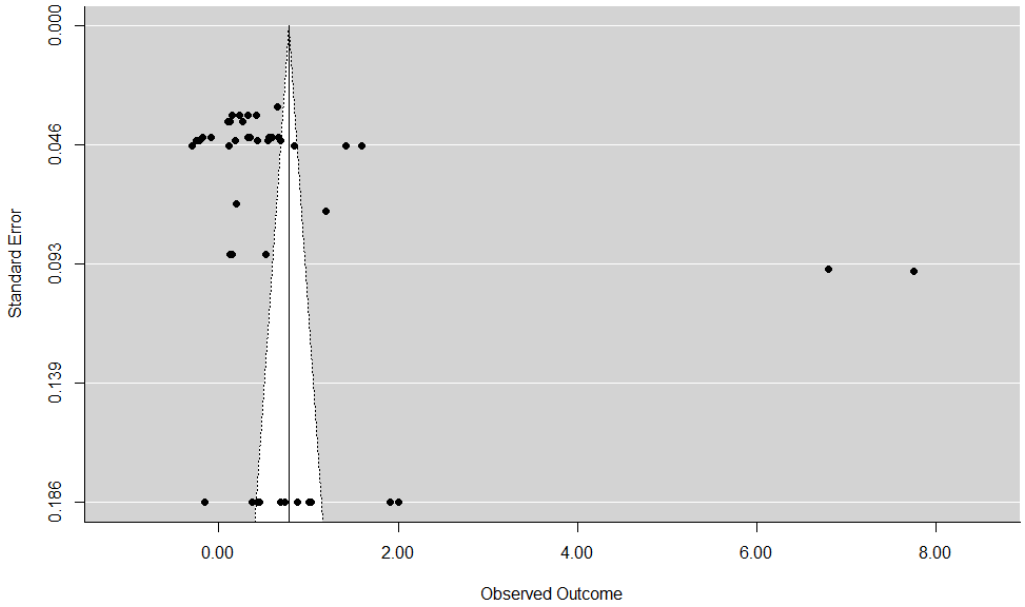


Beef Cow

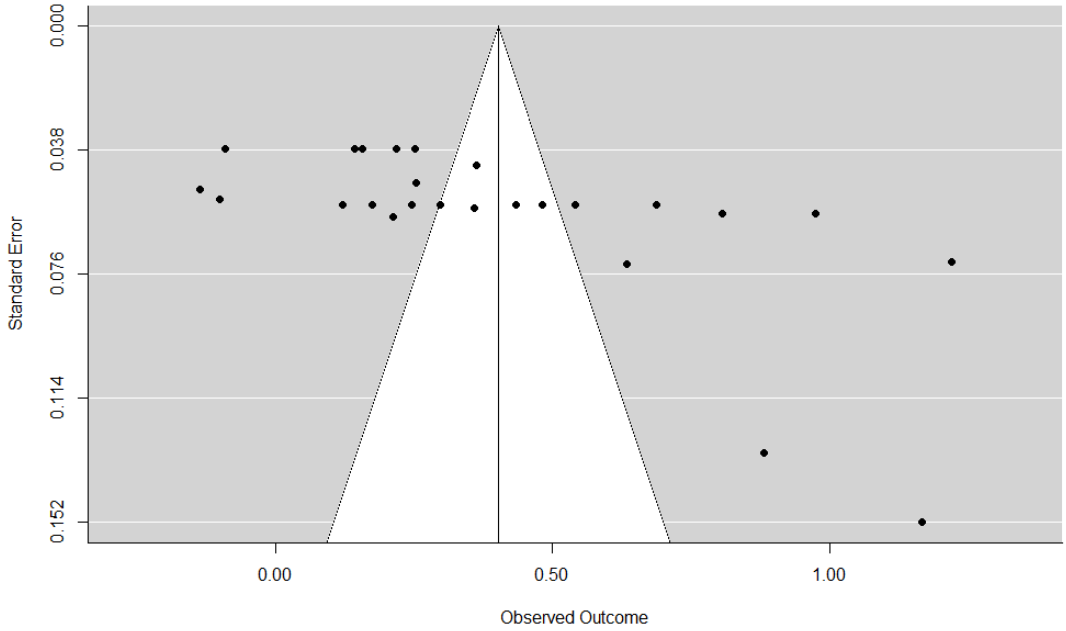
Pigs



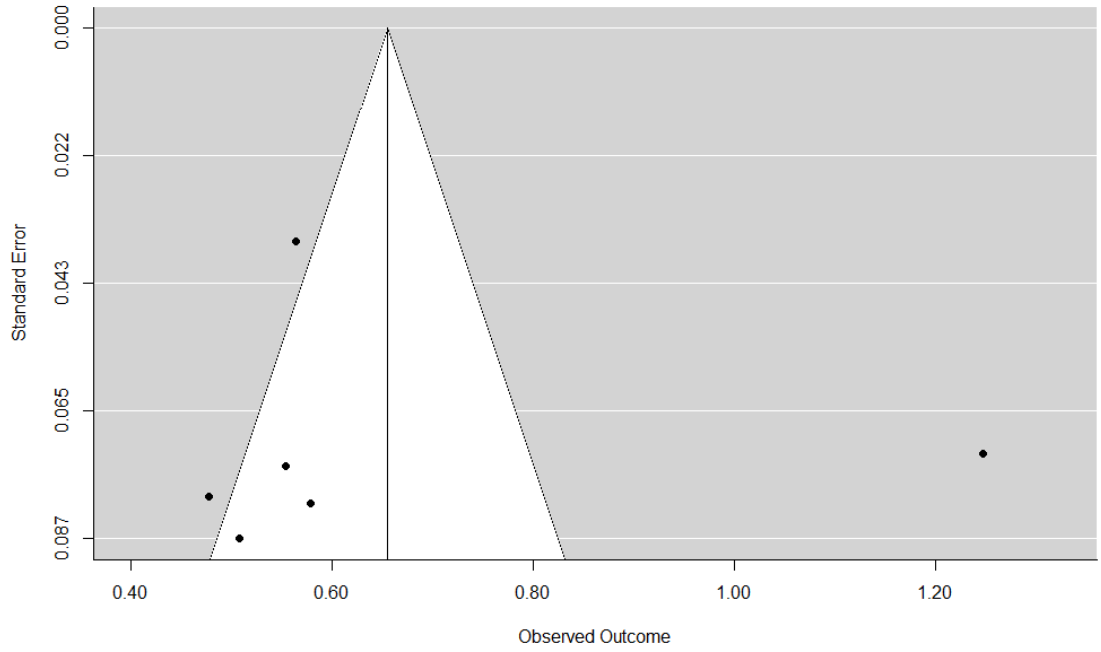
Layer hen



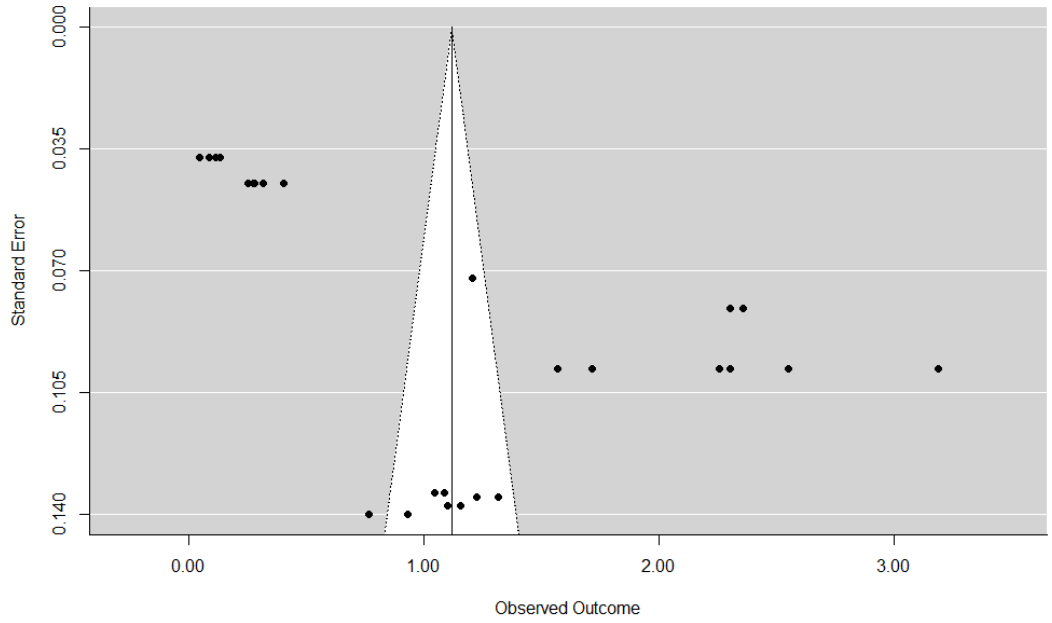
Broiler chicken



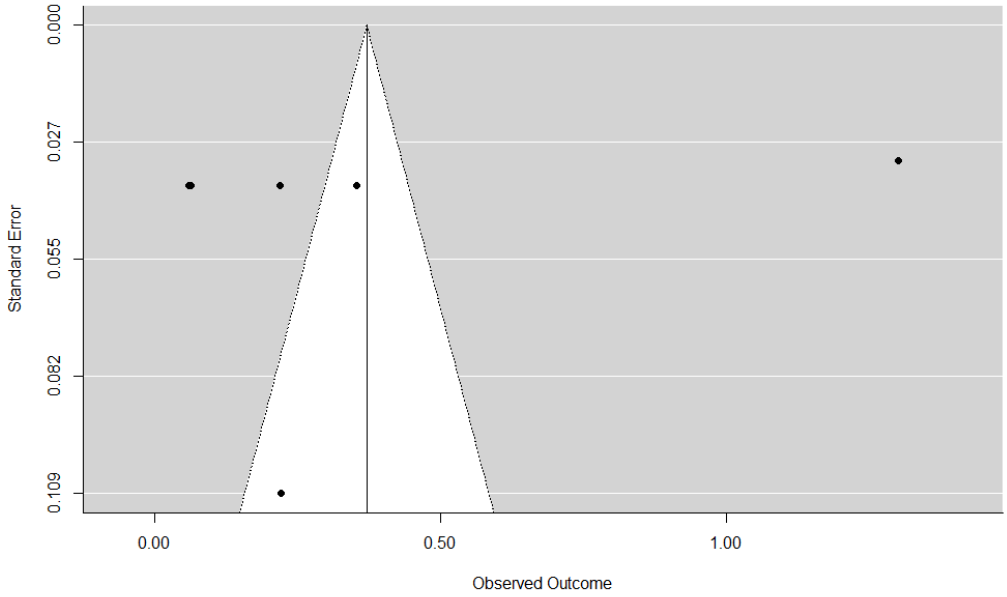
Mixed



Dairy cow

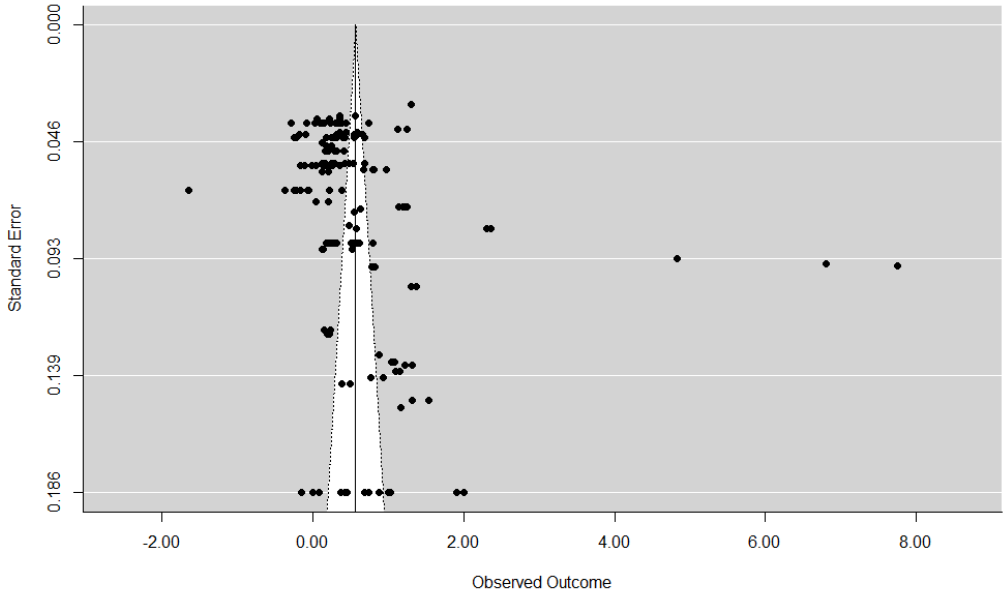


Fish

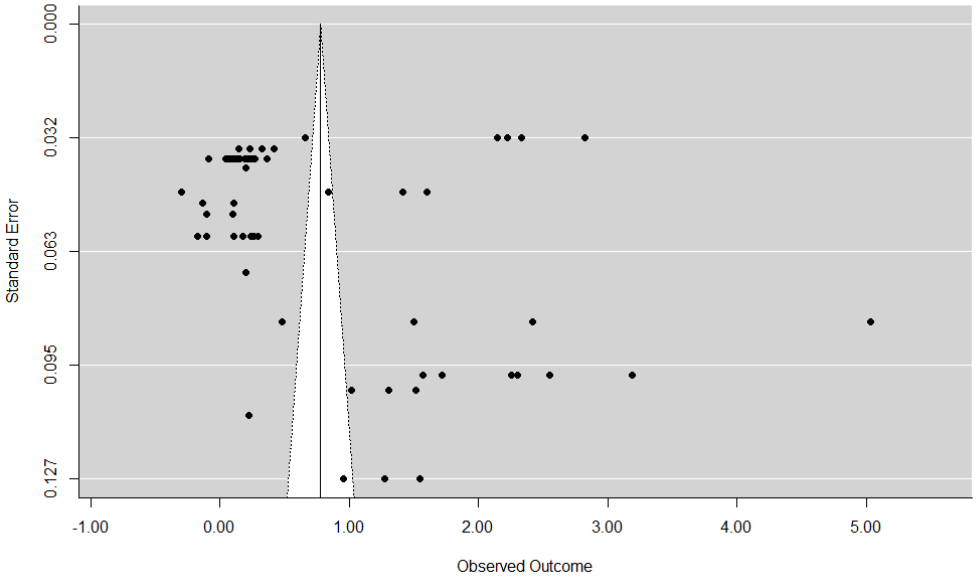


Population

Citizens

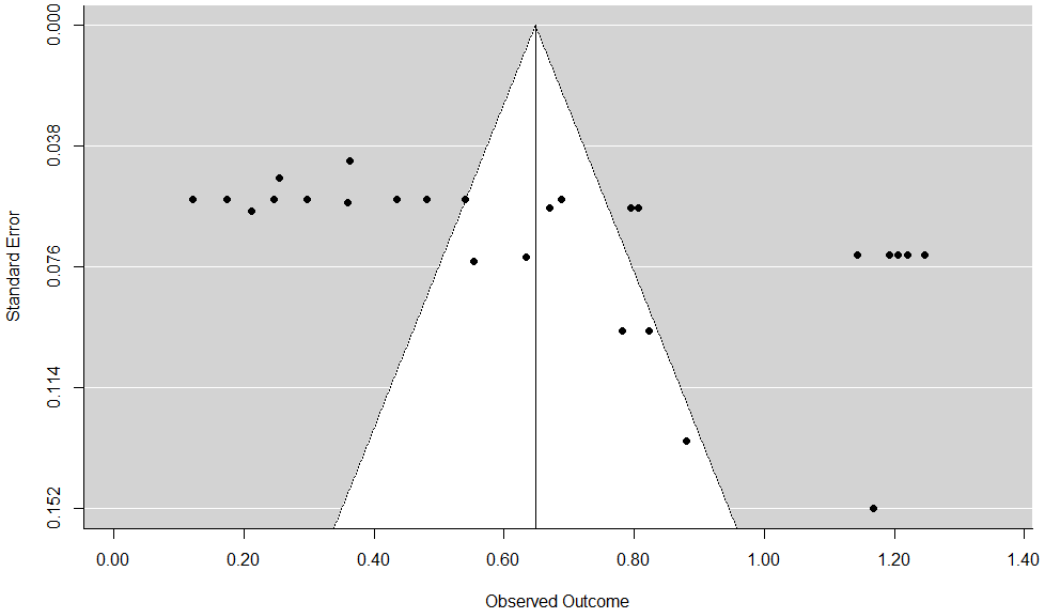


Consumers

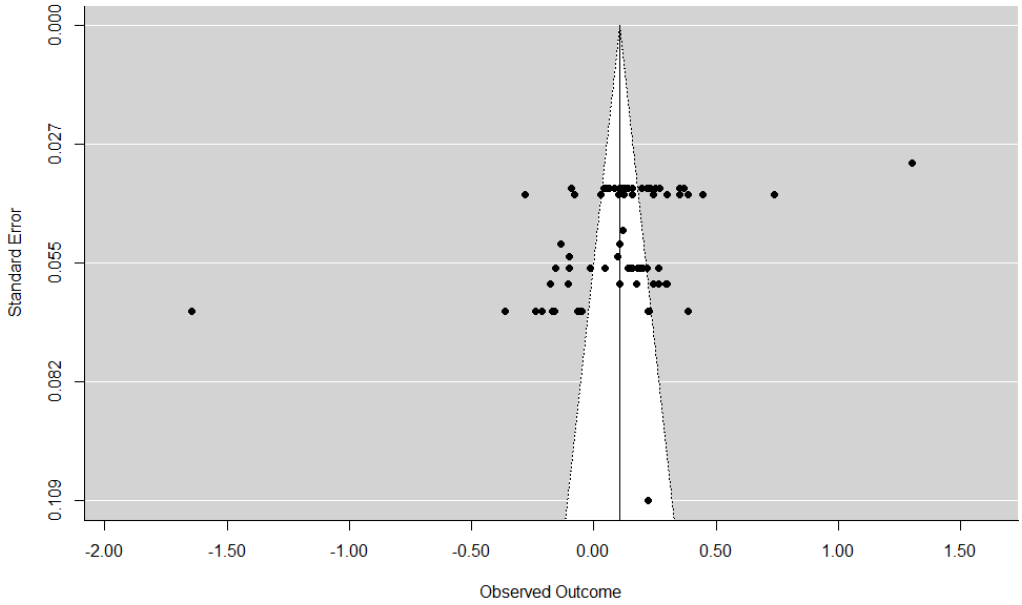


Region

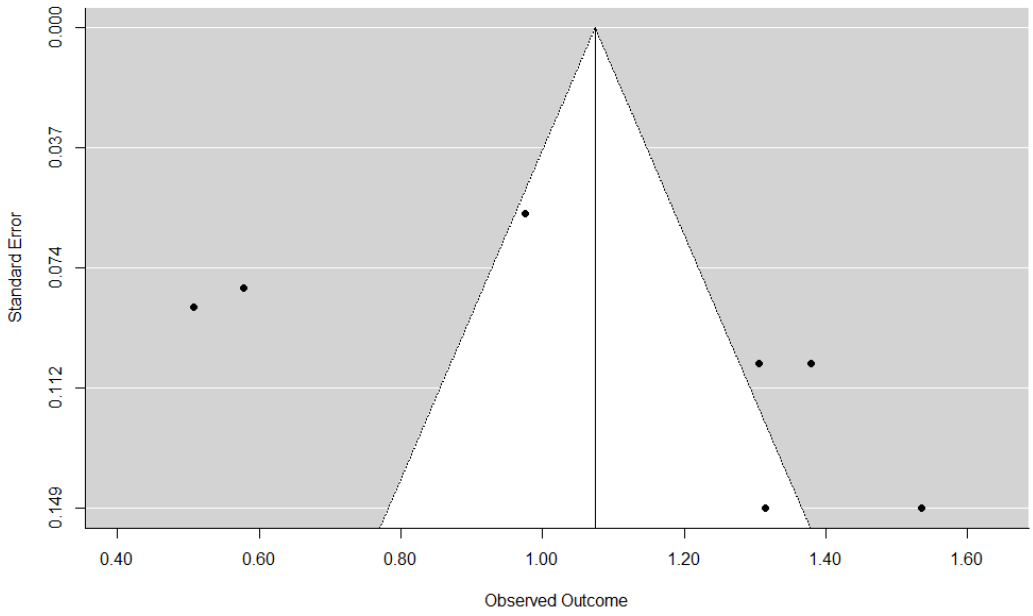
UK



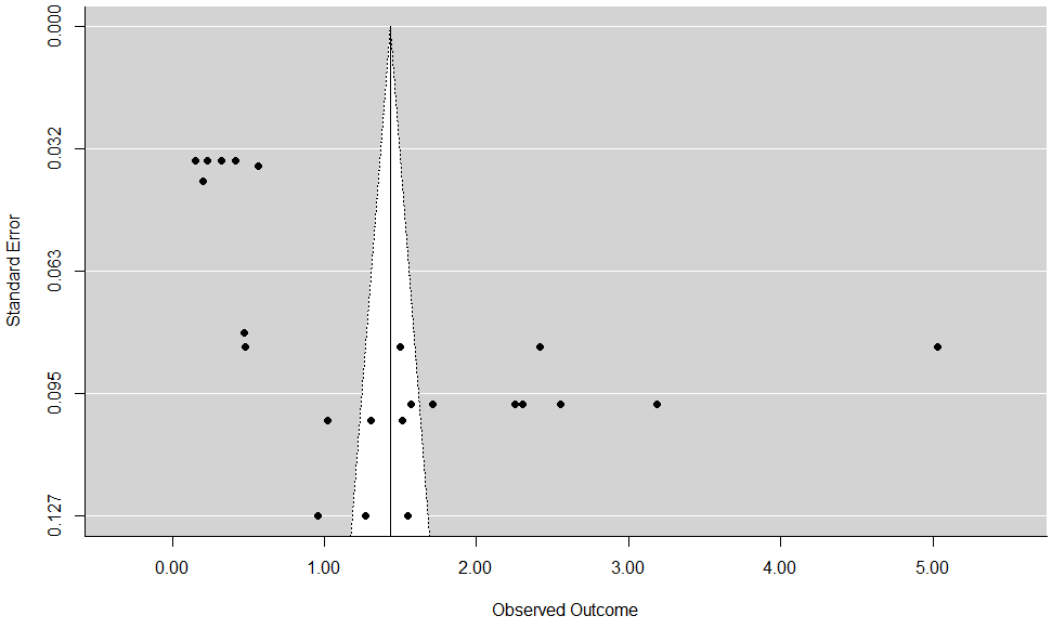
Northern Europe



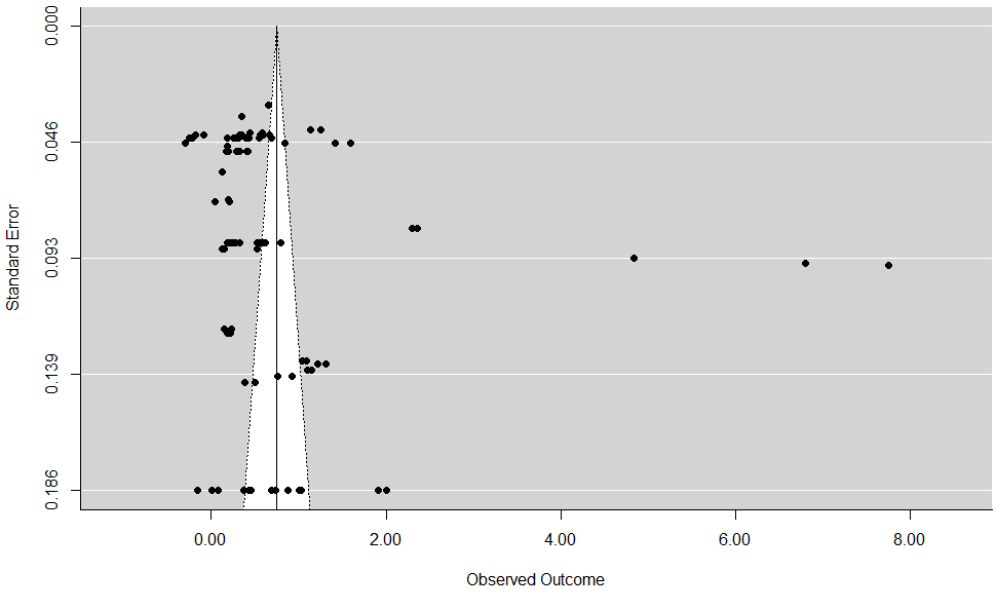
Western Europe



Southern Europe

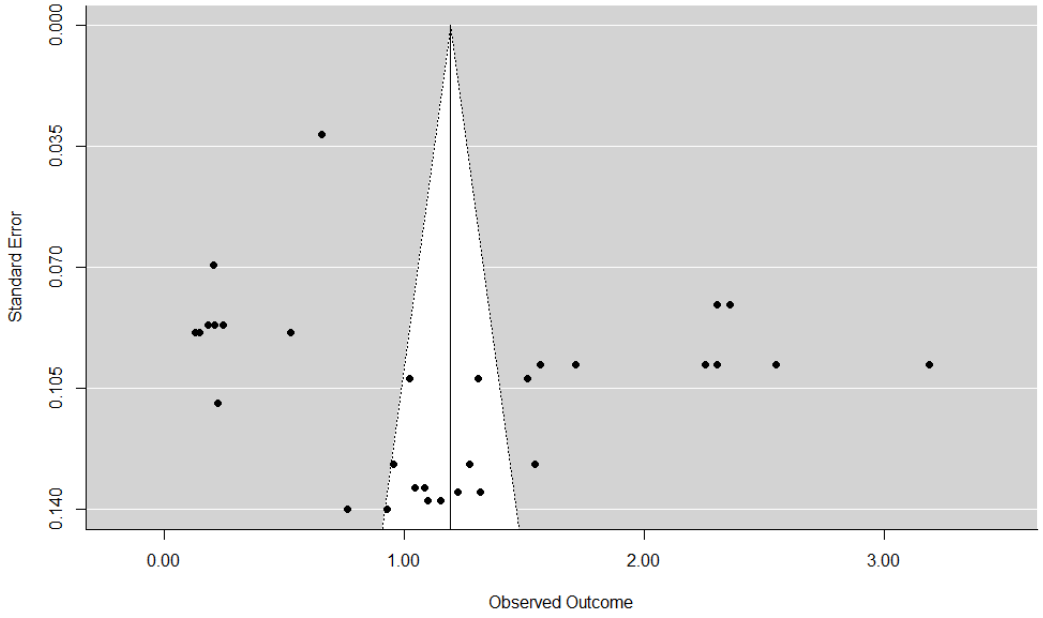


North America

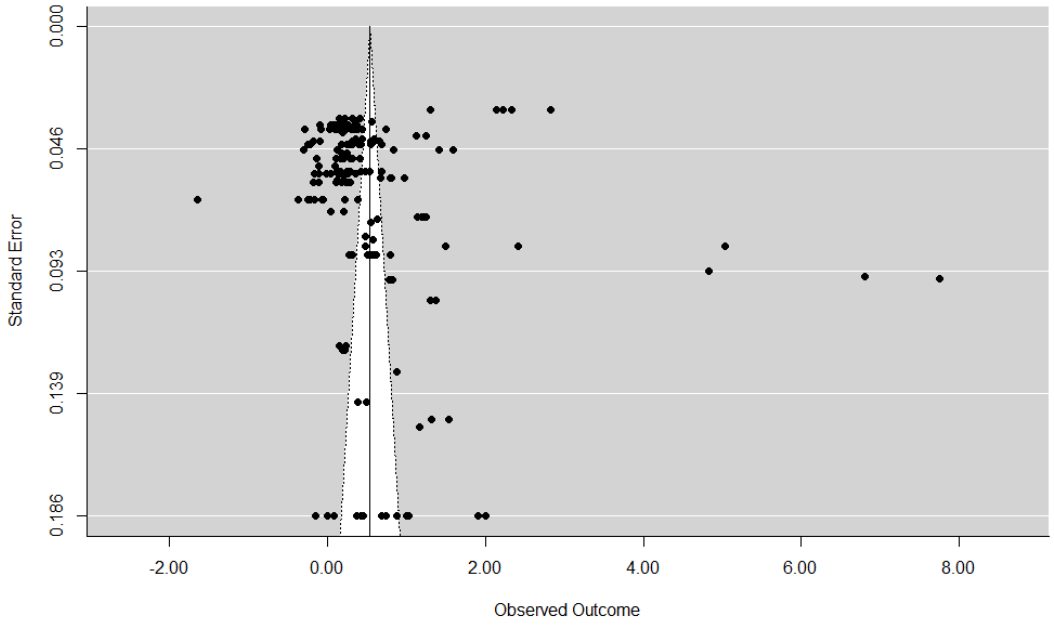


Methods

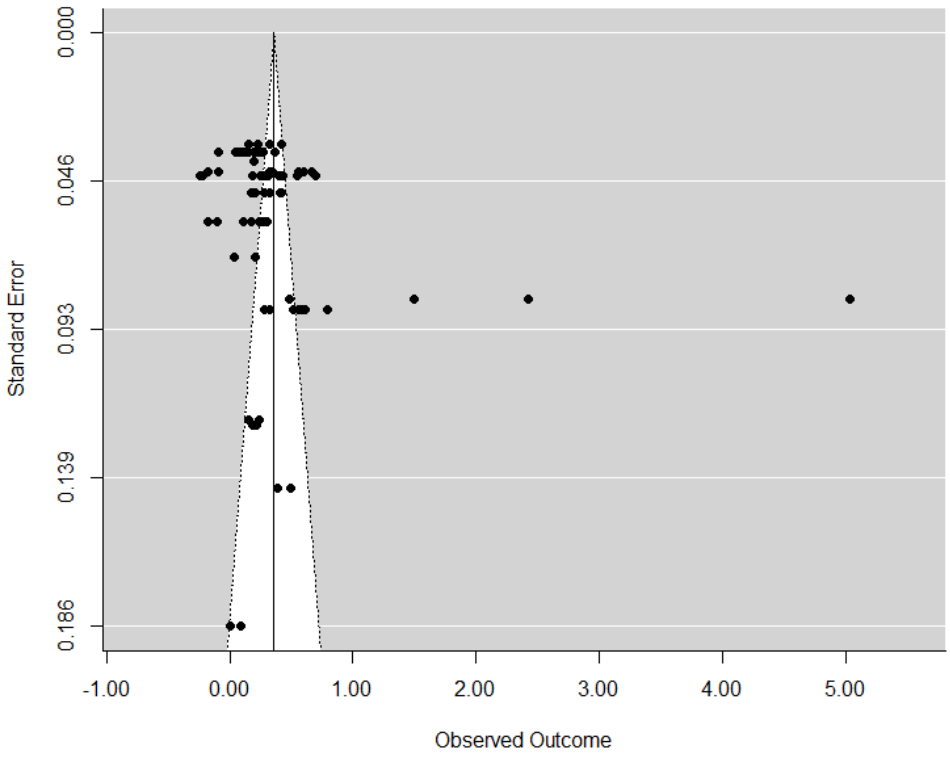
Revealed preference



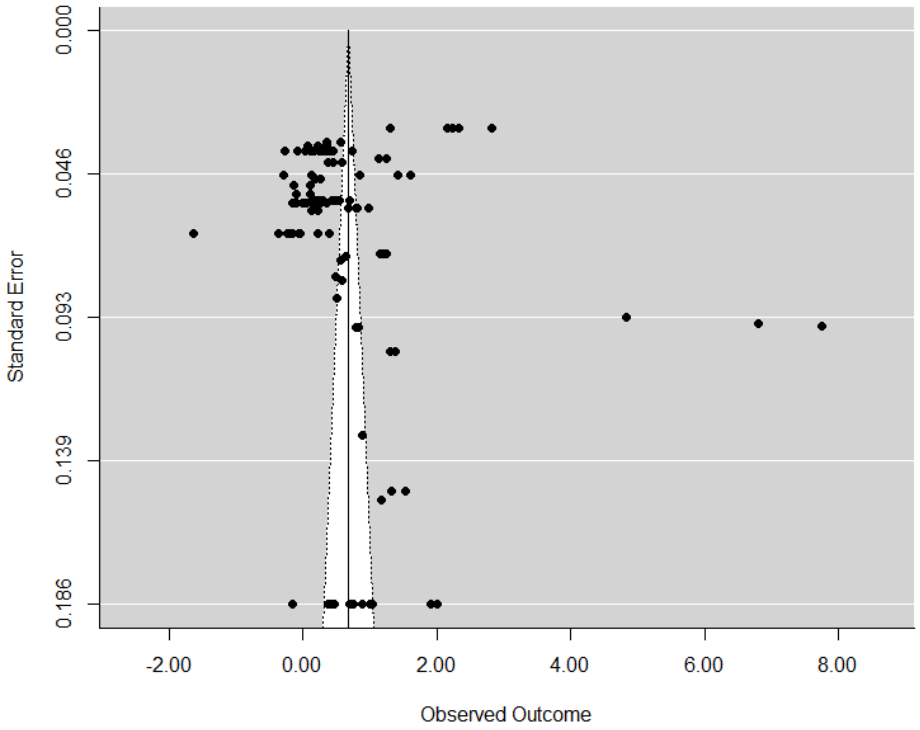
Stated preference



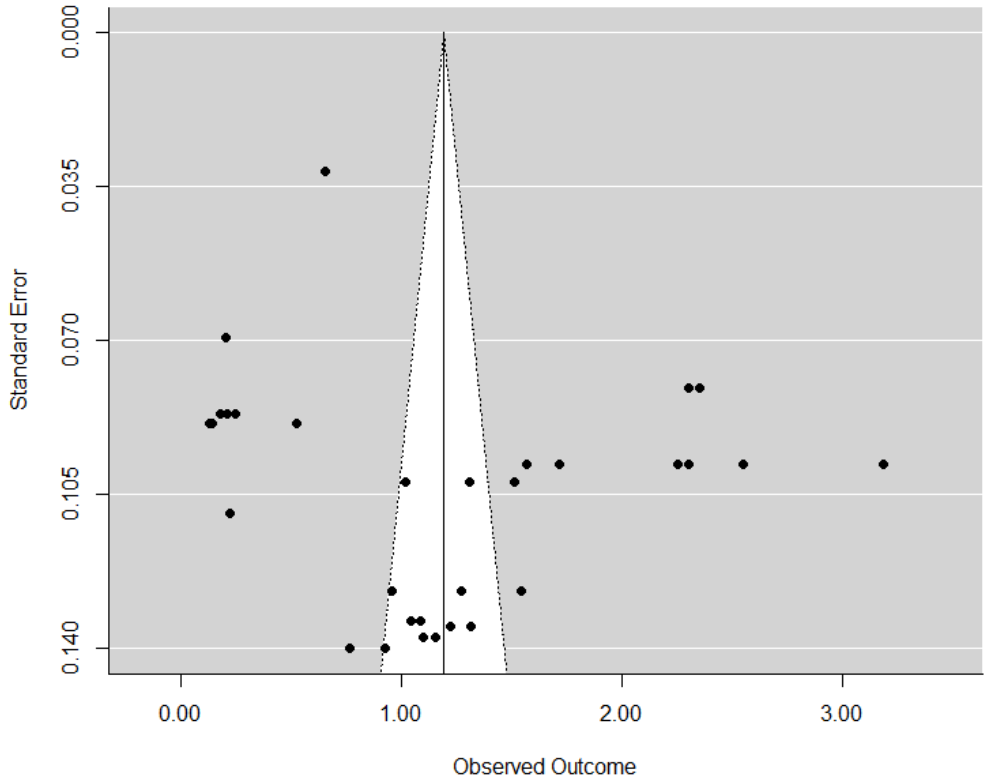
Cheap talk script used



Cheap talk script not used



Cheap talk script not needed



Appendix Q: Constructs, items and response options for the survey instrument

Name of Scale	Source	Question Asked	Example Item	Response
General concern	Rosati and Saba (2004)	*To what extent do you agree or disagree that you are concerned about the…*	Use of antibiotics in production animals to treat diseases.	Five point Likert scale anchored by Strongly disagree – Strongly agree
Human health concern	Rosati and Saba (2004)	*To what extent do you agree or disagree that the following pose a risk to human health*	Use of antibiotics in production animals to treat diseases	Five point Likert scale anchored by Strongly disagree – Strongly agree
Animal health concern	Rosati and Saba (2004)	*To what extent do you agree or disagree that the following pose a risk to animal health*	Use of antibiotics in production animals to treat diseases	Five point Likert scale anchored by Strongly disagree – Strongly agree
Risk perception	Poínhos *et al* (2014) Van Dijk *et al* (2011) Fischer and Frewer (2009) Frewer *et al* (1994)	*Intensive farming systems offer …*	Increased incidence of animal diseases. Reduced consumer health.	Five point Likert scale anchored by Strongly disagree – Strongly agree
Benefit perception	Poínhos *et al* (2014) Van Dijk *et al* (2011) Fischer and Frewer (2009)	*Intensive farming systems offer …*	Improved animal physical health. Faster treatment of animal diseases.	Five point Likert scale anchored by Strongly disagree – Strongly agree
Trust and responsibility	Poínhos *et al* (2014) Rosati and Saba (2004) Poortinga *et al* (2004) Poortinga and Pidgeon (2003) Frewer *et al* (1996)	*To what extent do you agree/ disagree that each of the following sources …*	Can be trusted to act to prevent animal diseases in production systems. Is responsible for the prevention of production diseases.	Five point Likert scale anchored by Strongly disagree – Strongly agree
Attitude to intensive animal production	Poínhos *et al* (2014) Van Dijk *et al* (2011) Crites *et al* (1994)	*Intensive animal production systems are …*	Worthless to valuable. Bad to good.	Five-point dichotomous scale
Intention to purchase	Poínhos *et al* (2014) Melnyk*et al* (2011)	*To what extent to you agree or disagree that …*	I intend to purchase I would consider purchasing I am definitely going to purchase	Five point Likert scale anchored by Strongly disagree – Strongly agree
Familiarity and knowledge	Latvala *et al* (2012) Verbeke *et al* (1999)	*Do you currently have or have had connections to raising farm (production) animals?* *I would describe myself as …*	Paying a high degree of attention to the media	Categorical

Attitudes to different interventions		*To what extent do you agree or disagree that these are acceptable?* *Which of the following reasons influenced your choice the most?*	Adjustments to feed composition Use of feed supplements e.g. probiotics Changes in the amount and time of light provision	Five point Likert scale anchored by Strongly disagree – Strongly agree Categorical
Likelihood of different interventions		*How likely do you think it will be that these interventions will be used?*	Adjustments to feed composition Use of feed supplements e.g. probiotics	Five point Likert scale anchored by Very unlikely – Very likely
Perceived ethical obligation	Shaw *et al* (2000) Sparks *et al* (1995)	I feel that I have an ethical obligation to …	Avoid animal products from intensive production systems	Five point Likert scale anchored by Strongly disagree – Strongly agree
Self-identity	Shaw *et al* (2000) Sparks *et al* (1995)	*I think of myself as someone who is …*	Concerned about intensive animal production systems Farm animal welfare	Five point Likert scale anchored by Strongly disagree – Strongly agree
Responsibility for costs		*Which actor(s) in the food chain do you think should be responsible for bearing the costs?*	Livestock farmers/ producers through making less profit	Categorical yes or no
Age	Eurostat (no date) UN (1982)	*What is your age?*	18-24 years' old 25-34 years' old 35-44 years' old	Categorical
Gender	None	*Gender*	Male Female I do not wish to specify	Categorical
Income	ESS-ERIC (2012)	*What is your yearly household income before tax?*	<€10-000 €10,001-€20,000 I do not wish to specify	Categorical – tailored to each country's currency
Education	UNESCO (2012)	*Which of the following best describes your highest level of education attained?*	Less than primary education Primary education Secondary education	Categorical based on ISCED categories.
Place of residence	Eurostat (2015) Kendall *et al* (2006)	*How would you describe where you live?*	City centre Town or suburb Rural area	Categorical based on EU definition
Religion	European Commission (2012)	*Which of the following best describes your religion?*	Christian Atheist	Categorical – based on EU breakdown
Diet		*Which of the below best describes your dietary choices?*	I eat meat and plants I am vegetarian	Categorical, multiple answer

Household composition	*How many persons are there in your household?* *How many persons under 18 years old are there in your household?*		Open ended
Responsibility for shopping	*Do you have the main responsibility for shopping in your household?*		Categorical
Employment	*What is your employment status?*	Employed full time	Categorical

Appendix R: Blank consumer surveys

Pig survey

Dear Sir/ Madam,

We write to invite you to take part in a research project which aims to understand what the European public think about pig production systems in Europe. We are asking you in our survey for your views on ways of reducing production diseases in pigs.

Production diseases usually originate from a complex interaction of the viruses and bacteria which are present on farms, animal genetics and the environment in which the animal is reared, including the characteristics of housing, feed and management practices used. They differ from epidemic diseases (such as foot and mouth disease or avian influenza) which are caused by new infections from outside the farm.

Answering our questions will take around 30 minutes. Participation in the study is voluntary and you have the right to decline the invitation or to withdraw from the study at any time. Your answers will be recorded and analyzed. Responses will be treated confidentially and reported so that individual respondents cannot be identified. The results will be used for research purposes only.

After completion of the survey, as a token of our thanks, you will be entered into a prize draw to win a £50 voucher. We thank you in advance for your time and contributions to this research.

Yours faithfully,

Professor Lynn J. Frewer

Newcastle University

prohealth@newcastle.ac.uk

By ticking this box, I agree to consent to take part in this research. ☐

This survey is part of the PROHEALTH project which has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for research, technological development and demonstration under Grant Agreement n°613574. This research is funded by the European Commission project "PROHEALTH" (http://www.fp7-prohealth.eu/).

1 Do you currently have or have had connections to raising farm (production) animals? Please tick

Yes, I currently live or have lived on a farm raising production animals	
Yes, I currently work or have worked on a farm raising production animals	
Yes, my family or close friends live or have lived on a farm raising production animals	
No	

2 Have you visited a working pig farm in the last 5 years? Please tick

Yes	
No	

3 Have you seen or heard anything about production diseases in pig production systems from any of the sources listed below in the past 3 months? Please tick.

Source of information	**Yes**	**No**
Television		
Radio		
Newspaper		
Magazine		
The internet		
Social media		
Friends or family members		

4 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *health* of pigs. Please tick one box in each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

5 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *welfare* of pigs. Please tick one box in each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

6 Below is a list of organisations and individuals. We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in pig production systems? Please tick one box in each row.

Information source	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
Social media, e.g. Twitter					
Traditional media, e.g. newspapers					

7 Please rate how you feel about intensive pig production systems by putting one tick in each row.

Intensive production systems are associated with a change towards more confined production systems with fewer production units (farms), and a large increase in the number of animals within these. Animals within these systems are generally raised in large numbers, in specialised indoor environments that offer a higher degree of environmental control.

Intensive pig production systems are …

Unpleasant	Fairly unpleasant	Neither unpleasant nor pleasant	Fairly pleasant	Pleasant

Good	Fairly good	Neither good nor bad	Fairly bad	Bad

Worthless	Fairly worthless	Neither worthless nor valuable	Fairly valuable	Valuable

Useful	Fairly useful	Neither useful nor useless	Fairly useless	Useless

Unsafe	Fairly unsafe	Neither safe nor unsafe	Fairly safe	Safe

Ethical	Fairly ethical	Neither ethical nor unethical	Fairly unethical	Unethical

8 To what extent do you agree or disagree that intensive pig production systems offer the following benefits, compared to non-intensive pig production systems: Please tick one box in each row.

Intensive pig systems are associated with:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Reduced animal stress					
Reduced incidence of animal diseases					
Faster treatment of animal diseases					
Improved animal welfare monitoring					
Improved human food safety					
Improved human food quality					
Improved nutritional quality of human food					
Improved consumer health					
Cheaper food of animal origin					
Increased availability of animal-based food products					
Benefits to the environment e.g. reduced CO_2 footprint					
A more sustainable approach to animal production					
A more cost-efficient production method					
Greater protection from predators					
Greater protection from bad weather					
More professionally run livestock farms					
Benefits to agriculture					
Benefits to you personally					
Benefits to your family					
Benefits to consumers					
Increased consumer trust in the food they buy					
A natural production method					

9 Please indicate the extent to which you agree or disagree that intensive pig production systems are associated with the following risks, compared to non-intensive pig production systems: Please tick one box in each row.

Intensive pig systems are associated with:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Increased animal stress					
Increased incidence of animal diseases					
Slower treatment of animal diseases					
Compromised animal welfare monitoring					
Reduced human food safety					
Reduced human food quality					
Reduced nutritional quality of human food					
Negative effects on consumer health					
More expensive food of animal origin					
Decreased availability of animal-based food products					
Risks to the environment e.g. increased CO_2 footprint					
An unsustainable approach to animal production					
A non-cost-efficient method of production					
Less protection from predators					
Less protection from bad weather					
Less professionally run livestock farms					
Risks to agriculture					
Risks to you personally					
Risks to your family					
Risks to consumers					
Decreased consumer trust in the food they buy					
An unnatural production method					

10 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

I am concerned about:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with pig production					
Whether minimum animal welfare standards are actually achieved in pig production systems					
Use of antibiotics in production animals as a growth promoter[1]					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics[2] to prevent animal diseases					
Antibiotic residues in foods					
Impacts of animal diseases on human health					
Impacts of animal diseases on animal welfare					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Impact of animal diseases on the environment					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

[1]Antiobiotic use as a growth promoter has been banned within the EU since 2006, but is still allowed in other parts of the world

[2]Probiotics are microorganisms, such as bacteria and yeast, introduced to the body for their potentially beneficial properties.

11 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

The following pose a risk to <u>human health</u>	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with pig production					
Whether minimum animal welfare standards are actually achieved in pig production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in food					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

12 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

The following pose a risk to <u>animal health</u>:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with pig production					
Whether minimum animal welfare standards are actually achieved in pig production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in animal feeds					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

13 A number of interventions can be used to prevent production diseases and treat sick animals in pig production systems. To what extent do you agree or disagree that these are <u>acceptable</u>? Please tick one box in each row

Interventions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Using medicines and antibiotics to treat sick pigs	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Efficient monitoring of pigs and pig housing conditions	☐	☐	☐	☐	☐
Enhanced control of air movement in pig houses	☐	☐	☐	☐	☐
Improvements in pigs' diet composition	☐	☐	☐	☐	☐
Adjustments in the quantity of pig feed available	☐	☐	☐	☐	☐
Breeding for genetically tougher or more resilient pigs	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the pigs from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of pigs in a given area	☐	☐	☐	☐	☐
Providing enrichment materials so pigs can perform natural behaviors	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

14 For each of these proposed interventions in question 13, please indicate which of the following reasons influenced your choice the most. Please tick one box in each row.

Interventions	Naturalness	Animal experience	Food safety	Humane animal care	Other
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Using medicines and antibiotics to treat sick pigs	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Efficient monitoring of pigs and pig house conditions	☐	☐	☐	☐	☐
Enhanced control of air movement in pig houses	☐	☐	☐	☐	☐
Improvements in pigs' diet composition	☐	☐	☐	☐	☐
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Breeding for genetically tougher or more resilient pigs	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the pigs from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of pigs in a given area	☐	☐	☐	☐	☐
Providing enrichment materials so pigs can perform natural behaviors	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

15 How likely do you think it is that these interventions will be used. Please indicate your opinion below Please tick one box in each row.

Interventions	Very unlikely	Unlikely	Neither likely nor unlikely	Likely	Very likely
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Using medicines and antibiotics to treat sick pigs	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Efficient monitoring of pigs and pig house conditions	☐	☐	☐	☐	☐
Enhanced control of air movement in pig houses	☐	☐	☐	☐	☐
Improvements in pigs' diet composition	☐	☐	☐	☐	☐
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Breeding for genetically tougher or more resilient pigs	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the pigs from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of pigs in a given area	☐	☐	☐	☐	☐
Providing enrichment materials so pigs can perform natural behaviors	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

16 Please indicate extent to which you agree or disagree with the following statements by ticking one box in each row.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I purchase foods produced using intensive production systems					
I intend to purchase foods produced using intensive production systems					
I would consider purchasing foods produced by intensive production systems					
I plan to reduce my consumption of foods from intensive production systems					
I avoid purchasing foods from intensive production systems					
I feel that I have an obligation to *purchase* animal products from intensive production systems					
I feel that I have an ethical obligation to *avoid* animal products from intensive production systems					
I think of myself as someone who is concerned about intensive animal production systems					
I think of myself as someone who is concerned about farm animal welfare					

17 Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive production systems?
Please tick one box in each row.

Stakeholder	Yes	No
Livestock farmers/ producers through making less profit		
Food manufacturers through making less profit		
Food retailers through making less profit		
Consumers, through higher product prices		
The general public, through increased taxes		
National government through providing subsidies and funds		
European Commission, through providing subsidies		

18 Gender

Male	
Female	
I do not wish to specify	

19 How old are you?

	Years

20 Which of the following best describe your highest education level attained.

Less than primary education	
Primary education	
Secondary education	
Vocational education	
University education	

21 What is your yearly household income before tax?

< £8,000	
£8,001 - £16,000	
£16,001 - £32,000	
£32,001 -£40,000	
£40,001 -£64,000	
> £64,001	
I do not wish to specify	

22 Which of the below describes your dietary choices? Tick all that apply

I eat pork	
I eat poultry meat	
I eat eggs	
I eat meat and plants	
I am vegetarian	
I am vegan	
I do not wish to specify	

23 How many persons are there in your household?

24 How many persons under 18 years old are there in your household?

25 Are you the person who does the main food shopping in your household?

Yes	
No	
Joint responsibility	

26 How would you describe where you live?

City centre	
Town or suburb	
Rural area	

26 Which of the following best describes your religious beliefs?

Buddhist	
Christian	
Hindu	
Jewish	
Muslim	
Sikh	
Other	
Atheist/ agnostic	
I do not wish to specify	

27 What is your employment status? *Tick all that apply*

Employed full-time	
Employed part-time	
Retired	
Homemaker	
Student	
Unemployed	
I do not wish to specify	

Thank you for your valuable contribution to our project. If you would like to find out more about the project and the research taking place, please visit our website, http://www.fp7-prohealth.eu/. Please remember that you are free to withdraw from this study at any time, without having to provide any underlying reason for doing so, and can so by contacting prohealth@newcastle.ac.uk .If you would like to be entered into the prize draw please provide your contact details below.

Layer survey

Dear Sir/ Madam,

We write to invite you to take part in a research project which aims to understand what the European public think about chicken production systems in Europe. We are asking you in our survey for your views on ways of reducing production diseases in layer hens, which are chickens used to lay eggs.

Production diseases usually originate from a complex interaction of the viruses and bacteria which are present on farms, animal genetics and the environment in which the animal is reared, including the characteristics of housing, feed and management practices used. They differ from epidemic diseases (such as foot and mouth disease or avian influenza) which are caused by new infections from outside the farm.

Answering our questions will take around 30 minutes. Participation in the study is voluntary and you have the right to decline the invitation or to withdraw from the study at any time. Your answers will be recorded and analyzed. Responses will be treated confidentially and reported so that individual respondents cannot be identified. The results will be used for research purposes only.

After completion of the survey, as a token of our thanks, you will be entered into a prize draw to win a £50 voucher. We thank you in advance for your time and contributions to this research.

Yours faithfully,

Professor Lynn J. Frewer

Newcastle University

prohealth@newcastle.ac.uk

By ticking this box, I agree to consent to take part in this research. ☐

This survey is part of the PROHEALTH project which has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for research, technological development and demonstration under Grant Agreement n°613574. This research is funded by the European Commission project "PROHEALTH" (http://www.fp7-prohealth.eu/).

1 Do you currently have or have had connections to raising farm (production) animals? Please tick

Yes, I currently live or have lived on a farm raising production animals	
Yes, I currently work or have worked on a farm raising production animals	
Yes, my family or close friends live or have lived on a farm raising production animals	
No	

2 Have you visited a working layer hen farm in the last 5 years? Please tick

Yes	
No	

3 Have you seen or heard anything about production diseases in layer hen production systems from any of the sources listed below in the past 3 months? Please tick.

Source of information	**Yes**	**No**
Television		
Radio		
Newspaper		
Magazine		
The internet		
Social media		
Friends or family members		

4 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *health* of layer hens Please tick one box in each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

5 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *welfare* of layer hens Please tick one box for each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

6 Below is a list of organisations, individuals and media. We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in layer hen production systems? Please tick one box in each row.

Information source	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	1	2	3	4	5
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
Social media, e.g. Twitter					
Traditional media, e.g. newspapers					

7 Please rate how you feel about intensive layer hen production systems by putting one tick for each row.

Intensive production systems are associated with a change towards more confined production systems with fewer production units (farms), and a large increase in the number of animals within these. Animals within these systems are generally raised in large numbers, in specialised indoor environments that offer a higher degree of environmental control.

Intensive layer hen production systems are …

Unpleasant	Fairly unpleasant	Neither unpleasant nor pleasant	Fairly pleasant	Pleasant

Good	Fairly good	Neither good nor bad	Fairly bad	Bad

Worthless	Fairly worthless	Neither worthless nor valuable	Fairly valuable	Valuable

Useful	Fairly useful	Neither useful nor useless	Fairly useless	Useless

Unsafe	Fairly unsafe	Neither safe nor unsafe	Fairly safe	Safe

Ethical	Fairly ethical	Neither ethical nor unethical	Fairly unethical	Unethical

8 To what extent do you agree or disagree that intensive layer hen production systems offer the following benefits compared to non-intensive layer hen production systems: Please tick one box for each row.

Intensive layer hen systems are associated with:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Reduced animal stress					
Reduced incidence of animal diseases					
Faster treatment of animal diseases					
Improved animal welfare monitoring					
Improved human food safety					
Improved human food quality					
Improved nutritional quality of human food					
Improved consumer health					
Cheaper food of animal origin					
Increased availability of animal-based food products					
Benefits to the environment e.g. reduced CO_2 footprint					
A more sustainable approach to animal production					
A more cost-efficient production method					
Greater protection from predators					
Greater protection from bad weather					
More professionally run livestock farms					
Benefits to agriculture					
Benefits to you personally					
Benefits to your family					
Benefits to consumers					
Increased consumer trust in the food they buy					
A natural production method					

9 Please indicate the extent to which you agree or disagree that intensive layer hen production systems are associated with the following <u>risks</u> compared to non-intensive layer hen production systems: Please tick one box in each row.

Intensive layer hen systems are associated with	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Increased animal stress					
Increased incidence of animal diseases					
Slower treatment of animal diseases					
Compromised animal welfare monitoring					
Reduced human food safety					
Reduced human food quality					
Reduced nutritional quality of human food					
Negative effects on consumer health					
More expensive food of animal origin					
Decreased availability of animal-based food products					
Risks to the environment e.g. increased CO_2 footprint					
An unsustainable approach to animal production					
A non-cost-efficient method of production					
Risks to agriculture					
Less protection from predators					
Less protection from bad weather					
Less professionally run livestock farms					
Risks to you personally					
Risks to your family					
Risks to consumers					
Decreased consumer trust in the food they buy					
An unnatural production method					

10 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

I am concerned about:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with layer hen production					
Whether minimum animal welfare standards are actually achieved in layer hen production systems					
Use of antibiotics in production animals as a growth promoter[1]					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics[2] to prevent animal diseases					
Antibiotic residues in foods					
Impacts of animal diseases on human health					
Impacts of animal diseases on animal welfare					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Impact of animal diseases on the environment					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

[1]Antiobiotic use as a growth promoter has been banned within the EU since 2006, but is still allowed in other parts of the world

[2]Probiotics are microorganisms, such as bacteria and yeast, introduced to the body for their potentially beneficial properties.

11 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

The following pose a risk to <u>human health</u>	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with layer hen production					
Whether minimum animal welfare standards are actually achieved in layer hen production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in food					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

12 Please indicate to what extent you agree with the following statements. Please tick one box in each row.

The following pose a risk to <u>animal health</u>:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with layer hen production					
Whether minimum animal welfare standards are actually achieved in layer hen production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in animal feeds					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

13 A number of interventions can be used to prevent production diseases and treat sick birds in layer hen production systems. To what extent do you agree or disagree that these are <u>acceptable</u>? Please tick one box in each row.

Interventions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

14 For each of the proposed interventions in question 13, please indicate which of the following reasons influenced your choice the most. Please tick one box in each row.

Interventions	Naturalness	Animal experience	Food safety	Humane animal care	Other
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene to prevent diseases	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

15 How likely do you think it is that these interventions will be used. Please indicate your opinion below Please tick one box in each row.

Interventions	Very unlikely	Unlikely	Neither likely nor unlikely	Likely	Very likely
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

16 Please indicate extent to which you agree or disagree with the following statements by ticking one box in each row.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I purchase foods produced using intensive production systems					
I intend to purchase foods produced using intensive production systems					
I would consider purchasing foods produced by intensive production systems					
I plan to reduce my consumption of foods from intensive production systems					
I avoid purchasing foods from intensive production systems					
I feel that I have an obligation to ***purchase*** animal products from intensive production systems					
I feel that I have an ethical obligation to ***avoid*** animal products from intensive production systems					
I think of myself as someone who is concerned about intensive animal production systems					
I think of myself as someone who is concerned about farm animal welfare					

17 Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive production systems?
Please tick one box in each row.

Stakeholder	Yes	No
Livestock farmers/ producers through making less profit		
Food manufacturers through making less profit		
Food retailers through making less profit		
Consumers, through higher product prices		
The general public, through increased taxes		
National government through providing subsidies and funds		
European Commission, through providing subsidies		

18 Gender

Male	
Female	
I do not wish to specify	

19 How old are you?

	Years

20 Which of the following best describe your highest education level attained.

Less than primary education	
Primary education	
Secondary education	
Vocational education	
University education	

21 What is your yearly household income before tax?

< £8,000	
£8,001 - £16,000	
£16,001 - £32,000	
£32,001 -£40,000	
£40,001 -£64,000	
> £64,001	
I do not wish to specify	

22 Which of the below describes your dietary choices? Tick all that apply

I eat pork	
I eat poultry meat	
I eat eggs	
I eat meat and plants	
I am vegetarian	
I am vegan	
I do not wish to specify	

23 How many persons are there in your household?

24 How many persons under 18 years old are there in your household?

25 Are you the person who does the main food shopping in your household?

Yes	
No	
Joint responsibility	

26 How would you describe where you live?

City centre	
Town or suburb	
Rural area	

26 Which of the following best describes your religious beliefs?

Buddhist	
Christian	
Hindu	
Jewish	
Muslim	
Sikh	
Other	
Atheist/ agnostic	
I do not wish to specify	

27 What is your employment status? ***Tick all that apply***

Employed full-time	
Employed part-time	
Retired	
Homemaker	
Student	
Unemployed	
I do not wish to specify	

Thank you for your valuable contribution to our project.

If you would like to find out more about the project and the research taking place, please visit our website, http://www.fp7-prohealth.eu/.

Please remember that you are free to withdraw from this study at any time, without having to provide any underlying reason for doing so, and can so by contacting prohealth@newcastle.ac.uk .

If you would like to be entered into the prize draw please provide your contact details below.

Broiler survey

Dear Sir/ Madam,

We write to invite you to take part in a research project which aims to understand what the European public think about chicken production systems in Europe. We are asking you in our survey for your views on ways of reducing production diseases in broiler chickens, which are chickens raised for meat production.

Production diseases usually originate from a complex interaction of the viruses and bacteria which are present on farms, animal genetics and the environment in which the animal is reared, including the characteristics of housing, feed and management practices used. They differ from epidemic diseases (such as foot and mouth disease or avian influenza) which are caused by new infections from outside the farm.

Answering our questions will take around 30 minutes. Participation in the study is voluntary and you have the right to decline the invitation or to withdraw from the study at any time. Your answers will be recorded and analyzed. Responses will be treated confidentially and reported so that individual respondents cannot be identified. The results will be used for research purposes only.

After completion of the survey, as a token of our thanks, you will be entered into a prize draw to win a £50 voucher. We thank you in advance for your time and contributions to this research.

Yours faithfully,

Professor Lynn J. Frewer

Newcastle University

prohealth@newcastle.ac.uk

By ticking this box, I agree to consent to take part in this research. ☐

This survey is part of the PROHEALTH project which has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) for research, technological development and demonstration under Grant Agreement n°613574. This research is funded by the European Commission project "PROHEALTH" (http://www.fp7-prohealth.eu/).

1 Do you currently have or have had connections to raising farm (production) animals? Please tick

Yes, I currently live or have lived on a farm raising production animals	
Yes, I currently work or have worked on a farm raising production animals	
Yes, my family or close friends live or have lived on a farm raising production animals	
No	

2 Have you visited a working broiler chicken farm in the last 5 years? Please tick

Yes	
No	

3 Have you seen or heard anything about production diseases in broiler chicken production systems from any of the sources listed below in the past 3 months? Please tick.

Source of information	**Yes**	**No**
Television		
Radio		
Newspaper		
Magazine		
The internet		
Social media		
Friends or family members		

4 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *health* of broiler chickens Please tick one box in each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
European Commission					
National government					
Animal health authorities e.g. RSPCA					
Veterinarians					
Animal welfare organisations					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

5 To what extent do you agree or disagree that the following organisations or individuals should take action for ensuring the *welfare* of broiler chickens Please tick one box in each row.

	Strongly Disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
The general public					
You as a consumer					

6 Below is a list of organisations and individuals. We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in broiler chicken production systems? Please tick one box in each row.

Information source	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	1	2	3	4	5
European Commission					
National government					
Animal health authorities					
Veterinarians					
Animal welfare organisations e.g. RSPCA					
Veterinary medicine producers					
Animal breeding companies					
Animal feed producers					
Animal housing manufacturers					
Farmers					
Animal Transporters					
Slaughterhouses					
Quality assurance systems e.g. Freedom Food					
Food manufacturers					
Food retailers					
Consumer organisations					
Social media, e.g. Twitter					
Traditional media, e.g. newspapers					

7 Please rate how you feel about intensive broiler chicken production systems by putting one tick for each row.

Intensive production systems are associated with a change towards more confined production systems with fewer production units (farms), and a large increase in the number of animals within these. Animals within these systems are generally raised in large numbers, in specialised indoor environments that offer a higher degree of environmental control.

Intensive broiler production systems are …

Unpleasant	Fairly unpleasant	Neither unpleasant nor pleasant	Fairly pleasant	Pleasant

Good	Fairly good	Neither good nor bad	Fairly bad	Bad

Worthless	Fairly worthless	Neither worthless nor valuable	Fairly valuable	Valuable

Useful	Fairly useful	Neither useful nor useless	Fairly useless	Useless

Unsafe	Fairly unsafe	Neither safe nor unsafe	Fairly safe	Safe

Ethical	Fairly ethical	Neither ethical nor unethical	Fairly unethical	Unethical

8 To what extent do you agree or disagree that intensive broiler chicken production systems offer the following benefits compared to non-intensive broiler chicken production systems:
Please tick one box for each row.

Intensive broiler chicken systems are associated with:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
Reduced animal stress					
Reduced incidence of animal diseases					
Faster treatment of animal diseases					
Improved animal welfare monitoring					
Improved human food safety					
Improved human food quality					
Improved nutritional quality of human food					
Improved consumer health					
Cheaper food of animal origin					
Increased availability of animal-based food products					
Benefits to the environment e.g. reduced CO_2 footprint					
A more sustainable approach to animal production					
A more cost-efficient production method					
Greater protection from predators					
Greater protection from bad weather					
More professionally run livestock farms					
Benefits to agriculture					
Benefits to you personally					
Benefits to your family					
Benefits to consumers					
Increased consumer trust in the food they buy					
A natural production method					

9 Please indicate the extent to which you agree or disagree that intensive broiler chicken production systems are associated with the following risks compared to non-intensive broiler chicken production systems: Please tick one box in each row.

Intensive broiler chicken systems are associated with:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
	1	**2**	**3**	**4**	**5**
Increased animal stress					
Increased incidence of animal diseases					
Slower treatment of animal diseases					
Compromised animal welfare monitoring					
Reduced human food safety					
Reduced human food quality					
Reduced nutritional quality of human food					
Negative effects on consumer health					
More expensive food of animal origin					
Decreased availability of animal-based food products					
Risks to the environment e.g. increased CO_2 footprint					
An unsustainable approach to animal production					
A non-cost-efficient method of production					
Risks to agriculture					
Less protection from predators					
Less protection from bad weather					
Less professionally run livestock farms					
Risks to you personally					
Risks to your family					
Risks to consumers					
Decreased consumer trust in the food they buy					
An unnatural production method					

10 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

I am concerned about:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with broiler chicken production					
Whether minimum animal welfare standards are actually achieved in broiler chicken production systems					
Use of antibiotics in production animals as a growth promoter [1]					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics[2] to prevent animal diseases					
Antibiotic residues in foods					
Impacts of animal diseases on human health					
Impacts of animal diseases on animal welfare					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Impact of animal diseases on the environment					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

[1]Antiobiotic use as a growth promoter has been banned within the EU since 2006, but is still allowed in other parts of the world

[2]Probiotics are microorganisms, such as bacteria and yeast, introduced to the body for their potentially beneficial properties.

11 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

The following pose a risk to <u>human health</u>	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with broiler chicken production					
Whether minimum animal welfare standards are actually achieved in broiler chicken production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in foods					
Impact of animal diseases on food quality					
Impact on animal diseases on food safety					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

12 Please indicate to what extent you agree or disagree with the following statements. Please tick one box in each row.

The following pose a risk to <u>animal health</u>:	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
The current minimum animal welfare standards associated with broiler chicken production					
Whether minimum animal welfare standards are actually achieved in broiler chicken production systems					
Use of antibiotics in production animals as a growth promoter					
Use of antibiotics in production animals to prevent diseases					
Use of antibiotics in production animals to treat diseases					
Use of vaccinations to prevent animal diseases					
Use of other veterinary medicines to treat animal diseases					
Use of probiotics to prevent animal diseases					
Antibiotic residues in animal feeds					
Antibiotic resistance as a result of the use of antibiotics in animals					
Animal production diseases in general					

13 A number of interventions can be used to prevent production diseases and treat sick birds in broiler chicken production systems. To what extent do you agree or disagree that these are <u>acceptable</u>? Please tick one box in each row.

Interventions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene to prevent diseases	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

14 For each of the proposed interventions in question 13, please indicate which of the following reasons influenced your choice the most. Please tick one box in each row.

Interventions	Naturalness	Animal experience	Food safety	Humane animal care	Other
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene and disease prevention measures	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements e.g. probiotics	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

15 How likely do you think it is that these interventions will be used. Please indicate your opinion below Please tick one box in each row.

Interventions	Very unlikely	Unlikely	Neither likely nor unlikely	Likely	Very likely
Adjustments in the quantity of feed available	☐	☐	☐	☐	☐
Adjustments to feed composition	☐	☐	☐	☐	☐
Changes in the amount and time of light provision	☐	☐	☐	☐	☐
Enhanced control of air movement in chicken houses	☐	☐	☐	☐	☐
Enhanced maintenance of the quality of the bedding	☐	☐	☐	☐	☐
Enhanced hygiene to prevent diseases	☐	☐	☐	☐	☐
Housing that allows birds greater freedom to move	☐	☐	☐	☐	☐
The preventive use of veterinary drugs, including antibiotics	☐	☐	☐	☐	☐
Use of feed supplements	☐	☐	☐	☐	☐
Providing farmers with a price premium that encourages enhanced animal health	☐	☐	☐	☐	☐
Providing materials and an environment where birds can perform natural behaviors	☐	☐	☐	☐	☐
Improvements in housing design	☐	☐	☐	☐	☐
Housing that protects the birds from adverse natural conditions	☐	☐	☐	☐	☐
Reducing the number of chickens in a given area	☐	☐	☐	☐	☐
Using antibiotics and medicines to treat sick birds	☐	☐	☐	☐	☐
The use of vaccination	☐	☐	☐	☐	☐
Doing nothing	☐	☐	☐	☐	☐

16 Please indicate extent to which you agree or disagree with the following statements by ticking one box in each row.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I purchase foods produced using intensive production systems					
I intend to purchase foods produced using intensive production systems					
I would consider purchasing foods produced by intensive production systems					
I plan to reduce my consumption of foods from intensive production systems					
I avoid purchasing foods from intensive production systems					
I feel that I have an obligation to ***purchase*** animal products from intensive production systems					
I feel that I have an ethical obligation to ***avoid*** animal products from intensive production systems					
I think of myself as someone who is concerned about intensive animal production systems					
I think of myself as someone who is concerned about farm animal welfare					

17 Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive production systems?
Please tick one box in each row.

Stakeholder	Yes	No
Livestock farmers/ producers through making less profit		
Food manufacturers through making less profit		
Food retailers through making less profit		
Consumers, through higher product prices		
The general public, through increased taxes		
National government through providing subsidies and funds		
European Commission, through providing subsidies		

18 Gender

Male	
Female	
I do not wish to specify	

19 How old are you?

	Years

20 Which of the following best describe your highest education level attained.

Less than primary education	
Primary education	
Secondary education	
Vocational education	
University education	

21 What is your yearly household income before tax?

< £8,000	
£8,001 - £16,000	
£16,001 - £32,000	
£32,001 -£40,000	
£40,001 -£64,000	
> £64,001	
I do not wish to specify	

22 Which of the below describes your dietary choices? Tick all that apply

I eat pork	
I eat poultry meat	
I eat eggs	
I eat meat and plants	
I am vegetarian	
I am vegan	
I do not wish to specify	

23 How many persons are there in your household?

24 How many persons under 18 years old are there in your household?

25 Are you the person who does the main food shopping in your household?

Yes	
No	
Joint responsibility	

26 How would you describe where you live?

City centre	
Town or suburb	
Rural area	

26 Which of the following best describes your religious beliefs?

Buddhist	
Christian	
Hindu	
Jewish	
Muslim	
Sikh	
Other	
Atheist/ agnostic	
I do not wish to specify	

27 What is your employment status? *Tick all that apply*

Employed full-time	
Employed part-time	
Retired	
Homemaker	
Student	
Unemployed	
I do not wish to specify	

Thank you for your valuable contribution to our project.

If you would like to find out more about the project and the research taking place, please visit our website, http://www.fp7-prohealth.eu/.

Please remember that you are free to withdraw from this study at any time, without having to provide any underlying reason for doing so, and can so by contacting prohealth@newcastle.ac.uk .

If you would like to be entered into the prize draw please provide your contact details below.

Appendix S: Survey descriptive statistics

1.1.1 Descriptive statistics

		Overall	Finland	Germany	Poland	Spain	UK
	N	789	158	158	157	158	158
Gender	Male	49.2*	49.4	48.1	50.3	49.4	48.7
	Female	50.4*	50.0	51.9	49.7	49.4	51.3
Age	18-24 years	13.7	11.4	13.3	13.4	16.5	13.9
	25-34 years	24.2	25.9	20.3	24.2	29.7	20.9
	35-44 years	22.7	25.9	19.6	21.7	24.7	21.5
	45-54 years	21.4	19.0	26.6	19.7	18.4	23.4
	55-64 years	13.7	12.7	17.7	18.5	9.5	10.1
	65+ years	4.4	5.0	2.5	2.5	1.2	10.1
Education	Less than primary	0.4	0.6	0.0	0.6	0.0	0.0
	Primary education	1.0	1.9	1.3	0.6	0.6	0.6
	Secondary education	28.5	23.4	27.2	34.4	20.3	37.3
	University education	47.0	43.0	24.1	61.1	65.2	41.8
	Vocational education	23.1	31.0	47.5	3.2	13.3	20.3
Income	Less than 5,000 €	2.5	1.9	2.5	2.5	3.2	2.5
	5 001 - 10 000 €	8.6	9.5	7.0	17.2	7.0	2.5
	10 001 – 20 000 €	19.8	12.7	12.0	32.5	26.6	15.2
	20 001 – 40 000 €	30.4	25.3	32.9	31.8	36.1	25.9
	40 001 – 60 000 €	14.6	16.5	17.1	2.5	13.9	22.8
	60 001 – 80 000 €	7.5	12.0	8.2	0.6	5.7	10.8
	More than 80 001 €	5.2	10.1	4.4	0.0	1.9	9.5
	I do not wish to specify	11.4	12.0	15.8	12.7	5.7	10.8
Diet	Vegan	1.5	3.8	3.2	0.0	0.0	0.6
	Vegetarian	6.5	10.8	7.0	5.1	3.8	5.7
	Omnivore	90.6	85.4	88.0	94.3	95.6	89.9
	I do not wish to specify	1.4	0.0	1.9	0.6	0.6	3.8
Place of residence	City centre	35.6	22.2	40.6	40.4	52.5	22.2
	Town or suburb	48.7	63.3	43.1	44.9	32.3	60.1
	Rural area	15.7	14.6	16.3	14.7	15.2	17.7

Population characteristics for the layer's survey

**values for gender to not add up to 100% due to 2 persons not wishing to specify their gender*

		Overall	Finland	Germany	Poland	Spain	UK
	N	790	158	160	156	158	158
Gender	Male	49.7	49.4	50.6	49.4	50.0	49.4
	Female	49.9	50.0	48.8	50.6	49.4	50.6
Age	18-24 years	13.3	11.4	13.8	13.5	15.2	12.7
	25-24 years	24.2	26.6	18.1	24.4	30.4	21.5
	35-44 years	22.3	21.5	21.3	21.8	25.3	21.5
	45-54 years	22.8	22.2	27.5	19.9	20.9	23.4
	55-64 years	12.4	11.4	18.8	16.7	6.3	8.9
	65+ years	5.1	6.9	0.6	3.8	1.9	12.0
Education	Less than primary education	0.3	0.0	0.6	0.0	0.0	0.6
	Primary education	1.5	4.4	1.3	0.0	1.9	0.0
	Secondary education	30.1	25.3	30.6	35.3	22.2	37.3
	University education	46.6	39.2	36.9	59.6	54.4	43.0
	Vocational education	21.5	31.0	30.6	5.1	21.5	19.0
Income	Less than 5,000 €	8.6	10.8	6.3	16.7	7.0	2.5
	5 001 - 10 000 €	3.5	2.5	0.6	5.8	1.9	7.0
	10 001 – 20 000 €	19.5	19.0	10.6	34.0	19.0	15.2
	20 001 – 40 000 €	30.4	27.8	33.1	24.4	41.8	24.7
	40 001 – 60 000 €	15.1	13.3	19.4	2.6	15.8	24.1
	60 001 – 80 000 €	7.5	8.2	13.1	1.9	7.0	7.0
	More than 80 001 €	5.6	5.7	5.6	0.6	0.6	15.2
	I do not wish to specify	9.9	12.7	11.3	14.1	7.0	4.4
Diet	Vegan	0.9	0.0	1.9	1.3	0.0	1.3
	Vegetarian	6.1	6.3	8.8	4.5	3.2	7.6
	Omnivore	92.2	93.0	88.1	94.2	95.6	89.9
	I do not wish to specify	0.9	0.6	1.3	0.0	1.3	1.3
Place of residence	City centre	35.9	24.1	31.6	38.2	62.0	23.4
	Town or suburb	46.6	60.1	36.1	49.7	29.1	58.2
	Rural area	17.5	15.8	32.2	12.1	8.9	18.4

Broiler survey participant characteristics

**values for gender to not add up to 100% due to 3 persons not wishing to specify their gender*

		Overall	Finland	Germany	Poland	Spain	UK
	N	751	150	150	151	152	148
Gender	Male	48*	49.3*	51	48.7	50	49.4*
	Female	50.3*	50.7*	50.7	49	51.3	50
Age	18-24 years	13.6	10.7	12.7	15.2	16.4	12.8
	25-34 years	23.6	24.7	18.7	23.8	30.3	20.9
	35-44 years	22.9	26.7	19.3	22.5	23.7	22.3
	45-54 years	22.5	19.3	29.3	19.9	20.4	23.6
	55-64 years	13.6	12.7	20	13.9	7.9	13.5
	65+ years	3.8	6	0.7	4.7	1.4	6.8
Education	Less than primary education	0.1	0	0.7	0	0	0
	Primary education	1.7	3.3	1.3	0.7	0.7	2.7
	Secondary education	26	26.7	24	29.1	20.4	29.7
	University education	49.7	33.3	39.3	64.9	63.8	46.6
	Vocational education	22.5	36.7	34.7	5.3	15.1	20.9
Income	Less than 5,000 €	3.6	6	1.3	6.6	2	2
	5 001 - 10 000 €	8.3	7.3	6	17.9	7.9	2
	10 001 – 20 000 €	19.7	12	12.9	29.9	25.3	18.4
	20 001 – 40 000 €	29.6	28	22	30.5	38.8	28.4
	40 001 – 60 000 €	14.9	12.7	24	3.3	15.1	19.6
	60 001 – 80 000 €	7.3	10.7	14.7	0.7	2.6	8.1
	More than 80 001 €	6.7	9.3	10	0.7	1.3	12.2
	I do not wish to specify	9.6	14	8.7	9.9	6.6	8.8
Diet	Vegan	0.9	0	0.7	1.3	0	2.7
	Vegetarian	5.9	6.7	10.7	2.6	2.6	6.8
	Omnivore	92.8	91.3	88.7	96	97.4	90.5
	I do not wish to specify	0.4	2	0	0	0	0
Place of residence	City centre	37.3	24.1	35.3	37.7	61.8	26.4
	Town or suburb	45.4	58	38.7	46.4	30.3	54.1
	Rural area	17.3	17.3	26	15.9	7.9	19.6

Pigs survey participant characteristics

*values for gender to not add up to 100% due to 3 persons not wishing to specify their gender

1.1.2 Unfamiliarity with farming

All responses are presented as the proportion (%) responding No to the statements listed unless otherwise specified. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
n	789	158	158	157	158	158	
Q1: Connections to raising farm animals							
No	78.6%	69.6%	89.2%	71.3%	77.2%	85.4%	***
Yes, currently live	6.3%	10.8%	3.2%	8.3%	4.4%	5.1%	
Yes, currently work	1.3%	1.3%	0%	2.5%	0.6%	1.9%	
Yes, family or close friends	13.8%	18.4%	7.6%	17.8%	17.7%	7.6%	
Q2: Have you visited a working farm?	83.3% No	91.8% No	87.3% No	78.3% No	69.6% No	89.2% No	***
Have you heard about production diseases from;							
Television	51.6% No	60.8% No	42.4% No	42.7% No	49.4% No	62.7% No	***
Radio	79.6% No	85.4% No	74.1% No	70.7% No	81.6% No	86.1% No	***
Newspaper	71.7% No	71.5% No	65.8% No	70.1% No	71.5% No	79.7% No	
Magazine	85.7% No	86.7% No	78.5% No	85.4% No	87.3% No	90.5% No	*
Internet	62.1% No	60.8% No	59.5% No	50.3% No	63.9% No	75.9% No	***
Social media	75.7% No	73.4% No	71.5% No	73.2% No	77.2% No	82.9% No	
Friends and family	74.7% No	79.7% No	70.3% No	64.3% No	74.7% No	84.2% No	***

Layers

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
n	790	158	160	156	158	158	
Q1: Connections to raising farm animals							
No	74.1%	67.7%	88.8%	65.4%	68.4%	79.7%	***
Yes, currently live	7.2%	8.9%	1.3%	9.6%	8.2%	8.2%	
Yes, currently work	2.5%	1.9%	2.5%	1.9%	4.4%	1.9%	
Yes, family or close friends	16.2%	21.5%	7.5%	23.1%	19%	10.1%	
Q2: Have you visited a working farm?	78.4% No	83.4% No	90.6% No	73.1% No	60.8% No	83.5% No	***
Have you heard about production diseases from;							
Television	57.3% No	73.4%No	45.0%No	43.6%No	58.9%No	65.8%No	***
Radio	81.0%No	90.5%No	78.8%No	67.9%No	87.3%No	80.4%No	***
Newspaper	73.2%No	77.2%No	68.1%No	67.9%No	78.5%No	74.1%No	
Magazine	87.5%No	89.2%No	86.3%No	81.4%No	89.9%No	90.5%No	
Internet	64.2%No	77.2%No	60.6%No	47.4%No	60.8%No	74.7%No	***
Social media	82.4%No	87.3%No	78.1%No	79.5%No	82.9%No	84.2%No	
Friends and family	75.6%No	88.6%No	72.5%No	62.2%No	74.1%No	80.4%No	***

Pigs

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Q1: Connections to raising farm animals							
No	77.1%	76.7%	86.7%	68.9%	75%	77.1%	
Yes, currently live	5.5%	4%	0.7%	9.3%	2%	11.5%	***
Yes, currently work	1.9%	2.7%	0.7%	4%	1.3%	0.7%	
Yes, family or close friends	16.7%	12%	17.9%	21.7%	9.5%	8.9%	
Q2: Have you visited a working farm?	77.5% No	86% No	90% No	66.9% No	66.4% No	78.4% No	***
Have you heard about production diseases from;							
Television	58.1% No	63.3% No	54% No	39.1% No	57.9% No	76.4% No	***
Radio	82.8% No	89.3% No	85.3% No	66.9% No	85.5% No	87.2% No	***
Newspaper	74.7% No	74% No	74.7% No	63.6% No	82.2% No	79.1% No	**
Magazine	88.5% No	89.3% No	86.7% No	82.8% No	92.8% No	91.2% No	
Internet	66.7% No	66% No	72.7% No	45.7% No	68.4% No	81.1% No	***
Social media	80.7% No	78.7% No	83.3% No	74.8% No	84.2% No	82.4% No	
Friends and family	79.2% No	83.3% No	82% No	69.5% No	77% No	84.5% No	**

1.1.3 Attitude and purchase intentions towards intensive production systems

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

Intensive production systems are …	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Unpleasant (1)/pleasant (5)	2.09 ± 1.03	2.33 ± 1.04	1.83 ± 1.00	2.05 ± 0.97	2.21 ± 1.11	2.11 ± 1.11	**
Good (1)/bad (5)	2.32 ± 1.05	2.44 ± 1.07	1.84 ± 0.94	2.34 ± 0.96	2.59 ± 1.04	2.38 ± 1.10	***
Worthless (1)/valuable (5)	2.72 ± 1.05	2.78 ± 1.02	2.35 ± 1.09	2.75 ± 1.02	2.67 ± 1.00	3.03 ± 0.99	***
Useful (1)/useless (5)	3.06 ± 1.11	3.22 ± 1.10	2.55 ± 1.16	3.04 ± 1.10	3.40 ± 1.02	3.10 ± 1.00	***
Unsafe (1)/safe (5)	2.63 ± 1.08	2.66 ± 1.14	2.34 ± 1.05	2.53 ± 0.98	2.85 ± 1.00	2.78 ± 1.13	***
Ethical (1)/unethical (5)	2.12 ± 1.06	2.21 ± 1.12	1.88 ± 1.06	2.00 ± 0.90	2.30 ± 1.05	2.23 ± 1.12	***

	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
I purchase foods produced using intensive production systems	3.04 ± 1.06	3.20 ± 1.00	2.86 ± 1.19	2.96 ± 0.95	3.28 ± 0.96	2.91 ± 1.14	**
I intend to purchase foods produced using intensive production systems	2.79 ± 1.08	2.94 ± 1.12	2.61 ± 1.19	2.72 ± 0.90	3.01 ± 0.99	2.67 ± 1.11	**
I would consider purchasing foods produced by intensive systems	2.90 ± 1.07	3.05 ± 1.10	2.78 ± 1.17	2.75 ± 0.92	3.14 ± 1.04	2.80 ± 1.07	**
I plan to reduce my consumption of foods from intensive production systems	3.53 ± 1.02	3.35 ± 1.08	3.56 ± 1.10	3.62 ± 0.93	3.59 ± 0.98	3.52 ± 0.98	
I avoid purchasing foods from intensive production systems	3.36 ± 1.09	3.22 ± 1.11	3.44 ± 1.19	3.42 ± 0.98	3.35 ± 1.10	3.35 ± 1.07	
I feel that I have an obligation to purchase animal products from intensive production systems	2.56 ± 1.15	2.23 ± 1.03	2.58 ± 1.24	2.55 ± 1.04	2.80 ± 1.18	2.62 ± 1.18	***
I feel that I have an ethical obligation to avoid animal products from intensive production systems	3.57 ± 1.05	3.49 ± 1.14	3.66 ± 1.11	3.46 ± 0.97	3.53 ± 0.66	3.72 ± 1.07	
I think of myself as someone who is concerned about intensive production systems	3.57 ± 1.01	3.38 ± 1.10	3.70 ± 1.03	3.66 ± 0.99	3.46 ± 0.94	3.63 ± 0.99	*
I think of myself as someone who is concerned about FAW	3.67 ± 1.01	3.60 ± 1.13	3.73 ± 1.08	3.58 ± 1.00	3.66 ± 0.90	3.77 ± 0.94	

Layers

Intensive production systems are …	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Unpleasant (1)/pleasant (5)	2.22 ± 1.04	2.41 ± 0.93	1.93 ± 1.03	2.35 ± 1.02	2.28 ± 0.97	2.15 ± 1.17	***
Good (1)/bad (5)	2.44 ± 1.05	2.72 ± 0.95	1.92 ± 0.97	2.63 ± 1.04	2.59 ± 1.00	2.34 ± 1.12	***
Worthless (1)/valuable (5)	3.06 ± 1.08	3.03 ± 0.92	2.67 ± 1.14	3.11 ± 1.02	3.13 ± 1.01	3.15 ± .13	***
Useful (1)/useless (5)	3.06 ± 1.08	3.23 ± 0.97	2.67 ± 1.14	3.11 ± 1.03	3.13 ± 1.01	3.15 ± 1.13	***
Unsafe (1)/safe (5)	2.64 ± 1.07	2.72 ± 1.01	2.33 ± 1.10	2.62 ± 1.00	2.80 ± 1.04	2.70 ± 1.13	**
Ethical (1)/unethical (5)	2.17 ± 1.04	2.35 ± 0.96	1.81 ± 0.99	2.33 ± 0.97	2.18 ± 0.99	2.18 ± 1.17	***

	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
I purchase foods produced using intensive production systems	3.00 ± 1.06	3.00 ± 0.96	2.91 ± 1.14	3.00 ± 1.02	3.22 ± 1.01	2.85 ± 1.12	*
I intend to purchase foods produced using intensive production systems	2.84 ± 1.12	2.91 ± 1.04	2.65 ± 1.22	2.88 ± 0.94	3.07 ± 1.11	2.67 ± 1.22	**
I would consider purchasing foods produced by intensive production systems	2.91 ± 1.11	3.08 ± 1.04	2.76 ± 1.14	2.86 ± 0.98	3.03 ± 1.09	2.82 ± 1.25	
I plan to reduce my consumption of foods from intensive production systems	3.43 ± 1.02	3.25 ± 0.94	3.52 ± 1.19	3.53 ± 0.96	3.49 ± 0.94	3.36 ± 1.04	*
I avoid purchasing foods from intensive production systems	3.38 ± 1.05	3.16 ± 1.02	3.45 ± 1.15	3.40 ± 0.87	3.41 ± 1.00	3.47 ± 1.14	*
I feel that I have an obligation to purchase animal products from intensive production systems	2.62 ± 1.16	2.32 ± 1.02	2.54 ± 1.33	2.86 ± 1.04	2.73 ± 1.03	2.63 ± 1.28	***
I feel that I have an ethical obligation to avoid animal products from intensive production systems	3.53 ± 1.11	3.33 ± 1.14	3.84 ± 1.18	3.36 ± 1.01	3.44 ± 1.03	3.66 ± 1.12	***
I think of myself as someone who is concerned about intensive animal production systems	3.53 ± 1.00	3.25 ± 1.12	3.71 ± 1.00	3.59 ± 0.98	3.37 ± 0.85	3.71 ± 0.97	***
I think of myself as someone who is concerned about FAW	3.70 ± 0.97	3.66 ± 1.02	3.71 ± 1.04	3.69 ± 0.91	3.56 ± 0.92	3.91 ± 0.94	*

Pigs

Intensive production systems are …	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Unpleasant (1)/pleasant (5)	2.18 ± 1.06	2.16 ± 0.95	1.93 ± 1.16	2.28 ± 1.00	2.26 ± 0.99	2.24 ± 1.17	**
Good (1)/bad (5)	2.43 ± 1.04	2.52 ± 1.03	1.95 ± 1.05	2.54 ± 0.94	2.66 ± 0.91	2.48 ± 1.11	***
Worthless (1)/valuable (5)	2.76 ± 1.03	2.81 ± 0.93	2.41 ± 1.12	2.77 ± 0.93	2.60 ± 0.98	3.21 ± 1.02	***
Useful (1)/useless (5)	3.09 ± 1.06	3.14 ± 1.02	2.63 ± 1.16	3.25 ± 0.98	3.28 ± 0.99	3.16 ± 1.00	***
Unsafe (1)/safe (5)	2.65 ± 1.08	2.59 ± 1.11	2.27 ± 1.09	2.70 ± 0.96	2.86 ± 1.05	2.84 ± 1.10	***
Ethical (1)/unethical (5)	2.23 ± 1.10	2.19 ± 1.07	2.87 ± 1.05	2.34 ± 1.03	2.45 ± 1.06	2.32 ± 1.20	***

	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
I purchase foods produced using intensive production systems	3.01 ± 1.02	2.98 ± 0.98	2.96 ± 1.11	3.04 ± 0.92	3.12 ± 1.00	2.93 ± 1.08	*
I intend to purchase foods produced using intensive production systems	2.79 ± 1.06	2.83 ± 1.04	2.59 ± 1.17	2.84 ± 0.93	2.97 ± 0.99	2.73 ± 1.12	
I would consider purchasing foods produced by intensive production systems	2.94 ± 1.06	2.93 ± 1.03	2.84 ± 1.12	2.88 ± 0.97	3.07 ± 1.00	2.98 ± 1.16	*
I plan to reduce my consumption of foods from intensive production systems	3.42 ± 1.07	3.29 ± 1.03	3.77 ± 1.08	3.37 ± 0.99	3.35 ± 1.10	3.31 ± 1.06	*
I avoid purchasing foods from intensive production systems	3.34 ± 1.07	3.25 ± 1.06	3.63 ± 1.08	3.33 ± 0.99	3.19 ± 1.08	3.30 ± 1.12	
I feel that I have an obligation to purchase animal products from intensive production systems	2.59 ± 1.13	2.37 ± 0.97	2.51 ± 1.25	2.75 ± 1.05	2.78 ± 1.09	2.54 ± 1.23	***
I feel that I have an ethical obligation to avoid animal products from intensive production systems	3.53 ± 1.10	3.41 ± 1.20	3.93 ± 1.01	3.30 ± 1.00	3.45 ± 1.07	3.54 ± 1.12	**
I think of myself as someone who is concerned about intensive animal production systems	3.53 ± 1.03	3.39 ± 1.10	3.79 ± 0.94	3.51 ± 1.00	3.27 ± 1.02	3.67 ± 1.02	**
I think of myself as someone who is concerned about FAW	3.67 ± 0.99	3.57 ± 1.08	3.88 ± 0.92	3.50 ± 0.91	3.55 ± 0.96	3.86 ± 1.00	*

1.1.4 Responsibility

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

Question: To what extent do you agree or disagree that the following organizations or individuals should be responsible for ensuring the health of broiler chickens?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	3.89 ± 1.03	3.94 ± 1.08	3.62 ± 1.13	3.80 ± 1.05	3.97 ± 1.01	4.13 ± 0.79	***
European Commission	3.96 ± 0.96	4.06 ± 0.97	3.95 ± 0.94	3.76 ± 1.05	4.13 ± 0.92	3.89 ± 0.90	**
National government	4.06 ± 0.94	4.11 ± 0.92	4.10 ± 0.93	3.86 ± 1.01	4.08 ± 0.99	4.16 ± 0.83	
Veterinarians	4.11 ± 0.94	4.34 ± 0.89	3.91 ± 1.01	4.18 ± 0.96	4.20 ± 0.88	3.92 ± 0.88	***
Animal health authorities	4.34 ± 0.86	4.58 ± 0.71	4.30 ± 0.89	4.20 ± 0.95	4.29 ± 0.86	4.35 ± 0.81	***
Veterinary medicine producers	3.99 ± 0.78	4.18 ± 0.98	3.98 ± 1.02	4.00 ± 0.93	3.99 ± 1.00	3.78 ± 0.92	***
Animal breeding companies	4.35 ± 0.89	4.39 ± 0.90	4.42 ± 0.82	4.39 ± 0.90	4.14 ± 1.06	4.40 ± 0.72	
Animal feed producers	4.02 ± 0.99	4.22 ± 0.91	3.79 ± 1.09	4.15 ± 0.93	4.08 ± 1.00	3.87 ± 0.95	***
Animal housing manufacturers	3.81 ± 1.05	3.98 ± 1.04	3.71 ± 1.16	3.55 ± 1.02	3.80 ± 1.09	4.00 ± 0.89	***
Farmers	4.43 ± 0.85	4.53 ± 0.87	4.45 ± 0.81	4.45 ± 0.84	4.26 ± 0.90	4.46 ± 0.82	*
Animal transporters	4.08 ± 0.97	3.91 ± 1.04	3.98 ± 1.02	3.67 ± 1.13	3.67 ± 1.13	3.97 ± 0.90	*
Slaughterhouses	4.05 ± 1.02	4.27 ± 0.91	4.01 ± 1.01	3.93 ± 1.05	4.03 ± 1.13	4.03 ± 0.99	*
Quality assurance systems	4.17 ± 0.92	4.21 ± 0.92	4.25 ± 0.90	4.06 ± 1.00	4.26 ± 0.92	4.06 ± 0.83	*
Food manufacturers	4.13 ± 0.94	4.23 ± 0.92	4.09 ± 0.96	4.17 ± 1.00	4.04 ± 1.04	4.11 ± 0.80	
Food retailers	3.76 ± 0.99	3.84 ± 1.01	3.69 ± 1.02	3.57 ± 1.01	3.73 ± 1.01	3.94 ± 0.88	*
Consumer organisations	3.76 ± 1.02	3.87 ± 1.03	3.66 ± 1.04	3.66 ± 1.07	3.91 ± 1.01	3.70 ± 0.93	*
The general public	3.41 ± 1.09	3.52 ± 1.18	3.39 ± 1.13	3.42 ± 1.02	3.39 ± 1.09	3.31 ± 1.07	*
You as a consumer	3.37 ± 1.16	3.53 ± 1.20	3.42 ± 1.17	3.05 ± 1.17	3.51 ± 1.17	3.34 ± 1.06	*

Question: To what extent do you agree or disagree that the following organizations or individuals should take action for ensuring the welfare of broiler chickens?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	4.09 ± 0.95	4.08 ± 1.05	4.05 ± 0.98	3.92 ± 0.94	4.11 ± 0.96	4.27 ± 0.79	*
European Commission	3.97 ± 0.99	4.04 ± 1.02	4.08 ± 0.94	3.76 ± 1.06	4.08 ± 3.90	3.90 ± 0.92	**
National government	4.07 ± 0.93	4.13 ± 0.94	4.15 ± 0.90	3.86 ± 0.97	4.10 ± 0.60	4.13 ± 0.88	*
Veterinarians	4.16 ± 0.89	4.41 ± 0.88	4.13 ± 0.94	4.18 ± 0.85	4.13 ± 0.90	3.97 ± 0.87	***
Animal health authorities	4.31 ± 0.84	4.49 ± 0.79	4.35 ± 0.83	4.14 ± 0.86	4.23 ± 0.90	4.36 ± 0.76	***
Veterinary medicine producers	3.93 ± 1.00	4.16 ± 1.01	3.94 ± 0.99	3.86 ± 1.03	3.90 ± 1.04	3.77 ± 0.90	***
Animal breeding companies	4.31 ± 0.87	4.33 ± 0.93	4.46 ± 0.77	4.30 ± 0.82	4.12 ± 1.03	4.36 ± 0.74	*
Animal feed producers	3.95 ± 1.00	4.20 ± 0.90	3.76 ± 1.04	3.92 ± 0.96	4.00 ± 1.03	3.86 ± 1.01	***
Animal housing manufacturers	3.96 ± 1.01	4.18 ± 1.00	3.79 ± 1.07	3.80 ± 1.00	3.97 ± 1.08	4.04 ± 0.86	***
Farmers	4.44 ± 0.82	4.58 ± 0.74	4.49 ± 0.79	4.38 ± 0.81	4.27 ± 0.98	4.48 ± 0.75	*
Animal transporters	4.04 ± 1.00	4.25 ± 0.96	4.09 ± 1.01	4.00 ± 0.91	3.81 ± 1.17	4.03 ± 0.87	**
Slaughterhouses	4.04 ± 1.03	4.30 ± 0.98	4.11 ± 1.04	3.90 ± 1.01	3.89 ± 1.14	3.99 ± 0.92	***
Quality assurance systems	4.14 ± 0.92	4.30 ± 0.98	4.11 ± 1.04	3.90 ± 1.01	3.89 ± 1.14	3.99 ± 0.92	
Food manufacturers	3.97 ± 0.99	4.13 ± 0.97	3.97 ± 1.03	3.97 ± 0.93	3.78 ± 1.08	3.97 ± 0.89	*
Food retailers	3.77 ± 1.01	3.93 ± 1.00	3.76 ± 1.05	3.57 ± 0.98	3.61 ± 1.06	3.97 ± 0.87	***
Consumer organisations	3.81 ± 1.00	3.99 ± 1.04	3.79 ± 1.07	3.68 ± 0.91	3.77 ± 1.09	3.82 ± 0.88	*
The general public	3.50 ± 1.08	3.59 ± 1.18	3.57 ± 1.16	3.53 ± 0.97	3.41 ± 1.04	3.39 ± 1.04	
You as a consumer	3.45 ± 1.11	3.68 ± 1.16	3.64 ± 1.17	3.20 ± 1.07	3.42 ± 1.09	3.33 ± 1.01	***

Question: Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive broiler chicken production systems?

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Livestock farmers/ producers through making less profits	65.4% Yes	36.1% Yes	83.5% Yes	83.4% Yes	67.7% Yes	56.3% Yes	***
Food manufacturers through making less profits	81.7% Yes	85.4% Yes	84.2% Yes	80.9% Yes	77.8% Yes	80.4% Yes	
Food retailers through making less profits	67.0% Yes	81.0% Yes	77.8% Yes	50.3% Yes	44.9% Yes	81.0% Yes	***
Consumers, through higher product prices	50.1% Yes	59.5% Yes	62.0% Yes	42.7% Yes	36.1% Yes	50.0% Yes	***
The general public, through increased taxes	28.4% Yes	29.1% Yes	29.1% Yes	23.6% Yes	31.6% Yes	28.5% Yes	
National government through providing subsidies and funds	68.1% Yes	65.8% Yes	60.1% Yes	71.3% Yes	77.2% Yes	65.8% Yes	
European commission, through providing subsidies	71.4% Yes	70.9% Yes	64.6% Yes	74.5% Yes	77.2% Yes	69.6% Yes	

Layers

Question: To what extent do you agree or disagree that the following organizations or individuals should take action for ensuring the health of laying hens?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Animal welfare organisations	3.91 ± 1.08	4.02 ± 1.00	3.83 ± 1.10	3.80 ± 1.19	3.94 ± 1.08	3.94 ± 1.01	
European Commission	3.91 ± 1.02	3.99 ± 0.90	4.03 ± 1.02	3.60 ± 1.12	4.01 ± 1.00	3.92 ± 0.99	***
National government	3.99 ± 1.04	4.04 ± 0.93	4.18 ± 0.94	3.74 ± 1.19	3.89 ± 1.18	4.09 ± 0.88	*
Veterinarians	4.12 ± 0.98	4.35 ± 0.77	4.06 ± 1.02	4.18 ± 1.06	4.05 ± 1.01	3.93 ± 0.97	***
Animal health authorities	4.33 ± 0.85	4.54 ± 0.67	4.39 ± 0.89	4.24 ± 0.90	4.17 ± 0.93	4.30 ± 0.80	***
Veterinary medicine producers	3.96 ± 0.89	4.23 ± 0.90	3.94 ± 1.03	3.92 ± 1.09	3.89 ± 0.96	3.79 ± 0.97	***
Animal breeding companies	4.28 ± 0.92	4.35 ± 0.87	4.43 ± 0.80	4.37 ± 0.96	4.08 ± 1.04	4.20 ± 0.88	**
Animal feed producers	4.04 ± 1.01	4.27 ± 0.89	3.87 ± 1.07	4.13 ± 1.07	4.04 ± 0.96	3.89 ± 1.03	***
Animal housing manufacturers	3.96 ± 0.98	4.04 ± 0.93	3.81 ± 1.06	3.58 ± 1.12	3.80 ± 1.02	3.96 ± 0.89	**
Farmers	4.39 ± 0.86	4.50 ± 0.80	4.52 ± 0.74	4.38 ± 0.95	4.13 ± 0.96	4.44 ± 0.79	***
Animal transporters	3.96 ± 0.98	4.12 ± 0.94	3.96 ± 1.02	3.97 ± 1.02	3.80 ± 1.02	3.96 ± 0.89	*
Slaughterhouses	3.95 ± 1.08	4.28 ± 0.90	3.93 ± 1.11	3.84 ± 1.12	3.82 ± 1.15	3.87 ± 1.05	***
Quality assurance systems	4.16 ± 0.92	4.25 ± 0.87	4.19 ± 0.95	4.08 ± 1.02	4.10 ± 0.94	4.16 ± 0.81	
Food manufacturers	4.07 ± 0.94	4.21 ± 0.95	4.03 ± 0.90	4.14 ± 0.93	3.93 ± 0.99	4.03 ± 0.93	*
Food retailers	3.71 ± 1.00	3.83 ± 1.01	3.71 ± 0.96	3.52 ± 1.03	3.63 ± 1.07	3.89 ± 0.97	**
Consumer organisations	3.77 ± 0.97	3.89 ± 0.98	3.76 ± 1.05	3.69 ± 0.96	3.71 ± 0.95	3.81 ± 0.92	
The general public	3.39 ± 1.09	3.54 ± 1.07	3.50 ± 1.05	3.31 ± 1.16	3.29 ± 1.07	3.30 ± 1.06	
You as a consumer	3.38 ± 1.14	3.56 ± 1.09	3.41 ± 1.17	3.11 ± 1.17	3.41 ± 1.15	3.43 ± 1.11	**

Question: To what extent do you agree or disagree that the following organizations or individuals should take action for ensuring the welfare of laying hens?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	4.11 ± 0.87	4.11 ± 0.96	4.16 ± 0.95	3.99 ± 1.04	4.07 ± 1.01	4.20 ± 0.87	
European Commission	3.91 ± 1.02	3.99 ± 0.92	4.04 ± 0.99	3.62 ± 1.13	4.00 ± 1.01	3.91 ± 0.97	**
National government	4.02 ± 0.98	4.01 ± 0.92	4.20 ± 0.91	3.76 ± 1.10	4.04 ± 1.02	4.08 ± 0.90	**
Veterinarians	4.09 ± 0.96	4.42 ± 0.72	4.16 ± 0.95	4.01 ± 1.03	3.91 ± 0.98	3.94 ± 1.00	***
Animal health authorities	4.28 ± 0.86	4.47 ± 0.66	4.36 ± 0.87	4.10 ± 0.94	4.14 ± 0.93	4.32 ± 0.82	***
Veterinary medicine producers	3.94 ± 1.00	4.08 ± 1.01	3.98 ± 1.00	3.91 ± 1.03	3.91 ± 0.98	3.84 ± 1.00	
Animal breeding companies	4.27 ± 0.89	4.26 ± 0.90	4.39 ± 0.85	4.35 ± 0.90	4.18 ± 0.95	4.20 ± 0.83	*
Animal feed producers	3.92 ± 1.01	4.16 ± 0.94	3.71 ± 1.13	3.97 ± 1.13	3.98 ± 0.99	3.75 ± 0.96	***
Animal housing manufacturers	4.00 ± 0.97	4.24 ± 0.84	3.88 ± 1.05	3.85 ± 1.01	3.97 ± 0.99	4.05 ± 0.90	**
Farmers	4.39 ± 0.85	4.52 ± 0.76	4.46 ± 0.78	4.38 ± 0.95	4.13 ± 0.93	4.46 ± 0.75	***
Animal transporters	3.96 ± 1.02	4.17 ± 0.97	4.11 ± 0.99	3.99 ± 1.00	3.91 ± 0.95	4.03 ± 0.96	*
Slaughterhouses	3.96 ± 1.02	4.23 ± 0.90	4.01 ± 1.02	3.85 ± 1.06	3.78 ± 1.10	3.91 ± 0.96	***
Quality assurance systems	4.10 ± 0.93	4.22 ± 0.86	4.12 ± 0.94	3.97 ± 1.02	4.09 ± 1.00	4.10 ± 0.83	
Food manufacturers	3.92 ± 1.00	4.05 ± 0.99	3.90 ± 1.02	3.99 ± 1.02	3.76 ± 1.03	3.90 ± 0.93	
Food retailers	3.67 ± 1.01	3.77 ± 1.05	3.64 ± 1.02	3.47 ± 1.03	3.62 ± 0.99	3.85 ± 0.93	**
Consumer organisations	3.77 ± 1.00	3.84 ± 0.97	3.78 ± 1.03	3.63 ± 1.01	3.76 ± 1.03	3.82 ± 1.94	
The general public	2.46 ± 1.11	3.55 ± 1.09	3.68 ± 1.01	3.40 ± 1.15	3.34 ± 1.11	3.32 ± 1.14	*
You as a consumer	3.48 ± 1.11	3.54 ± 1.10	3.67 ± 1.02	3.21 ± 1.15	3.53 ± 1.13	3.46 ± 1.09	**

Question: Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive layer hen production systems?

	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Livestock farmers/ producers through making less profits	66.6% Yes	37.3% Yes	80.6% Yes	87.2% Yes	65.2% Yes	62.7% Yes	***
Food manufacturers through making less profits	80.0% Yes	78.5% Yes	81.9% Yes	84.6% Yes	74.7% Yes	80.4% Yes	
Food retailers through making less profits	69.5% Yes	81.6% Yes	75.6% Yes	58.3% Yes	51.9% Yes	79.7% Yes	***
Consumers, through higher product prices	52.2% Yes	53.2% Yes	68.1% Yes	46.8% Yes	37.3% Yes	55.1% Yes	***
The general public, through increased taxes	31.6% Yes	27.2% Yes	32.5% Yes	35.9% Yes	27.8% Yes	34.8% Yes	
National government through providing subsidies and funds	67.3% Yes	63.9% Yes	51.9% Yes	77.6% Yes	73.4% Yes	70.3% Yes	***
European commission, through providing subsidies	71.1% Yes	74.1% Yes	58.1% Yes	78.8% Yes	80.4% Yes	64.6% Yes	***

Pigs

Question: To what extent do you agree or disagree that the following organizations or individuals should take action for ensuring the health of pigs?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	3.93 ± 1.00	3.94 ± 1.01	3.87 ± 0.93	3.88 ± 1.01	3.89 ± 1.12	4.09 ± 0.92	
European Commission	3.87 ± 1.06	3.93 ± 1.00	4.00 ± 1.01	3.79 ± 1.07	3.84 ± 1.20	3.77 ± 1.01	
National government	4.01 ± 0.99	4.07 ± 0.88	4.15 ± 0.89	3.90 ± 1.01	3.90 ± 1.21	4.05 ± 0.89	
Veterinarians	4.23 ± 0.90	4.48 ± 0.75	4.23 ± 0.88	4.36 ± 0.83	4.04 ± 1.06	4.03 ± 0.90	***
Animal health authorities	4.33 ± 0.90	4.51 ± 0.78	4.42 ± 0.71	4.32 ± 0.85	4.11 ± 1.16	4.30 ± 0.91	*
Veterinary medicine producers	4.05 ± 0.97	4.28 ± 0.89	4.09 ± 0.88	4.11 ± 0.95	3.83 ± 1.12	3.93 ± 0.96	***
Animal breeding companies	4.31 ± 0.91	4.30 ± 0.80	4.59 ± 0.61	4.54 ± 0.74	3.90 ± 1.18	4.23 ± 0.93	***
Animal feed producers	4.11 ± 0.97	4.31 ± 0.88	4.15 ± 0.83	4.25 ± 0.85	3.92 ± 1.15	3.91 ± 1.01	***
Animal housing manufacturers	3.81 ± 1.05	4.07 ± 0.95	3.78 ± 1.06	3.66 ± 1.10	3.74 ± 1.14	3.82 ± 0.96	*
Farmers	4.46 ± 0.82	4.59 ± 0.68	4.66 ± 0.56	4.54 ± 0.70	4.05 ± 1.08	4.46 ± 0.83	***
Animal transporters	3.98 ± 1.00	4.15 ± 0.92	4.11 ± 0.96	4.04 ± 0.94	3.67 ± 1.13	3.93 ± 0.97	***
Slaughterhouses	4.09 ± 1.04	4.37 ± 0.82	4.15 ± 1.02	4.17 ± 0.87	3.81 ± 1.27	3.99 ± 1.10	**
Quality assurance systems	4.15 ± 0.93	4.31 ± 0.77	4.35 ± 0.76	4.11 ± 0.95	4.01 ± 1.10	3.95 ± 0.95	***
Food manufacturers	4.04 ± 1.00	4.15 ± 0.95	4.19 ± 0.85	4.15 ± 0.96	3.81 ± 1.16	3.89 ± 0.99	**
Food retailers	3.72 ± 1.03	3.77 ± 1.04	3.80 ± 0.97	3.69 ± 1.11	3.64 ± 1.05	3.71 ± 0.96	
Consumer organisations	3.75 ± 1.01	3.83 ± 0.93	3.80 ± 0.96	3.73 ± 0.97	3.74 ± 1.11	3.66 ± 1.05	
The general public	3.39 ± 1.10	3.63 ± 1.03	3.57 ± 1.05	3.33 ± 1.14	3.28 ± 1.05	3.16 ± 1.18	***
You as a consumer	3.34 ± 1.19	3.59 ± 1.09	3.58 ± 1.19	2.93 ± 1.20	3.43 ± 1.17	3.18 ± 1.17	***

Question: To what extent do you agree or disagree that the following organizations or individuals should take action for ensuring the welfare of pigs?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	4.06 ± 1.02	4.05 ± 1.09	4.25 ± 0.89	3.84 ± 1.05	3.99 ± 1.06	4.19 ± 0.93	**
European Commission	3.90 ± 1.05	3.91 ± 1.07	4.11 ± 1.01	3.70 ± 1.03	3.95 ± 1.12	3.81 ± 1.00	***
National government	4.00 ± 1.01	4.03 ± 0.94	4.33 ± 0.82	3.77 ± 1.02	3.85 ± 1.21	4.02 ± 0.94	***
Veterinarians	4.23 ± 0.90	4.49 ± 0.83	4.25 ± 0.80	4.27 ± 0.87	4.06 ± 1.04	4.07 ± 0.87	***
Animal health authorities	4.28 ± 0.89	4.50 ± 0.74	4.39 ± 0.78	4.18 ± 0.93	4.08 ± 1.05	4.24 ± 0.84	***
Veterinary medicine producers	3.97 ± 1.01	4.17 ± 1.02	4.03 ± 0.94	3.96 ± 0.98	3.88 ± 1.10	3.80 ± 0.95	**
Animal breeding companies	4.29 ± 0.89	4.33 ± 0.88	4.51 ± 0.69	4.40 ± 0.83	3.97 ± 1.12	4.24 ± 0.80	***
Animal feed producers	4.00 ± 1.00	4.28 ± 0.91	3.96 ± 0.96	4.05 ± 0.96	3.84 ± 1.15	3.89 ± 0.96	***
Animal housing manufacturers	3.96 ± 1.01	4.12 ± 0.98	4.04 ± 0.98	3.81 ± 1.07	3.85 ± 1.10	3.97 ± 0.89	
Farmers	4.42 ± 0.84	4.57 ± 0.71	4.59 ± 0.61	4.44 ± 0.81	4.01 ± 1.09	4.50 ± 0.77	***
Animal transporters	4.10 ± 1.00	4.26 ± 0.92	4.23 ± 0.86	4.13 ± 1.00	3.74 ± 1.17	4.14 ± 0.93	***
Slaughterhouses	4.05 ± 1.06	4.30 ± 1.00	4.26 ± 0.91	3.99 ± 0.98	3.70 ± 1.23	4.01 ± 1.03	***
Quality assurance systems	4.09 ± 0.96	4.24 ± 0.87	4.26 ± 0.82	3.99 ± 1.02	3.97 ± 1.11	3.99 ± 0.94	*
Food manufacturers	3.91 ± 1.04	4.07 ± 1.02	3.99 ± 1.01	3.86 ± `.06	3.73 ± 1.15	3.91 ± 1.04	*
Food retailers	3.68 ± 1.07	3.76 ± 1.10	3.87 ± 1.02	3.51 ± 1.0	3.51 ± 1.13	3.76 ± 0.96	**
Consumer organisations	3.74 ± 1.03	3.82 ± 1.04	3.99 ± 0.93	3.58 ± 1.02	3.74 ± 1.11	3.56 ± 1.02	***
The general public	3.50 ± 1.11	3.66 ± 1.07	3.82 ± 1.01	3.31 ± 1.08	3.45 ± 1.08	3.24 ± 1.19	***
You as a consumer	3.42 ± 1.13	3.67 ± 1.05	3.78 ± 1.00	2.99 ± 1.14	3.42 ± 1.15	3.26 ± 1.11	***

Question: Which actor(s) in the food chain do you think should bear the costs incurred as a result of any interventions introduced to prevent production diseases in intensive production systems?

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Livestock farmers/ producers through making less profits	62.6% Yes	32% Yes	79.3% Yes	79.5% Yes	63.8% Yes	58.1% Yes	***
Food manufacturers through making less profits	77.9% Yes	79.3% Yes	78% Yes	77.5% Yes	75% Yes	79.7% Yes	
Food retailers through making less profits	64.4% Yes	76% Yes	75.3% Yes	48.3% Yes	50% Yes	73% Yes	***
Consumers, through higher product prices	51.7% Yes	46.7% Yes	73.3% Yes	39.1% Yes	44.1% Yes	55.4% Yes	***
The general public, through increased taxes	28.6% Yes	22.7% Yes	29.3% Yes	31.3% Yes	28.9% Yes	31.1% Yes	
National government through providing subsidies and funds	70.4% Yes	66.7% Yes	66% Yes	74.2% Yes	80.3% Yes	64.9% Yes	*
European commission, through providing subsidies	73.6% Yes	77.3% Yes	65.3% Yes	80.8% Yes	81.6% Yes	62.8% Yes	***

1.1.5 Trust

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (strongly disagree) to 5(strongly agree) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

Question: We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in broiler chicken production systems?

	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Animal welfare organisations	3.81 ± 1.03	3.56 ± 1.09	4.03 ± 0.97	3.57 ± 1.06	3.86 ± 1.03	4.02 ± 0.92	***
European Commission	3.36 ± 1.06	3.08 ± 0.99	3.33 ± 1.15	3.18 ± 0.98	3.75 ± 1.03	3.45 ± 0.99	***
National government	3.26 ± 1.10	3.06 ± 0.98	3.42 ± 1.07	2.90 ± 1.10	3.55 ± 1.15	3.36 ± 1.08	***
Veterinarians	3.71 ± 0.97	3.66 ± 0.99	3.68 ± 1.01	3.45 ± 1.02	3.94 ± 0.90	3.82 ± 0.85	***
Animal health authorities	3.74 ± 1.01	3.75 ± 0.98	3.71 ± 1.07	3.39 ± 0.99	3.98 ± 0.97	3.87 ± 0.93	***
Veterinary medicine producers	3.20 ± 1.09	2.77 ± 1.12	3.23 ± 1.12	3.00 ± 1.06	3.50 ± 1.03	3.47 ± 0.92	***
Animal breeding companies	3.01 ± 1.18	2.80 ± 1.11	3.01 ± 1.30	2.83 ± 1.12	3.30 ± 1.13	3.13 ± 1.17	***
Animal feed producers	2.96 ± 1.09	2.66 ± 0.99	2.82 ± 1.18	2.91 ± 1.05	3.28 ± 1.15	3.14 ± 0.97	***
Animal housing manufacturers	2.98 ± 1.05	2.85 ± 0.93	2.77 ± 2.05	2.92 ± 0.97	3.12 ± 1.12	3.23 ± 1.10	***
Farmers	3.19 ± 1.12	3.09 ± 1.09	3.23 ± 1.20	2.83 ± 1.14	3.41 ± 1.09	3.39 ± 1.00	***
Animal transporters	2.89 ± 1.07	2.72 ± 0.94	2.78 ± 1.15	2.77 ± 2.05	3.07 ± 1.10	3.10 ± 1.06	***
Slaughterhouses	2.95 ± 1.13	2.74 ± 1.07	2.87 ± 1.21	2.85 ± 1.10	3.23 ± 1.10	3.04 ± 2.20	***
Quality assurance systems	3.59 ± 1.02	3.30 ± 0.94	3.63 ± 1.09	3.34 ± 1.01	3.89 ± 1.01	3.80 ± 0.93	***
Food manufacturers	3.02 ± 1.10	2.80 ± 1.01	2.96 ± 1.23	2.88 ± 1.09	3.27 ± 1.06	3.21 ± 1.01	***
Food retailers	3.02 ± 1.05	2.82 ± 0.96	2.99 ± 1.14	2.86 ± 1.02	3.24 ± 0.99	3.20 ± 1.06	***
Consumer organisations	3.66 ± 0.95	3.32 ± 0.93	3.89 ± 0.94	3.49 ± 0.96	3.89 ± 0.90	3.69 ± 0.87	***
Social media	2.98 ± 1.10	2.93 ± 0.87	3.11 ± 1.17	3.05 ± 1.08	3.00 ± 1.18	2.80 ± 1.16	
Traditional media	3.36 ± 0.97	3.15 ± 0.89	3.53 ± 1.03	3.20 ± 0.96	3.61 ± 0.98	3.34 ± 0.92	***

Layers

Question: We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in laying hen production systems?

Stakeholder	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	3.93 ± 0.97	3.63 ± 1.02	4.11 ± 0.90	3.87 ± 0.99	3.94 ± 0.92	4.07 ± 0.93	***
European Commission	3.39 ± 1.03	3.15 ± 0.93	3.35 ± 1.08	3.28 ± 1.03	3.71 ± 1.01	3.47 ± 1.01	***
National government	3.27 ± 1.10	3.09 ± 1.01	3.26 ± 1.15	2.97 ± 1.07	3.50 ± 1.12	3.54 ± 1.03	***
Veterinarians	3.79 ± 0.96	3.78 ± 0.93	3.56 ± 1.07	3.65 ± 0.98	4.01 ± 0.89	3.96 ± 0.85	***
Animal health authorities	3.76 ± 0.96	3.75 ± 0.87	3.65 ± 1.08	3.60 ± 0.91	3.89 ± 0.97	3.91 ± 0.93	**
Veterinary medicine producers	3.23 ± 1.10	2.84 ± 1.13	3.09 ± 1.19	3.03 ± 0.98	3.68 ± 0.99	3.50 ± 1.00	***
Animal breeding companies	3.12 ± 1.16	2.98 ± 0.97	2.97 ± 1.31	3.01 ± 1.18	3.44 ± 1.16	3.23 ± 1.10	***
Animal feed producers	3.09 ± 1.10	2.89 ± 0.98	2.77 ± 1.21	2.94 ± 1.06	3.56 ± 1.06	3.27 ± 0.98	***
Animal housing manufacturers	3.05 ± 1.06	3.09 ± 0.92	2.70 ± 1.21	2.92 ± 0.97	3.25 ± 1.09	3.30 ± 0.96	***
Farmers	3.27 ± 1.13	3.24 ± 1.03	3.09 ± 1.24	3.01 ± 1.18	3.53 ± 1.08	3.49 ± 1.04	***
Animal transporters	2.96 ± 1.09	2.91 ± 1.00	2.74 ± 1.23	2.90 ± 1.08	3.19 ± 1.02	3.04 ± 1.06	**
Slaughterhouses	2.98 ± 1.11	3.01 ± 0.99	2.73 ± 1.23	2.87 ± 1.04	3.25 ± 1.13	3.03 ± 1.10	***
Quality assurance systems	3.61 ± 0.99	3.50 ± 0.86	3.42 ± 1.09	3.49 ± 0.97	3.84 ± 1.01	3.82 ± 0.93	***
Food manufacturers	3.09 ± 1.11	2.97 ± 1.00	2.90 ± 1.26	2.97 ± 1.09	3.43 ± 1.04	3.20 ± 1.08	***
Food retailers	3.08 ± 1.05	3.01 ± 0.92	2.90 ± 1.12	2.92 ± 1.01	3.32 ± 1.00	3.25 ± 1.03	***
Consumer organisations	3.69 ± 0.93	3.44 ± 0.89	3.84 ± 0.98	3.56 ± 0.88	3.82 ± 0.98	3.78 ± 0.86	***
Social media	3.01 ± 1.12	2.84 ± 1.06	3.16 ± 1.16	3.23 ± 0.95	3.08 ± 1.12	2.73 ± 1.21	***
Traditional media	3.40 ± 0.96	3.37 ± 0.86	3.61 ± 1.00	3.31 ± 0.94	3.43 ± 0.99	3.27 ± 1.00	**

Pigs

Question: We would like you to tell us the extent to which you agree or disagree that they can be trusted to provide the public with accurate information about production diseases in pig production systems?

	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Animal welfare organisations	3.78 ± 1.04	3.47 ± 1.14	4.04 ± 0.98	3.72 ± 1.00	3.66 ± 1.06	4.03 ± 0.92	***
European Commission	3.34 ± 1.06	3.02 ± 0.89	3.20 ± 1.16	3.45 ± 1.06	3.65 ± 1.07	3.36 ± 0.98	***
National government	3.25 ± 1.09	3.13 ± 0.91	3.24 ± 1.15	3.16 ± 1.11	3.41 ± 1.23	3.32 ± 0.99	
Veterinarians	3.79 ± 0.92	3.70 ± 0.85	3.60 ± 1.04	3.80 ± 0.88	3.98 ± 0.87	3.86 ± 0.93	**
Animal health authorities	3.80 ± 0.95	3.79 ± 0.81	3.65 ± 1.11	3.83 ± 0.88	3.95 ± 0.96	3.77 ± 0.96	
Veterinary medicine producers	3.22 ± 1.06	2.85 ± 0.96	3.05 ± 1.13	3.34 ± 1.01	3.46 ± 1.04	3.41 ± 1.00	***
Animal breeding companies	3.14 ± 1.14	2.89 ± 0.97	2.89 ± 1.38	3.17 ± 1.09	3.47 ± 1.12	3.27 ± 1.10	***
Animal feed producers	3.07 ± 1.06	2.87 ± 0.92	2.84 ± 1.18	3.07 ± 1.05	3.27 ± 1.10	3.29 ± 0.93	***
Animal housing manufacturers	3.07 ± 1.06	3.05 ± 0.77	2.69 ± 1.11	3.13 ± 0.96	3.23 ± 0.92	3.23 ± 0.92	***
Farmers	3.33 ± 1.11	3.11 ± 1.01	3.14 ± 1.29	3.24 ± 1.04	3.58 ± 1.08	3.57 ± 1.1.04	***
Animal transporters	2.91 ± 1.05	2.73 ± 0.88	2.73 ± 1.24	2.91 ± 1.06	3.16 ± 1.02	3.01 ± 0.97	***
Slaughterhouses	3.01 ± 1.12	2.88 ± 0.97	2.81 ± 1.33	3.03 ± 1.06	3.25 ± 1.10	3.11 ± 1.08	**
Quality assurance systems	3.63 ± 0.95	3.57 ± 0.82	3.48 ± 1.07	3.60 ± 0.93	3.73 ± 1.00	3.77 ± 0.91	*
Food manufacturers	3.05 ± 1.07	2.86 ± 0.96	2.87 ± 1.24	3.15 ± 1.03	3.26 ± 1.13	3.11 ± 0.95	**
Food retailers	3.08 ± 1.01	2.91 ± 0.87	2.99 ± 1.18	3.14 ± 1.01	3.20 ± 1.00	3.15 ± 0.93	*
Consumer organisations	3.63 ± 0.92	3.37 ± 0.82	3.89 ± 0.94	3.64 ± 0.99	3.81 ± 0.87	3.45 ± 0.87	***
Social media	2.94 ± 1.13	2.96 ± 0.85	2.99 ± 1.20	3.20 ± 1.13	2.96 ± 1.16	2.60 ± 1.21	***
Traditional media	3.33 ± 1.02	3.19 ± 0.82	3.60 ± 1.06	3.36 ± 1.02	3.45 ± 1.00	3.02 ± 1.09	***

1.1.6 Perceived risks and benefits

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (strongly disagree) to 5(strongly agree) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

Question: To what extent do you agree or disagree that intensive broiler chicken production systems offer the following benefits compared to non-intensive broiler chicken production systems?

Perceived benefit	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Reduced animal stress	2.49 ± 1.32	2.14 ± 1.07	2.42 ± 1.37	2.31 ± 1.20	3.27 ± 1.45	2.30 ± 1.17	***
Reduced incidence of animal diseases	2.71 ± 1.29	2.46 ± 1.08	2.57 ± 1.39	2.52 ± 1.20	3.49 ± 1.33	2.52 ± 1.15	***
Faster treatment of animal diseases	2.96 ± 1.22	2.91 ± 1.12	2.72 ± 1.30	2.68 ± 1.13	3.64 ± 1.19	2.86 ± 1.13	***
Improved animal welfare monitoring	2.84 ± 1.27	2.69 ± 1.11	2.62 ± 1.33	2.78 ± 1.15	3.47 ± 1.37	2.61 ± 1.16	***
Improved human food safety	2.89 ± 1.24	2.79 ± 1.02	2.62 ± 1.25	2.71 ± 1.18	3.63 ± 1.32	2.96 ± 1.12	***
Improved human food quality	2.77 ± 1.28	2.58 ± 1.04	2.57 ± 1.34	2.54 ± 1.20	3.51 ± 1.38	2.63 ± 1.15	***
Improved nutritional quality of food	2.72 ± 1.27	2.56 ± 1.09	2.49 ± 1.28	2.51 ± 1.18	3.41 ± 1.37	2.63 ± 1.18	***
Improved consumer health	2.77 ± 1.26	2.61 ± 1.03	2.54 ± 1.27	2.52 ± 1.16	3.47 ± 1.36	2.69 ± 1.21	***
Cheaper food of animal origin	3.58 ± 1.14	3.73 ± 1.06	3.39 ± 1.23	3.64 ± 1.71	3.44 ± 1.22	3.72 ± 0.96	*
Increased availability of animal based products	3.56 ± 1.08	3.50 ± 1.06	3.52 ± 1.14	3.62 ± 1.05	3.58 ± 1.14	3.60 ± 0.99	
Benefits to the environment	2.94 ± 1.15	3.09 ± 0.98	2.63 ± 1.26	2.80 ± 1.06	3.37 ± 1.25	2.85 ± 1.02	***
A more sustainable approach to animal production	2.80 ± 1.21	2.63 ± 1.10	2.42 ± 1.22	2.66 ± 1.05	3.39 ± 1.31	2.89 ± 1.16	***
A more cost efficient production method	3.63 ± 1.06	3.80 ± 1.03	3.60 ± 1.07	3.52 ± 1.12	3.59 ± 1.08	3.66 ± 1.01	
Greater protection from predators	3.42 ± 1.12	3.44 ± 1.07	3.32 ± 1.25	3.31 ± 1.10	3.52 ± 1.14	3.50 ± 1.04	
Greater protection from bad weather	3.41 ± 1.13	3.44 ± 1.06	3.30 ± 1.25	3.18 ± 1.14	3.55 ± 1.14	3.55 ± 1.04	*
More professionally run livestock farms	3.04 ± 1.15	3.06 ± 1.07	2.87 ± 1.25	2.93 ± 1.06	3.47 ± 1.16	2.88 ± 1.10	***
Benefits to agriculture	3.16 ± 1.64	3.21 ± 1.07	3.28 ± 1.20	3.05 ± 1.08	3.43 ± 1.26	2.81 ± 1.11	***
Benefits to you personally	2.91 ± 1.26	2.87 ± 1.17	2.63 ± 1.39	2.91 ± 1.12	3.48 ± 1.27	2.66 ± 1.14	***
Benefits to your family	2.88 ± 1.23	2.86 ± 1.12	2.61 ± 1.36	2.85 ± 1.12	3.44 ± 1.23	2.66 ± 1.12	***
Benefits to consumers	3.01 ± 1.18	3.02 ± 1.09	2.71 ± 1.32	3.00 ± 1.06	3.49 ± 1.21	2.84 ± 1.08	***
Increased consumer trust in the food they buy	2.78 ± 1.24	2.63 ± 1.07	2.52 ± 1.34	2.62 ± 1.11	3.51 ± 1.26	2.60 ± 1.15	***
A natural production method	2.54 ± 1.32	2.13 ± 1.10	2.40 ± 1.37	2.48 ± 1.18	3.36 ± 1.39	2.32 ± 1.17	***

Question: To what extent do you agree or disagree that intensive broiler chicken production systems are associated with the following risks compared to non-intensive broiler chicken production systems?

Perceived risk	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Increased animal stress	3.99 ± 1.03	3.92 ± 1.08	4.14 ± 1.02	3.99 ± 0.90	3.80 ± 1.18	4.08 ± 0.91	
Increased incidence of animal diseases	3.71 ± 1.02	3.53 ± 1.02	3.96 ± 1.01	3.65 ± 0.95	3.57 ± 1.13	3.82 ± 0.94	***
Slower treatment of animal diseases	3.44 ± 1.06	3.19 ± 1.07	3.62 ± 1.01	3.46 ± 0.95	3.41 ± 1.20	3.52 ± 1.00	**
Compromised animal welfare monitoring	3.64 ± 1.04	3.68 ± 1.07	3.84 ± 1.05	3.46 ± 0.94	3.54 ± 1.17	3.68 ± 0.95	*
Reduced human food safety	3.54 ± 1.06	3.22 ± 1.03	3.73 ± 1.07	3.66 ± 0.99	3.54 ± 1.14	3.54 ± 1.03	***
Reduced human food quality	3.60 ± 1.05	3.26 ± 1.0	3.85 ± 1.02	3.71 ± 0.98	3.57 ± 1.15	3.61 ± 1.00	***
Reduced nutritional quality of human food	3.64 ± 1.05	3.30 ± 1.02	3.82 ± 1.05	3.78 ± 0.93	3.61 ± 1.16	3.68 ± 0.99	***
Negative effects on consumer health	3.54 ± 1.05	3.23 ± 1.01	3.75 ± 1.08	3.71 ± 0.95	3.45 ± 1.15	3.56 ± 0.97	***
More expensive food of animal origin	2.76 ± 1.10	2.47 ± 0.95	2.80 ± 1.12	2.90 ± 1.11	2.88 ± 1.25	2.74 ± 1.02	**
Decreased availability of animal based foods	2.75 ± 1.10	2.49 ± 0.96	2.71 ± 1.10	2.83 ± 1.15	2.94 ± 1.19	2.78 ± 1.07	**
Risks to the environment	3.27 ± 1.00	2.99 ± 0.91	3.39 ± 1.05	3.36 ± 0.97	3.42 ± 1.10	3.18 ± 0.93	***
An unsustainable approach to animal production	3.46 ± 1.09	3.39 ± 1.09	3.80 ± 1.06	3.50 ± 0.97	3.31 ± 1.21	3.33 ± 1.06	***
A non-cost efficient production method	2.74 ± 1.12	2.46 ± 1.01	2.68 ± 1.04	2.83 ± 1.11	2.89 ± 1.29	2.85 ± 1.08	**
Less protection from predators	2.85 ± 1.10	2.96 ± 0.97	2.61 ± 1.14	2.89 ± 1.06	3.09 ± 1.19	2.72 ± 1.09	***
Less protection from bad weather	2.74 ± 1.10	2.44 ± 1.02	2.59 ± 1.11	2.90 ± 1.07	3.06 ± 1.17	2.73 ± 1.04	***
Less professionally run livestock farms	3.05 ± 1.11	2.52 ± 1.05	3.25 ± 1.10	3.08 ± 0.99	3.14 ± 1.18	3.27 ± 1.03	***
Risks to agriculture	3.24 ± 1.05	2.97 ± 1.05	3.34 ± 1.11	3.31 ± 0.96	3.21 ± 1.11	3.37 ± 0.96	**
Risks to you personally	3.34 ± 1.06	3.09 ± 1.00	3.53 ± 1.14	3.36 ± 1.00	3.37 ± 1.10	3.36 ± 1.04	**
Risks to your family	3.36 ± 1.06	3.08 ± 0.97	3.58 ± 1.14	3.39 ± 1.01	3.44 ± 1.09	3.32 ± 1.05	***
Risks to consumers	3.38 ± 1.06	3.11 ± 0.94	3.56 ± 1.14	3.40 ± 1.01	3.43 ± 1.13	3.39 ± 1.05	**
Decreased consumer trust in the food they buy	3.59 ± 1.04	3.51 ± 1.01	3.76 ± 1.09	3.46 ± 1.02	3.61 ± 1.13	3.59 ± 0.94	
An unnatural production method	3.82 ± 1.07	3.81 ± 1.07	4.04 ± 1.05	3.64 ± 1.06	3.72 ± 1.09	3.88 ± 1.02	**

Layers

Question: To what extent do you agree or disagree that intensive laying hen production systems offer the following benefits compared to non-intensive laying hen production systems?

Perceived benefit	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Reduced animal stress	2.47 ± 1.31	2.32 ± 1.10	2.16 ± 1.33	2.45 ± 1.15	3.16 ± 1.41	2.27 ± 1.31	***
Reduced incidence of animal diseases	2.69 ± 1.26	2.61 ± 1.05	2.32 ± 1.28	2.70 ± 1.12	3.35 ± 1.29	2.46 ± 1.31	***
Faster treatment of animal diseases	2.97 ± 1.19	2.92 ± 1.08	2.66 ± 1.23	2.86 ± 1.15	3.55 ± 1.12	2.84 ± 1.18	***
Improved animal welfare monitoring	2.87 ± 1.24	2.82 ± 1.12	2.51 ± 1.25	2.94 ± 1.11	3.40 ± 1.33	2.70 ± 1.20	***
Improved human food safety	2.87 ± 1.20	2.76 ± 1.06	2.52 ± 1.25	2.83 ± 1.05	3.46 ± 1.25	2.81 ± 1.16	***
Improved human food quality	2.76 ± 1.24	2.65 ± 1.06	2.34 ± 1.27	2.76 ± 1.16	3.35 ± 1.32	2.68 ± 1.18	***
Improved nutritional quality of human food	2.71 ± 1.23	2.59 ± 1.02	2.31 ± 1.22	2.67 ± 1.15	3.37 ± 1.31	2.61 ± 1.17	***
Improved consumer health	2.76 ± 1.23	2.70 ± 1.07	2.36 ± 1.24	2.71 ± 1.13	3.41 ± 1.29	2.63 ± 1.18	***
Cheaper food of animal origin	3.58 ± 1.10	3.55 ± 1.10	3.47 ± 1.22	3.55 ± 1.00	3.66 ± 1.06	3.65 ± 1.11	
Increased availability of animal based products	3.52 ± 1.05	3.59 ± 0.98	3.51 ± 1.14	3.47 ± 0.97	3.55 ± 1.09	3.47 ± 1.09	
Benefits to the environment e.g. reduced CO_2 footprint	2.90 ± 1.16	3.04 ± 1.01	2.39 ± 1.18	2.90 ± 1.05	3.36 ± 1.23	2.83 ± 1.09	***
A more sustainable approach to animal production	2.84 ± 1.19	2.76 ± 1.13	2.39 ± 1.21	2.79 ± 1.10	3.41 ± 1.18	2.85 ± 1.12	***
A more cost efficient production method	3.59 ± 1.11	3.79 ± 1.00	3.56 ± 1.25	3.45 ± 1.04	3.53 ± 1.13	3.59 ± 1.08	*
Greater protection from predators	3.41 ± 1.08	3.46 ± 1.04	3.23 ± 1.19	3.29 ± 1.03	3.62 ± 1.03	3.46 ± 1.04	*
Greater protection from bad weather	3.43 ± 1.06	3.49 ± 1.02	3.26 ± 1.15	3.29 ± 1.03	3.56 ± 1.10	3.56 ± 1.01	*
More professionally run livestock farms	3.07 ± 1.14	3.10 ± 1.08	2.85 ± 1.21	3.09 ± 1.03	3.37 ± 1.16	2.92 ± 1.13	***
Benefits to agriculture	3.16 ± 1.12	3.22 ± 1.07	3.09 ± 1.23	3.16 ± 1.01	3.38 ± 1.10	2.94 ± 1.14	*
Benefits to you personally	2.89 ± 1.19	2.85 ± 1.12	2.48 ± 1.24	2.97 ± 1.07	3.46 ± 1.14	2.69 ± 1.16	***
Benefits to your family	2.90 ± 1.19	2.81 ± 1.09	2.51 ± 1.25	2.98 ± 1.04	3.52 ± 1.17	2.69 ± 1.16	***
Benefits to consumers	3.06 ± 1.18	3.03 ± 1.08	2.65 ± 1.29	3.11 ± 1.07	3.58 ± 1.15	2.96 ± 1.16	***
Increased consumer trust in the food they buy	2.81 ± 1.19	2.72 ± 1.09	2.42 ± 1.24	2.75 ± 1.08	3.46 ± 1.22	2.70 ± 1.09	***
A natural production method	2.56 ± 1.33	2.26 ± 1.15	2.21 ± 1.30	2.54 ± 1.14	3.39 ± 1.40	2.39 ± 1.28	***

Question: To what extent do you agree or disagree that intensive laying hen production systems are associate with the following risks compared to non-intensive laying hen production systems?

Perceived risk	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Increased animal stress	3.96 ± 1.00	3.81 ± 0.93	4.24 ± 0.92	3.81 ± 1.00	3.81 ± 1.12	4.10 ± 0.97	***
Increased incidence of animal diseases	3.74 ± 1.03	3.53 ± 0.96	4.00 ± 1.03	3.58 ± 0.99	3.72 ± 1.04	3.84 ± 1.06	***
Slower treatment of animal diseases	3.43 ± 1.07	3.16 ± 1.04	3.63 ± 1.01	3.37 ± 1.07	3.50 ± 1.08	3.51 ± 1.10	**
Compromised animal welfare monitoring	3.64 ± 1.05	3.57 ± 1.04	3.80 ± 1.05	3.32 ± 1.04	3.76 ± 1.03	3.73 ± 1.03	***
Reduced human food safety	3.52 ± 1.06	3.15 ± 1.00	3.78 ± 1.06	3.53 ± 1.02	3.66 ± 1.05	3.47 ± 1.10	***
Reduced human food quality	3.61 ± 1.07	3.21 ± 1.05	3.94 ± 1.04	3.62 ± 1.03	3.73 ± 1.04	3.56 ± 1.06	***
Reduced nutritional quality of human food	3.59 ± 1.07	3.16 ± 1.06	3.89 ± 1.04	3.63 ± 1.05	3.69 ± 1.03	3.55 ± 1.03	***
Negative effects on consumer health	3.50 ± 1.05	3.12 ± 1.01	3.81 ± 1.01	3.56 ± 1.04	3.63 ± 1.05	3.38 ± 1.06	***
More expensive food of animal origin	2.77 ± 1.13	2.58 ± 1.05	2.71 ± 1.24	2.76 ± 1.08	2.99 ± 1.15	2.80 ± 1.10	*
Decreased availability of animal based foods	2.82 ± 1.12	2.63 ± 101	2.66 ± 1.19	2.77 ± 1.05	3.17 ± 1.16	2.89 ± 1.09	***
Risks to the environment	3.36 ± 1.01	3.08 ± 0.91	3.53 ± 1.05	3.35 ± 1.01	3.53 ± 1.03	3.32 ± 0.97	***
An unsustainable approach to animal production	3.50 ± 1.07	3.34 ± 1.03	3.87 ± 1.07	3.55 ± 0.97	3.47 ± 1.08	3.26 ± 1.09	***
A non-cost efficient production method	2.94 ± 1.10	2.50 ± 1.03	2.71 ± 1.16	2.89 ± 1.05	3.20 ± 1.17	2.86 ± 1.10	***
Less protection from predators	2.94 ± 1.10	3.03 ± 0.94	2.71 ± 1.16	2.89 ± 1.05	3.20 ± 1.17	2.86 **± 1.10**	***
Less protection from bad weather	2.80 ± 1.11	2.45 ± 0.99	2.69 ± 1.13	2.85 ± 1.09	3.18 ± 1.14	2.85 ± 1.10	***
Less professionally run livestock farms	3.10 ± 1.10	2.54 ± 1.01	3.35 ± 1.08	3.08 ± 0.98	3.32 ± 1.11	3.19 ± 1.10	***
Risks to agriculture	3.21 ± 1.07	2.91 ± 1.02	3.32 ± 1.10	3.28 ± 1.11	3.28 ± 0.94	3.25 ± 1.12	**
Risks to you personally	3.23 ± 1.09	3.01 ± 1.03	3.52 ± 1.17	3.34 ± 0.96	3.46 ± 1.11	3.25 ± 1.09	***
Risks to your family	3.32 ± 1.08	2.97 ± 1.04	3.54 ± 1.19	3.31 ± 0.98	3.46 ± 1.08	3.30 ± 1.10	***
Risks to consumers	3.33 ± 1.10	2.96 ± 1.03	3.55 ± 1.20	3.36 ± 0.97	3.53 ± 1.10	3.27 ± 1.10	***
Decreased consumer trust in the food they buy	3.53 ± 1.05	3.30 ± 1.01	3.78 ± 1.06	3.42 ± 0.96	3.54 ± 1.10	3.58 ± 1.05	***
An unnatural production method	3.82 ± 1.04	3.77 ± 1.03	4.01 ± 1.06	3.63 ± 1.03	3.82 ± 104	3.87 ± 1.00	**

Pigs

Question: To what extent do you agree or disagree that intensive pig production systems offer the following benefits compared to non-intensive pig production systems?

Perceived benefits	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
Reduced animal stress	2.52 ± 1.32	2.28 ± 1.12	2.21 ± 1.35	2.44 ± 1.15	3.35 ± 1.39	2.33 ± 1.22	***
Reduced incidence of animal diseases	2.80 ± 1.28	2.56 ± 1.07	2.31 ± 1.20	2.69 ± 1.13	3.71 ± 1.19	2.72 ± 1.25	***
Faster treatment of animal diseases	3.10 ± 1.20	3.03 ± 1.07	2.68 ± 1.26	2.89 ± 1.13	3.76 ± 1.16	3.15 ± 1.07	***
Improved animal welfare monitoring	3.00 ± 1.25	2.83 ± 1.12	2.51 ± 1.29	3.07 ± 1.05	3.55 ± 1.34	3.02 ± 1.18	***
Improved human food safety	2.99 ± 1.25	2.89 ± 1.03	2.56 ± 1.31	2.87 ± 1.15	3.68 ± 1.30	2.94 ± 1.13	***
Improved human food quality	2.85 ± 1.29	2.71 ± 1.07	2.44 ± 1.31	2.72 ± 1.19	3.57 ± 1.37	2.81 ± 1.22	***
Improved nutritional quality of human food	2.80 ± 1.28	2.59 ± 1.06	2.43 ± 1.31	2.61 ± 1.11	3.61 ± 1.37	2.76 ± 1.18	***
Improved consumer health	2.87 ± 1.26	2.72 ± 1.02	2.43 ± 1.33	2.67 ± 1.12	3.71 ± 1.27	2.78 ± 1.12	***
Cheaper food of animal origin	3.65 ± 1.05	3.60 ± 0.98	3.47 ± 1.20	3.72 ± 0.98	3.77 ± 1.07	3.70 ± 0.99	
Increased availability of animal based products	3.56 ± 1.03	3.39 ± 0.87	3.53 ± 1.21	3.52 ± 1.01	3.85 ± 0.92	3.50 ± 1.07	***
Benefits to the environment	2.96 ± 1.17	3.00 ± 0.95	2.41 ± 1.18	2.77 ± 1.01	3.60 ± 1.24	3.00 ± 1.15	***
A more sustainable approach to animal production	2.89 ± 1.24	2.73 ± 1.07	2.36 ± 1.27	2.74 ± 1.06	3.64 ± 1.23	2.99 ± 1.19	***
A more cost efficient production method	3.66 ± 1.07	3.81 ± 1.01	3.57 ± 1.18	3.56 ± 1.02	3.76 ± 1.07	3.58 ± 1.02	
Greater protection from predators	3.42 ± 1.09	3.47 ± 1.00	3.04 ± 1.27	3.34 ± 0.97	3.72 ± 1.08	3.50 ± 1.01	***
Greater protection from bad weather	3.41 ± 1.09	3.41 ± 1.04	3.01 ± 1.22	3.34 ± 0.99	3.72 ± 1.04	3.59 ± 1.00	***
More professionally run livestock farms	3.12 ± 1.17	3.06 ± 1.03	2.80 ± 1.26	2.94 ± 1.09	3.76 ± 1.11	3.04 ± 1.11	***
Benefits to agriculture	3.18 ± 1.14	3.27 ± 1.00	2.95 ± 1.26	3.07 ± 1.06	3.64 ± 1.08	2.94 ± 1.13	***
Benefits to you personally	2.87 ± 1.22	2.83 ± 1.05	2.47 ± 1.33	2.85 ± 1.06	3.43 ± 1.32	2.77 ± 1.13	***
Benefits to your family	2.89 ± 1.21	2.85 ± 1.06	2.45 ± 1.27	2.81 ± 1.03	3.47 ± 1.20	2.85 ± 1.15	***
Benefits to consumers	3.07 ± 1.17	3.07 ± 1.00	2.73 ± 1.31	2.91 ± 1.05	3.57 ± 1.21	3.03 ± 1.10	***
Increased consumer trust in the food they buy	2.83 ± 1.25	2.69 ± 1.09	2.41 ± 1.34	2.75 ± 1.09	3.55 ± 1.29	2.73 ± 1.12	***
A natural production method	2.54 ± 1.34	2.23 ± 1.16	2.20 ± 1.32	2.52 ± 1.22	3.37 ± 1.41	2.37 ± 1.20	***

Perceived risks	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Increased animal stress	3.88 ± 1.10	3.83 ± 1.08	4.21 ± 0.96	3.77 ± 1.04	3.48 ± 1.33	4.10 ± 0.91	***
Increased incidence of animal diseases	3.61 ± 1.08	3.48 ± 1.01	4.05 ± 0.98	3.56 ± 1.02	3.29 ± 1.25	3.67 ± 0.94	***
Slower treatment of animal diseases	3.31 ± 1.08	2.98 ± 1.02	3.63 ± 1.08	3.38 ± 0.98	3.24 ± 1.19	3.32 ± 1.02	***
Compromised animal welfare monitoring	3.55 ± 1.06	3.53 ± 1.05	3.89 ± 1.04	3.36 ± 1.00	3.47 ± 1.17	3.48 ± 0.99	***
Reduced human food safety	3.46 ± 1.08	3.18 ± 0.98	3.84 ± 1.04	3.57 ± 0.99	3.28 ± 1.24	3.43 ± 1.00	***
Reduced human food quality	3.56 ± 1.07	3.25 ± 0.97	3.95 ± 1.05	3.64 ± 1.00	3.43 ± 1.25	3.52 ± 0.95	***
Reduced nutritional quality of human food	3.50 ± 1.07	3.20 ± 1.01	3.83 ± 1.05	3.58 ± 1.00	3.37 ± 1.25	3.50 ± 0.93	***
Negative effects on consumer health	3.42 ± 1.08	3.13 ± 1.01	3.82 ± 1.06	3.57 ± 0.98	3.26 ± 1.23	3.30 ± 0.94	***
More expensive food of animal origin	2.75 ± 1.12	2.56 ± 0.96	2.81 ± 1.24	2.83 ± 1.12	2.74 ± 1.11	2.80 ± 1.14	
Decreased availability of animal based foods	2.72 ± 1.08	2.55 ± 0.92	2.73 ± 1.13	2.77 ± 1.11	2.81 ± 1.16	2.77 ± 1.09	
Risks to the environment	3.27 ± 1.02	3.01 ± 0.91	3.62 ± 1.09	3.32 ± 0.91	3.22 ± 1.14	3.16 ± 0.92	***
An unsustainable approach to animal production	3.40 ± 1.05	3.27 ± 0.99	3.88 ± 0.98	3.44 ± 0.95	3.20 ± 1.22	3.25 ± 0.95	***
A non-cost efficient production method	2.78 ± 1.11	2.59 ± 0.99	2.81 ± 1.18	2.81 ± 1.09	2.66 ± 1.21	3.02 ± 1.05	**
Less protection from predators	2.91 ± 1.09	2.98 ± 0.91	2.87 ± 1.19	2.96 ± 1.06	2.89 ± 1.16	2.86 ± 1.09	
Less protection from bad weather	2.78 ± 1.10	2.49 ± 0.90	2.85 ± 1.19	2.92 ± 1.04	2.86 ± 1.09	2.76 ± 1.13	*
Less professionally run livestock farms	3.04 ± 1.10	2.51 ± 0.93	3.25 ± 1.17	3.14 ± 1.00	3.10 ± 1.21	3.20 ± 0.99	***
Risks to agriculture	3.23 ± 1.04	2.93 ± 0.91	3.51 ± 1.10	3.34 ± 1.02	3.12 ± 1.15	3.27 ± 0.93	***
Risks to you personally	3.30 ± 1.01	2.96 ± 1.00	3.71 ± 1.10	3.33 ± 1.06	3.22 ± 1.22	3.29 ± 0.99	***
Risks to your family	3.33 ± 1.11	3.01 ± 1.01	3.77 ± 1.08	3.36 ± 1.07	3.26 ± 1.23	3.26 ± 1.02	***
Risks to consumers	3.34 ± 1.10	2.99 ± 0.96	3.77 ± 1.07	3.44 ± 1.06	3.21 ± 1.24	3.30 ± 0.99	***
Decreased consumer trust in the food they buy	3.51 ± 1.09	3.32 ± 0.99	3.83 ± 1.09	3.56 ± 0.98	3.34 ± 1.28	3.53 ± 1.02	***
An unnatural production method	3.78 ± 1.10	3.67 ± 1.05	4.09 ± 1.06	3.68 ± 1.03	3.55 ± 1.27	3.94 ± 1.01	***

Question: To what extent do you agree or disagree that intensive pig production systems are associated with the following risks compared to non-intensive pig production systems?

1.1.7 Concern

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (strongly disagree) to 5 (strongly agree)/ Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Overall

	Layers			Broilers			Pigs		
	General concern	**Human concern**	**Animal concern**	**General concern**	**Human concern**	**Animal concern**	**General concern**	**Human concern**	**Animal concern**
The current minimum animal welfare standards associated with X production	3.78 ± 0.97	3.50 ± 1.05	3.91 ± 0.91	3.83 ± 0.98	3.56 ± 0.99	3.77 ± 0.99	3.77 ± 0.97	3.54 ± 1.01	3.75 ± 1.00
Whether animal welfare standards are actually achieved in X production	3.83 ± 0.97	3.66 ± 0.98	3.82 ± 0.96	3.88 ± 1.01	3.70 ± 0.99	3.84 ± 0.98	3.85 ± 0.99	3.68 ± 0.97	3.83 ± 0.96
Use of antibiotics in production animals as a growth promoter	3.95 ± 1.09	4.03 ± 0.99	3.92 ± 0.99	4.04 ± 1.07	4.05 ± 0.99	3.95 ± 0.98	3.98 ± 1.07	4.03 ± 0.97	3.93 ± 1.01
Use of antibiotics in production animals to prevent diseases	3.82 ± 106	3.89 ± 1.01	3.75 ± 1.04	3.89 ± 1.06	3.96 ± 0.96	3.72 ± 1.05	3.86 ± 1.05	3.84 ± 1.01	3.69 ± 1.05
Use of antibiotics in production animals to treat diseases	3.67 ± 1.10	3.77 ± 1.02	3.56 ± 1.13	3.71 ± 1.11	3.78 ± 1.08	3.54 ± 1.12	3.63 ± 1.12	3.70 ± 1.04	3.49 ± 1.13
Use of vaccinations to prevent animal diseases	3.43 ± 1.14	3.50 ± 1.08	3.36 ± 1.13	3.43 ± 1.13	3.49 ± 1.10	3.31 ± 1.16	3.43 ± 1.13	3.47 ± 1.08	3.31 ± 1.17
Use of other veterinary medicines to treat animal diseases	3.43 ± 1.14	3.54 ± 1.02	3.40 ± 1.10	3.43 ± 1.10	3.53 ± 1.04	3.38 ± 1.12	3.42 ± 1.12	2.51 ± 1.04	3.33 ± 1.10
Use of probiotics to prevent animal diseases	3.40 ± 1.11	3.45 ± 1.08	3.36 ± 1.10	3.43 ± 1.15	3.47 ± 1.14	3.40 ± 1.14	3.38 ± 1.12	3.46 ± 1.07	3.37 ± 1.14
Antibiotic residues in food*	4.00 ± 1.07	4.04 ± 0.97	3.93 ± 0.95	4.05 ± 1.06	4.08 ± 0.98	3.89 ± 1.01	3.98 ± 1.02	4.02 ± 1.00	3.85 ± 1.01
Antibiotic resistance as a result of the use of antibiotics in animals	4.10 ± 0.97	4.06 ± 0.96	3.99 ± 0.97	4.12 ± 0.96	4.09 ± 0.97	3.98 ± 0.95	4.08 ± 0.97	4.04 ± 0.93	3.93 ± 0.98
Animal production diseases in general	3.96 ± 0.92	3.91 ± 0.91	3.97 ± 0.92	3.98 ± 0.93	3.94 ± 0.94	3.95 ± 0.94	3.97 ± 0.93	3.94 ± 0.90	3.92 ± 0.93
Impacts of animal diseases on food quality	4.03 ± 0.92	3.93 ± 0.91		4.20 ± 0.95	3.99 ± 0.94		3.99 ± 0.96	3.95 ± 0.95	
Impacts of animal diseases on food safety	4.03 ± 0.92	3.98 ± 0.93		4.05 ± 0.96	4.02 ± 0.93		4.02 ± 0.95	3.96 ± 0.94	
Impacts of animal diseases on human health	4.01 ± 0.94			4.03 ± 1.00			4.01 ± 0.97		
Impacts of animal diseases on animal welfare	3.96 ± 0.81			3.95 ± 0.78			3.97 ± 0.93		
Impact of animal diseases on the environment	3.83 ± 0.96			3.86 ± 0.97			3.83 ± 0.98		

Broilers

I am concerned about:	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.83 ± 0.98	3.78 ± 1.04	3.99 ± 0.98	3.64 ± 0.91	3.91 ± 0.95	3.84 ± 0.98	**
Whether animal welfare standards are actually achieved in X production	3.88 ± 1.01	3.85 ± 1.07	3.94 ± 1.05	3.74 ± 1.01	3.96 ± 0.95	3.93 ± 0.99	
Use of antibiotics in production animals as a growth promoter	4.04 ± 1.07	4.08 ± 1.05	4.15 ± 1.11	4.01 ± 0.98	3.97 ± 1.16	3.99 ± 1.03	
Use of antibiotics in production animals to prevent diseases	3.89 ± 1.06	3.80 ± 1.12	4.16 ± 1.03	3.77 ± 0.99	3.82 ± 1.13	3.90 ± 0.99	**
Use of antibiotics in production animals to treat diseases	3.71 ± 1.11	3.29 ± 1.20	4.07 ± 1.07	3.62 ± 1.00	3.84 ± 1.12	3.74 ± 1.03	***
Use of vaccinations to prevent animal diseases	3.43 ± 1.13	3.03 ± 1.11	3.62 ± 1.14	3.29 ± 1.06	3.74 ± 1.09	3.49 ± 1.11	***
Use of other veterinary medicines to treat animal diseases	3.43 ± 1.10	3.08 ± 1.16	3.64 ± 1.08	3.34 ± 1.00	3.65 ± 1.11	3.47 ± 1.07	***
Use of probiotics to prevent animal diseases	3.43 ± 1.15	2.95 ± 1.18	3.82 ± 1.09	3.25 ± 1.05	3.61 ± 1.11	3.50 ± 1.10	***
Antibiotic residues in food*	4.05 ± 1.06	4.01 ± 1.09	4.26 ± 1.05	4.07 ± 0.99	4.00 ± 1.09	3.91 ± 1.04	**
Antibiotic resistance as a result of the use of antibiotics in animals	4.03 ± 1.00	3.86 ± 1.06	4.14 ± 1.01	4.06 ± 0.95	4.15 ± 1.02	3.91 ± 0.96	**
Animal production diseases in general	3.95 ± 0.78	3.92 ± 1.01	3.93 ± 1.06	3.89 ± 0.93	3.97 ± 0.99	4.01 ± 0.91	
Impacts of animal diseases on food quality	4.20 ± 0.95	3.84 ± 1.01	4.15 ± 0.90	3.99 ± 0.92	4.17 ± 0.95	3.93 ± 0.95	**
Impacts of animal diseases on food safety	4.05 ± 0.96	3.91 ± 1.02	4.16 ± 0.94	4.03 ± 0.93	4.10 ± 1.00	4.06 ± 0.91	
Impacts of animal diseases on human health	3.86 ± 0.97	3.71 ± 1.06	4.11 ± 0.98	3.80 ± 0.82	3.84 ± 1.02	3.82 ± 0.94	***
Impacts of animal diseases on animal welfare	4.12 ± 0.96	4.11 ± 1.03	4.28 ± 0.94	4.06 ± 0.82	4.13 ± 0.98	4.03 ± 1.01	*
Impact of animal diseases on the environment	3.98 ± 0.93	3.78 ± 0.97	4.17 ± 0.92	3.92 ± 0.84	4.04 ± 0.95	4.01 ± 1.01	***

The following pose a risk to human health	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.56 ± 0.99	3.27 ± 1.02	3.68 ± 1.02	3.58 ± 0.91	3.61 ± 0.98	3.67 ± 0.95	***
Whether animal welfare standards are actually achieved in X production	3.70 ± 0.99	3.47 ± 1.06	3.82 ± 0.99	3.64 ± 0.89	3.75 ± 1.05	3.80 ± 0.90	**
Use of antibiotics in production animals as a growth promoter	4.05 ± 0.99	4.03 ± 1.05	4.27 ± 0.97	3.99 ± 0.94	3.91 ± 1.09	4.06 ± 0.87	**
Use of antibiotics in production animals to prevent diseases	3.96 ± 0.96	3.85 ± 1.02	4.26 ± 0.90	3.97 ± 0.92	3.82 ± 1.01	3.88 ± 0.89	***
Use of antibiotics in production animals to treat diseases	3.78 ± 1.08	3.41 ± 1.10	4.07 ± 1.10	3.83 ± 1.01	3.82 ± 1.06	3.76 ± 1.01	***
Use of vaccinations to prevent animal diseases	3.49 ± 1.10	3.29 ± 1.06	3.57 ± 1.16	3.43 ± 1.06	3.63 ± 1.11	3.54 ± 1.06	*
Use of other veterinary medicines to treat animal diseases	3.53 ± 1.04	3.27 ± 1.07	3.73 ± 1.06	3.49 ± 1.01	3.69 ± 1.04	3.48 ± 0.96	***
Use of probiotics to prevent animal diseases	3.47 ± 1.14	2.98 ± 1.19	3.80 ± 1.17	3.40 ± 1.05	3.69 ± 1.07	3.48 ± 1.05	***
Antibiotic residues in food	4.08 ± 0.98	4.09 ± 0.92	4.39 ± 0.88	4.10 ± 0.96	3.96 ± 1.10	3.89 ± 0.98	***
Impacts of animal diseases on food quality	3.99 ± 0.94	3.83 ± 1.00	4.26 ± 0.82	4.01 ± 0.88	4.00 ± 1.02	3.85 ± 0.91	***
Impacts of animal diseases on food safety	4.02 ± 0.93	3.90 ± 1.00	4.21 ± 0.85	4.08 ± 0.85	4.00 ± 1.04	3.91 ± 0.86	*
Antibiotic resistance as a result of the use of antibiotics in animals	4.09 ± 0.97	4.06 ± 1.05	4.32 ± 0.94	4.00 ± 0.90	4.05 ± 1.00	4.03 ± 0.95	**
Animal production diseases in general	3.94 ± 0.94	3.74 ± 0.99	4.19 ± 0.91	3.99 ± 0.82	3.93 ± 1.00	3.84 ± 0.91	***

The following pose a risk to animal health	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.77 ± 0.99	3.68 ± 1.04	4.01 ± 1.02	3.68 ± 0.98	3.72 ± 0.97	3.76 ± 0.95	**
Whether animal welfare standards are actually achieved in X production	3.84 ± 0.98	3.79 ± 1.05	4.04 ± 0.98	3.71 ± 0.90	3.78 ± 1.01	3.89 ± 0.93	*
Use of antibiotics in production animals as a growth promoter	3.95 ± 0.98	4.05 ± 0.98	4.20 ± 0.92	3.83 ± 0.99	3.89 ± 1.03	3.79 ± 0.96	***
Use of antibiotics in production animals to prevent diseases	3.72 ± 1.05	3.69 ± 1.06	4.04 ± 1.04	3.62 ± 1.04	3.63 ± 1.14	3.63 ± 0.93	***
Use of antibiotics in production animals to treat diseases	3.54 ± 1.12	3.23 ± 1.18	3.92 ± 1.10	3.50 ± 1.08	3.57 ± 1.13	3.48 ± 1.03	***
Use of vaccinations to prevent animal diseases	3.31 ± 1.16	3.16 ± 1.13	3.44 ± 1.23	3.22 ± 1.17	3.39 ± 1.17	3.35 ± 1.10	
Use of other veterinary medicines to treat animal diseases	3.38 ± 1.12	3.15 ± 1.15	3.51 ± 1.19	3.31 ± 1.06	3.51 ± 1.12	3.41 ± 1.07	*
Use of probiotics to prevent animal diseases	3.40 ± 1.14	2.99 ± 1.19	3.77 ± 1.13	3.32 ± 1.03	3.54 ± 1.11	3.38 ± 1.10	***
Antibiotic residues in feed	3.89 ± 1.01	3.89 ± 1.01	4.25 ± 0.88	3.80 ± 1.03	3.77 ± 1.03	3.77 ± 0.96	***
Antibiotic resistance as a result of the use of antibiotics in animals	3.98 ± 0.95	3.98 ± 1.01	4.28 ± 0.89	3.88 ± 0.94	3.92 ± 0.91	3.85 ± 9.95	***
Animal production diseases in general	3.95 ± 0.94	3.95 ± 0.98	4.20 ± 0.88	3.84 ± 0.93	3.92 ± 0.94	3.82 ± 0.91	***

Layers

I'm concerned about	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.78 ± 0.97	3.61 ± 1.00	3.98 ± 0.96	3.71 ± 0.86	3.77 ± 1.02	3.80 ± 0.95	**
Whether animal welfare standards are actually achieved in X production	3.83 ± 0.97	3.70 ± 0.92	4.01 ± 0.92	3.69 ± .05	3.75 ± 1.05	3.99 ± 0.84	**
Use of antibiotics in production animals as a growth promoter	3.95 ± 1.09	3.91 ± 1.08	4.13 ± 1.00	3.94 ± 1.12	3.82 ± 1.21	3.98 ± 1.04	
Use of antibiotics in production animals to prevent diseases	3.82 ± 106	3.66 ± 1.09	4.08 ± 1.00	3.76 ± 1.07	3.72 ± 1.11	3.87 ± 0.98	**
Use of antibiotics in production animals to treat diseases	3.67 ± 1.10	3.21 ± 1.15	3.95 ± 1.04	3.65 ± 1.09	3.78 ± 1.09	3.73 ± 1.01	***
Use of vaccinations to prevent animal diseases	3.43 ± 1.14	3.13 ± 1.14	3.56 ± 1.16	3.41 ± 1.12	3.68 ± 1.10	3.37 ± 1.13	***
Use of other veterinary medicines to treat animal diseases	3.43 ± 1.14	3.17 ± 1.13	3.56 ± 1.16	3.42 ± 1.05	3.65 ± 1.12	3.37 ± 1.15	**
Use of probiotics to prevent animal diseases	3.40 ± 1.11	2.92 ± 1.09	3.70 ± 1.09	3.43 ± 1.08	3.59 ± 1.05	3.36 ± 1.08	***
Antibiotic residues in food*	4.00 ± 1.07	3.92 ± 1.00	4.23 ± 0.99	4.01 ± 1.07	3.91 ± 1.19	3.92 ± 1.04	*
Antibiotic resistance as a result of the use of antibiotics in animals	4.01 ± 0.94	3.94 ± 0.91	4.11 ± 0.94	4.04 ± 0.99	4.01 ± 0.98	3.96 ± 0.89	
Animal production diseases in general	3.96 ± 0.81	3.98 ± 0.88	3.96 ± 1.00	3.98 ± 0.95	3.92 ± 0.97	3.96 ± 0.81	
Impacts of animal diseases on food quality	4.03 ± 0.92	3.88 ± 0.93	4.11 ± 0.93	3.94 ± 0.98	4.05 ± 0.98	3.99 ± 0.80	*
Impacts of animal diseases on food safety	4.03 ± 0.92	3.99 ± 0.93	4.08 ± 0.95	4.00 ± 0.98	4.08 ± 0.96	3.99 ± 0.80	
Impacts of animal diseases on human health	3.83 ± 0.96	3.70 ± 1.01	3.96 ± 0.95	3.83 ± 0.96	3.79 ± 1.03	3.89 ± 0.80	
Impacts of animal diseases on animal welfare	4.10 ± 0.97	4.08 ± 1.00	4.33 ± 0.88	4.10 ± 0.94	3.94 ± 1.02	4.04 ± 0.95	**
Impact of animal diseases on the environment	3.96 ± 0.92	3.90 ± 0.90	4.11 ± 0.95	3.99 ± 0.88	3.97 ± 0.98	3.85 ± 0.90	

The following pose a risk to human health	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.50 ± 1.05	3.20 ± .06	3.61 ± 1.13	3.66 ± 0.86	3.58 ± 1.04	3.44 ± 1.06	***
Whether animal welfare standards are actually achieved in X production	3.66 ± 0.98	3.51 ± 0.97	3.70 ± 1.03	3.67 ± 0.92	3.75 ± 0.98	3.68 ± 0.99	
Use of antibiotics in production animals as a growth promoter	4.03 ± 0.99	4.13 ± 0.94	4.18 ± 0.92	3.99 ± 1.01	3.89 ± 1.09	3.97 ± 0.96	
Use of antibiotics in production animals to prevent diseases	3.89 ± 1.01	3.89 ± 0.99	4.08 ± 0.97	3.87 ± 1.01	3.80 ± 1.06	3.78 ± 1.01	
Use of antibiotics in production animals to treat diseases	3.77 ± 1.02	3.54 ± 1.10	4.04 ± 0.97	3.80 ± 0.98	3.82 ± 1.01	3.63 ± 1.04	***
Use of vaccinations to prevent animal diseases	3.50 ± 1.08	3.30 ± 1.11	3.54 ± 1.12	3.47 ± 1.04	3.74 ± 1.02	3.46 ± 1.06	*
Use of other veterinary medicines to treat animal diseases	3.54 ± 1.02	3.39 ± 1.06	3.59 ± 1.12	3.54 ± 1.00	3.77 ± 0.90	3.42 ± 0.99	***
Use of probiotics to prevent animal diseases	3.45 ± 1.08	3.07 ± 1.13	3.69 ± 1.05	3.47 ± 1.04	3.65 ± 1.01	3.37 ± 1.06	***
Antibiotic residues in food	4.04 ± 0.97	4.13 ± 0.87	4.21 ± 0.95	3.99 ± 1.00	3.90 ± 1.06	3.96 ± 0.96	*
Impacts of animal diseases on food quality	3.93 ± 0.91	3.88 ± 0.93	4.04 ± 0.95	3.83 ± 0.91	4.06 ± 0.83	3.84 ± 0.93	*
Impacts of animal diseases on food safety	3.98 ± 0.93	4.00 ± 0.89	4.02 ± 0.95	3.92 ± 0.97	4.07 ± 0.94	3.88 ± 0.88	
Antibiotic resistance as a result of the use of antibiotics in animals	4.06 ± 0.96	4.12 ± 0.92	4.29 ± 0.86	3.94 ± 0.99	3.97 ± 0.98	3.96 ± 1.00	**
Animal production diseases in general	3.91 ± 0.91	3.82 ± 0.89	3.99 ± 0.92	3.92 ± 095	3.99 ± 093	3.82 ± 0.86	

The following pose a risk to animal health	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.91 ± 0.91	3.53 ± 0.78	3.99 ± 0.92	3.92 ± 0.95	3.99 ± 0.93	3.82 ± 0.86	***
Whether animal welfare standards are actually achieved in X production	3.82 ± 0.96	3.76 ± 0.90	4.04 ± 0.95	3.73 ± 0.87	3.67 ± 1.05	3.87 ± 0.97	***
Use of antibiotics in production animals as a growth promoter	3.92 ± 0.99	4.09 ± 0.88	4.12 ± 0.99	3.85 ± 0.94	3.76 ± 1.06	3.78 ± 1.05	***
Use of antibiotics in production animals to prevent diseases	3.75 ± 1.04	3.72 ± 1.08	3.93 ± 1.07	3.72 ± 0.99	3.73 ± 0.98	3.66 ± 1.06	
Use of antibiotics in production animals to treat diseases	3.56 ± 1.13	3.31 ± 1.22	3.71 ± 1.15	3.55 ± 1.04	3.72 ± 1.05	3.53 ± 1.13	*
Use of vaccinations to prevent animal diseases	3.36 ± 1.13	3.13 ± 1.17	3.37 ± 1.21	3.38 ± 1.06	3.52 ± 1.06	3.40 ± 1.11	*
Use of other veterinary medicines to treat animal diseases	3.40 ± 1.10	3.20 ± 1.13	3.38 ± 1.23	3.48 ± 1.01	3.58 ± 1.01	3.37 ± 1.07	*
Use of probiotics to prevent animal diseases	3.36 ± 1.10	2.97 ± 1.18	3.58 ± 1.12	3.40 ± 1.04	3.53 ± 1.02	3.35 ± 1.05	***
Antibiotic residues in feed	3.93 ± 0.95	3.96 ± 0.95	4.09 ± 1.01	3.94 ± 0.86	3.86 ± 0.97	3.78 ± 093	*
Antibiotic resistance as a result of the use of antibiotics in animals	3.99 ± 0.97	4.03 ± 0.95	4.15 ± 1.01	3.91 ± 0.91	3.85 ± 1.00	3.99 ± 0.95	*
Animal production diseases in general	3.97 ± 0.92	3.94 ± 0.92	4.21 ± 0.87	3.95 ± 0.86	3.85 ± 0.99	3.88 ± 0.91	**

Pigs

I'm concerned about	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.77 ± 0.97	3.55 ± 1.08	4.23 ± 0.83	3.52 ± 0.94	3.79 ± 0.95	3.78 ± 0.89	***
Whether animal welfare standards are actually achieved in X production	3.85 ± 0.99	3.67 ± 1.01	4.17 ± 0.84	3.65 ± 1.05	3.89 ± 0.97	3.85 ± 0.99	***
Use of antibiotics in production animals as a growth promoter	3.98 ± 1.07	3.89 ± 1.13	4.27 ± 0.93	3.93 ± 1.11	3.84 ± 1.15	3.95 ± 0.97	**
Use of antibiotics in production animals to prevent diseases	3.86 ± 1.05	3.67 ± 1.12	4.25 ± 0.96	3.78 ± 1.01	3.83 ± 1.03	3.77 ± 1.00	***
Use of antibiotics in production animals to treat diseases	3.63 ± 1.12	3.20 ± 1.19	4.07 ± 1.02	3.58 ± 1.08	3.76 ± 1.06	3.53 ± 1.07	***
Use of vaccinations to prevent animal diseases	3.43 ± 1.13	3.10 ± 1.19	3.70 ± 1.09	3.30 ± 1.17	3.70 ± 1.03	3.35 ± 1.08	***
Use of other veterinary medicines to treat animal diseases	3.42 ± 1.12	3.08 ± 1.14	3.71 ± 1.07	3.30 ± 1.13	3.70 ± 1.04	3.29 ± 1.09	***
Use of probiotics to prevent animal diseases	3.38 ± 1.12	2.86 ± 1.09	3.77 ± 1.11	3.35 ± 1.09	3.64 ± 1.04	3.30 ± 1.07	***
Antibiotic residues in food*	3.98 ± 1.02	3.88 ± 1.02	4.41 ± 0.80	3.99 ± 1.05	3.83 ± 1.10	3.79 ± 1.02	***
Antibiotic resistance as a result of the use of antibiotics in animals	4.01 ± 0.97	3.85 ± 0.97	4.21 ± 0.92	4.08 ± 0.92	4.07 ± 0.95	3.83 ± 1.01	***
Animal production diseases in general	3.97 ± 0.93	3.97 ± 0.98	4.15 ± 0.89	3.91 ± 0.90	3.96 ± 0.93	3.87 ± 0.94	
Impacts of animal diseases on food quality	3.99 ± 0.96	3.85 ± 0.96	4.21 ± 0.94	4.04 ± 0.88	3.97 ± 0.96	3.87 ± 0.94	**
Impacts of animal diseases on food safety	4.02 ± 0.95	3.89 ± 0.97	4.20 ± 0.90	4.04 ± 0.98	4.07 ± 0.89	3.91 ± 1.01	*
Impacts of animal diseases on human health	3.83 ± 0.98	3.70 ± 1.03	4.15 ± 0.87	3.76 ± 0.94	3.81 ± 1.00	3.73 ± 0.99	***
Impacts of animal diseases on animal welfare	4.08 ± 0.97	4.08 ± 0.94	4.39 ± 0.87	3.97 ± 0.94	3.99 ± 1.03	3.96 ± 1.01	***
Impact of animal diseases on the environment	3.97 ± 0.93	3.83 ± 0.93	4.30 ± 0.81	3.86 ± 0.92	4.01 ± 0.94	3.85 ± 0.96	***

The following pose a risk to human health	Overall	Finland	Germany	Poland	Spain	UK	Chi-square
The current minimum animal welfare standards associated with X production	3.54 ± 1.01	3.15 ± 1.12	3.79 ± 1.05	3.66 ± 0.86	3.59 ± 0.98	3.51 ± 0.94	***
Whether animal welfare standards are actually achieved in X production	3.68 ± 0.97	3.45 ± 1.07	3.95 ± 0.98	3.70 ± 0.91	3.65 ± 0.94	3.66 ± 0.92	***
Use of antibiotics in production animals as a growth promoter	4.03 ± 0.97	4.06 ± 0.90	4.41 ± 0.80	4.04 ± 0.96	3.78 ± 1.09	3.84 ± 0.98	***
Use of antibiotics in production animals to prevent diseases	3.84 ± 1.01	3.76 ± 1.00	4.28 ± 0.92	3.88 ± 0.94	3.56 ± 1.07	3.72 ± 0.98	***
Use of antibiotics in production animals to treat diseases	3.70 ± 1.04	3.37 ± 1.07	4.13 ± 1.00	3.70 ± 0.99	3.68 ± 1.04	3.59 ± 0.97	***
Use of vaccinations to prevent animal diseases	3.47 ± 1.08	3.19 ± 1.11	3.77 ± 1.13	3.49 ± 1.08	3.55 ± 1.04	3.36 ± 0.95	***
Use of other veterinary medicines to treat animal diseases	2.51 ± 1.04	3.21 ± 1.03	3.76 ± 1.07	3.52 ± 1.01	3.67 ± 1.00	3.41 ± 1.01	***
Use of probiotics to prevent animal diseases	3.46 ± 1.07	3.03 ± 1.09	3.85 ± 1.07	3.48 ± 1.03	3.60 ± 1.01	3.32 ± 0.99	***
Antibiotic residues in food	4.02 ± 1.00	3.98 ± 0.95	4.42 ± 0.81	4.01 ± 1.03	3.86 ± 1.08	3.81 ± 0.99	***
Impacts of animal diseases on food quality	3.95 ± 0.95	3.80 ± 0.90	4.26 ± 0.88	4.05 ± 0.84	3.83 ± 1.02	3.79 ± 1.01	***
Impacts of animal diseases on food safety	3.96 ± 0.94	3.85 ± 0.88	4.23 ± 0.87	4.01 ± 0.95	3.86 ± 1.01	3.85 ± 0.94	***
Antibiotic resistance as a result of the use of antibiotics in animals	4.04 ± 0.93	4.04 ± 0.87	4.43 ± 0.76	3.95 ± 0.82	3.91 ± 1.00	3.86 ± 0.96	***
Animal production diseases in general	3.94 ± 0.90	3.71 ± 0.89	4.27 ± 0.84	3.95 ± 0.82	3.93 ± 0.95	3.84 ± 0.90	***

The following pose a risk to animal health	Overall	Finland	Germany	Poland	Spain	UK	Chi square
The current minimum animal welfare standards associated with X production	3.75 ± 1.00	3.67 ± 1.03	4.06 ± 0.99	3.68 ± 0.96	3.60 ± 1.08	3.76 ± 0.88	***
Whether animal welfare standards are actually achieved in X production	3.83 ± 0.96	3.88 ± 0.95	4.09 ± 0.96	3.70 ± 0.93	3.63 ± 1.03	3.88 ± 0.85	***
Use of antibiotics in production animals as a growth promoter	3.93 ± 1.01	3.95 ± 1.04	4.27 ± 0.90	3.88 ± 0.94	3.78 ± 1.06	3.75 ± 1.02	***
Use of antibiotics in production animals to prevent diseases	3.69 ± 1.05	3.65 ± 1.11	4.05 ± 1.02	3.59 ± 0.98	3.60 ± 1.05	3.57 ± 1.04	***
Use of antibiotics in production animals to treat diseases	3.49 ± 1.13	3.16 ± 1.22	3.95 ± 1.12	3.46 ± 1.03	3.50 ± 1.12	3.37 ± 1.05	***
Use of vaccinations to prevent animal diseases	3.31 ± 1.17	3.02 ± 1.25	3.56 ± 1.23	3.30 ± 1.04	3.44 ± 1.17	3.22 ± 1.08	***
Use of other veterinary medicines to treat animal diseases	3.33 ± 1.10	3.01 ± 1.16	3.64 ± 1.13	3.26 ± 1.09	3.43 ± 1.07	3.32 ± 0.96	***
Use of probiotics to prevent animal diseases	3.37 ± 1.14	2.98 ± 1.16	3.78 ± 1.13	3.36 ± 1.07	3.44 ± 1.16	3.28 ± 1.02	***
Antibiotic residues in feed	3.85 ± 1.01	3.77 ± 1.08	4.24 ± 0.93	3.85 ± 0.98	3.70 ± 0.99	3.70 ± 0.99	***
Antibiotic resistance as a result of the use of antibiotics in animals	3.93 ± 0.98	3.94 ± 1.00	4.25 ± 0.96	3.83 ± 0.96	3.87 ± 0.96	3.78 ± 0.95	***
Animal production diseases in general	3.92 ± 0.93	3.88 ± 0.93	4.22 ± 0.90	3.86 ± 0.95	3.85 ± 0.96	3.80 ± 0.87	***

1.1.8 Intervention preferences

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (Very unacceptable) to 5(very acceptable) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

To what extent do you agree or disagree that these are acceptable?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Adjustments in the quantity of feed available	3.45 ± 1.01	3.36 ± 0.96	3.42 ± 1.05	3.31 ± 1.06	3.62 ± 0.98	3.53 ± 0.98	
Adjustments to feed composition	3.63 ± 0.97	3.72 ± 0.90	3.68 ± 1.02	3.34 ± 1.07	3.83 ± 0.91	3.58 ± 0.89	***
Changes in the amount and time of light provision	3.56 ± 1.01	3.67 ± 0.91	3.46 ± 1.05	3.48 ± 1.01	3.70 ± 1.04	3.49 ± 1.00	
Enhanced control air movement in chicken houses	3.94 ± 0.94	4.13 ± 0.87	3.91 ± 0.97	3.94 ± 0.90	4.01 ± 0.93	3.72 ± 0.98	**
Enhanced maintenance of the quality of the bedding	4.04 ± 0.88	4.20 ± 0.86	4.03 ± 0.94	4.04 ± 0.81	3.92 ± 0.87	3.72 ± 0.98	
Enhanced hygiene and disease prevention measures	4.19 ± 0.91	4.34 ± 0.80	4.23 ± 0.60	4.07 ± 0.98	4.28 ± 0.82	4.00 ± 0.95	**
Housing that allows birds greater freedom to move	4.18 ± 0.98	4.29 ± 0.88	4.16 ± 1.11	4.03 ± 1.01	4.16 ± 0.95	4.23 ± 0.90	
The preventative use of veterinary drugs	2.88 ± 1.07	2.50 ± 1.05	2.50 ± 1.19	2.83 ± 1.12	3.35 ± 1.08	3.20 ± 1.13	***
Use of feed supplements e.g. probiotics	3.12 ± 1.09	3.19 ± 1.07	2.74 ± 1.19	3.25 ± 0.96	3.13 ± 1.13	3.30 ± 1.02	***
Providing farmers with a price premium that encourages enhanced bird health	3.94 ± 0.93	3.99 ± 0.98	4.03 ± 0.99	3.83 ± 0.94	3.94 ± 0.92	3.91 ± 0.83	
Providing materials and an environment where birds can perform natural behaviours	4.15 ± 0.92	4.29 ± 0.87	4.24 ± 0.93	3.97 ± 0.98	4.11 ± 0.90	4.11 ± 0.91	*
Improvements in housing design	4.10 ± 0.89	4.27 ± 0.83	4.14 ± 0.92	3.91 ± 0.94	4.01 ± 0.87	4.18 ± 0.86	**
Housing that protects the birds from adverse natural conditions	4.00 ± 0.90	4.04 ± 0.88	3.91 ± 0.94	3.96 ± 0.88	4.06 ± 0.91	4.05 ± 0.89	
Reducing the number of birds in a given area	4.12 ± 0.90	4.18 ± 0.86	4.20 ± 0.95	4.05 ± 0.92	3.96 ± 0.90	4.20 ± 0.86	*
Using antibiotics and medicines to treat sick birds	3.33 ± 1.05	3.40 ± 0.98	3.13 ± 1.18	3.45 ± 1.02	3.46 ± 1.07	3.54 ± 0.94	**
The use of vaccination	3.41 ± 0.99	3.37 ± 0.95	3.47 ± 1.12	3.14 ± 0.95	3.59 ± 0.99	3.49 ± 0.89	***
Doing nothing	2.12 ± 1.19	2.10 ± 1.08	1.92 ± 1.18	2.25 ± 1.25	2.10 ± 1.30	2.21 ± 1.15	

Significance values: **p< 0.05, ** p< 0.01 and *** p<0.001*

Layers

To what extent do you agree or disagree that these are acceptable?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Adjustments to the quantity of feed available	3.46 ± 0.96	3.40 ± 0.92	3.44 ± 0.99	3.32 ± 0.96	3.64 ± 0.93	3.48 ± 0.96	
Adjustments to feed composition	3.65 ± 0.95	3.61 ± 1.02	3.69 ± 0.92	3.33 ± 1.01	3.93 ± 0.91	3.72 ± 0.81	***
Changes in the amount and time of light provision	3.59 ± 1.02	3.65 ± 0.96	3.52 ± 1.11	3.53 ± 0.98	3.61 ± 1.05	3.66 ± 0.98	
Enhanced control of air movement in chicken houses	3.92 ± 0.92	4.13 ± 0.85	3.87 ± 0.98	3.91 ± 0.88	3.90 ± 0.93	3.79 ± 0.93	**
Enhanced maintenance of the quality of the bedding	4.06 ± 0.88	4.23 ± 0.83	3.95 ± 0.92	4.07 ± 0.84	3.99 ± 0.94	4.09 ± 0.85	
Enhanced hygiene and disease prevention measures	4.18 ± 0.86	4.43 ± 0.76	4.10 ± 0.95	4.10 ± 0.83	4.13 ± 0.92	4.14 ± 0.82	***
Housing that allows birds greater freedom to move	4.11 ± 0.99	4.38 ± 0.85	4.04 ± 1.25	3.87 ± 0.86	4.06 ± 0.96	4.20 ± 0.90	***
The preventative use of veterinary drugs including antibiotics	3.17 ± 1.21	2.56 ± 1.12	2.51 ± 1.14	4.07 ± 0.94	3.47 ± 1.03	3.28 ± 1.08	***
Use of feed supplements e.g. probiotics	3.19 ± 1.07	3.11 ± 1.00	2.81 ± 1.12	3.31 ± 1.06	3.34 ± 1.11	3.40 ± 0.99	***
Providing farmers with a price premium that encourages enhanced bird health	3.91 ± 0.96	3.90 ± 1.04	3.92 ± 1.07	3.91 ± 0.88	3.87 ± 0.95	3.92 ± 0.87	
Providing materials and an environment where birds can perform natural behaviours	4.16 ± 0.92	4.34 ± 0.87	4.23 ± 1.00	4.02 ± 0.93	4.04 ± 0.97	4.18 ± 0.80	**
Improvements in housing design	4.07 ± 0.92	4.27 ± 0.80	3.96 ± 1.04	4.02 ± 0.93	3.97 ± 0.96	4.11 ± 0.79	*
Housing that protects the birds from adverse natural conditions	3.99± 0.92	4.07 ± 0.85	3.86 ± 0.99	3.93 ± 0.97	4.13 ± 0.91	3.99 ± 0.86	
Reducing the number of birds in a given area	4.10 ± 0.94	4.10 ± 0.87	4.23 ± 0.97	4.06 ± 0.97	3.91 ± 0.98	4.19 ± 0.86	**
Using antibiotics to treat sick birds	3.34 ± 1.06	3.28 ± 1.00	3.22 ± 1.15	3.21 ± 0.99	3.49 ± 1.10	3.47 ± 1.05	*
The use of vaccination	3.45 ± 0.98	3.31 ± 0.96	3.49 ± 0.98	3.37 ± 0.94	3.49 ± 1.03	3.58 ± 0.96	
Doing nothing	2.12 ± 1.21	1.94 ± 1.13	2.00 ± 1.19	2.28 ± 1.22	2.18 ± 1.28	2.18 ± 1.20	*

Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Pigs

To what extent do you agree or disagree that these are acceptable?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Enhanced hygiene and disease prevention measures	4.17 ± 0.87	4.33 ± 0.77	4.29 ± 0.84	3.96 ± 0.94	4.16 ± 0.89	4.09 ± 0.85	***
Using medicines and antibiotics to treat sick picks	3.37 ± 1.02	3.41 ± 1.06	3.05 ± 1.11	3.03 ± 0.90	3.61 ± 1.00	3.76 ± 0.77	***
The preventive use of veterinary drugs including antibiotics	2.74 ± 1.18	2.22 ± 1.08	2.25 ± 1.12	2.59 ± 1.04	3.34 ± 1.13	3.32 ± 1.01	***
Use of feed supplements e.g. probiotics	3.17 ± 1.10	3.02 ± 1.08	2.64 ± 1.19	3.26 ± 0.96	3.48 ± 1.02	3.44 ± 1.05	***
The use of vaccination	3.52 ± 0.98	3.42 ± 1.02	3.36 ± 1.06	3.40 ± 0.95	3.66 ± 0.97	3.76 ± 0.81	***
Efficient monitoring of pigs and pig housing conditions	4.17 ± 0.87	4.36 ± 0.73	4.25 ± 0.93	3.97 ± 0.88	4.11 ± 0.95	4.19 ± 0.80	***
Enhanced control of air movement in pig houses	4.17 ± 0.87	4.35 ± 0.73	4.20 ± 0.88	4.06 ± 0.92	4.16 ± 0.91	4.05 ± 0.89	*
Improvements in pigs' diet composition	4.19 ± 0.88	4.33 ± 0.73	4.21 ± 0.95	4.05 ± 0.92	4.15 ± 0.93	4.20 ± 0.85	
Adjustments in the quantity of pig feed available	3.86 ± 0.91	3.66 ± 0.85	3.87 ± 0.94	3.70 ± 0.94	4.13 ± 0.84	3.96 ± 0.89	***
Breeding for genetically tougher or more resilient pigs	3.16 ± 1.15	3.39 ± 1.11	2.61 ± 1.20	3.31 ± 1.10	3.59 ± 1.04	3.40 ± 1.06	***
Improvements in housing design	4.12 ± 0.89	4.29 ± 0.80	4.09 ± 0.99	4.01 ± 0.89	4.16 ± 0.90	4.09 ± 0.87	
Housing that protects pigs from adverse natural conditions	3.96 ± 0.94	4.01 ± 0.93	3.65 ± 1.05	3.94 ± 0.88	4.16 ± 0.86	4.03 ± 0.89	***
Reducing the number of pigs in a given area	4.14 ± 0.91	4.22 ± 0.90	4.30 ± 0.97	3.95 ± 0.89	4.04 ± 0.95	4.18 ± 0.80	***
Providing enrichment materials so pigs can perform natural behaviours	4.19 ± 0.88	4.35 ± 0.79	4.42 ± 0.88	3.97 ± 0.88	4.14 ± 0.92	4.08 ± 0.85	***
Providing farmers with a price premium that encourages enhanced animal health	4.10 ± 0.92	3.97 ± 1.00	4.27 ± 0.93	4.03 ± 0.84	4.23 ± 0.86	3.99 ± 0.92	**
Doing nothing	2.35 ± 1.30	1.97 ± 1.12	1.59 ± 0.95	2.25 ± 1.11	3.67 ± 0.96	2.26 ± 1.27	***

Significance values: **p< 0.05, ** p< 0.01 and *** p<0.001*)

1.1.9 Intervention likelihood

All responses are reported as the mean ± the standard deviation (SD). Responses are based on a 1 (Very unlikely) to 5(very likely) Likert scale. Significance values: *p< 0.05, ** p< 0.01 and *** p<0.001

Broilers

How likely to you think these interventions will be used?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Adjustments in the quantity of feed available	3.30 ± 0.99	3.47 ± 0.92	3.21 ± 1.02	3.39 ± 1.00	3.25 ± 0.99	3.20 ± 0.99	*
Adjustments to feed composition	3.43 ± 1.00	3.67 ± 0.89	3.31 ± 1.03	3.52 ± 0.99	3.34 ± 1.07	3.32 ± 1.00	**
Changes in the amount and time of light provision	3.26 ± 0.99	3.56 ± 0.89	3.09 ± 1.01	3.28 ± 0.98	3.28 ± 1.04	3.09 ± 0.97	***
Enhanced control air movement in chicken houses	3.19 ± 0.99	3.49 ± 1.00	3.00 ± 0.97	3.17 ± 1.01	3.14 ± 0.99	3.16 ± 0.91	***
Enhanced maintenance of the quality of the bedding	3.12 ± 1.05	3.42 ± 1.01	2.97 ± 1.06	3.15 ± 1.08	3.15 ± 1.04	2.94 ± 0.98	***
Enhanced hygiene and disease prevention measures	3.26 ± 1.04	3.53 ± 0.97	3.04 ± 1.08	3.25 ± 1.04	3.32 ± 1.07	3.14 ± 0.98	***
Housing that allows birds greater freedom to move	2.90 ± 1.11	3.16 ± 1.11	2.53 ± 1.13	2.97 ± 1.12	2.96 ± 1.06	2.88 ± 1.07	***
The preventative use of veterinary drugs	3.41 ± 1.04	3.34 ± 1.08	3.39 ± 1.07	3.38 ± 0.99	3.40 ± 1.05	3.39 ± 0.99	
Use of feed supplements e.g. probiotics	3.42 ± 1.00	3.55 ± 0.91	3.39 ± 1.07	3.38 ± 0.99	3.40 ± 1.05	3.39 ± 0.99	
Providing farmers with a price premium that encourages enhanced bird health	2.87 ± 1.08	2.94 ± 1.15	2.70 ± 1.03	2.92 ± 1.08	2.96 ± 1.12	2.85 ± 1.02	
Providing materials and an environment where birds can perform natural behaviours	2.86 ± 1.09	3.04 ± 1.11	2.56 ± 1.05	2.92 ± 1.12	2.91 ± 1.10	2.86 ± 1.04	**
Improvements in housing design	3.07 ± 1.04	3.32 ± 1.05	2.87 ± 1.07	3.08 ± 1.03	3.08 ± 1.04	3.01 ± 1.00	***
Housing that protects the birds from adverse natural conditions	3.22 ± 0.99	3.41 ± 1.00	3.17 ± 0.94	3.18 ± 1.00	3.21 ± 1.04	3.12 ± 0.94	*
Reducing the number of birds in a given area	2.78 ± 1.08	2.81 ± 1.16	2.59 ± 1.04	2.89 ± 0.99	2.91 ± 1.13	2.70 ± 1.07	*
Using antibiotics and medicines to treat sick birds	3.45 ± 1.00	3.54 ± 0.96	3.44 ± 1.10	3.37 ± 1.03	3.44 ± 0.98	3.47 ± 0.94	
The use of vaccination	3.40 ± 1.00	3.53 ± 0.94	3.25 ± 1.03	3.41 ± 0.99	3.40 ± 1.06	3.41 ± 0.96	
Doing nothing	3.11 ± 1.26	2.89 ± 1.23	3.03 ± 1.30	3.18 ± 1.23	3.16 ± 1.37	3.28 ± 1.13	

Layers

How likely do you think it is that these interventions will be used?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Adjustments to the quantity of feed available	2.12 ± 1.21	3.53 ± 0.94	2.00 ± 1.19	2.28 ± 1.22	2.18 ± 1.28	2.18 ± 1.20	***
Adjustments to feed composition	3.51 ± 0.99	3.78 ± 0.91	3.30 ± 1.00	3.65 ± 0.94	3.34 ± 1.06	3.48 ± 0.96	***
Changes in the amount and time of light provision	3.32 ± 1.00	3.63 ± 0.85	3.15 ± 1.04	3.25 ± 0.90	3.23 ± 1.06	3.34 ± 1.07	***
Enhanced control of air movement in chicken houses	3.26 ± 1.04	3.56 ± 0.93	3.00 ± 1.00	3.19 ± 1.00	3.30 ± 1.05	3.27 ± 1.12	***
Enhanced maintenance of the quality of the bedding	3.14 ± 1.04	3.37 ± 0.98	2.90 ± 1.01	3.12 ± 1.00	3.28 ± 1.07	3.01 ± 1.07	***
Enhanced hygiene and disease prevention measures	3.24 ± 1.06	3.49 ± 1.01	2.89 ± 1.04	3.21 ± 0.96	3.33 ± 1.10	3.28 ± 1.09	***
Housing that allows birds greater freedom to move	2.93 ± 1.12	3.09 ± 1.06	2.58 ± 1.17	2.97 ± 1.12	3.08 ± 1.09	2.91 ± 1.11	***
The preventative use of veterinary drugs including antibiotics	3.43 ± 1.03	3.44 ± 0.94	3.49 ± 1.16	3.45 ± 1.04	3.41 ± 1.03	3.38 ± 0.99	
Use of feed supplements e.g. probiotics	3.49 ± 0.99	3.72 ± 0.78	3.46 ± 1.13	3.44 ± 0.97	3.31 ± 1.04	3.54 ± 0.99	**
Providing farmers with a price premium that encourages enhanced bird health	2.87 ± 1.09	2.88 ± 1.11	2.60 ± 1.03	3.03 ± 1.00	2.91 ± 1.07	2.93 ± 1.17	**
Providing materials and an environment where birds can perform natural behaviours	2.88 ± 1.09	3.03 ± 1.02	2.51 ± 1.11	2.86 ± 1.05	3.03 ± 1.03	2.96 ± 1.15	***
Improvements in housing design	3.05 ± 1.05	3.39 ± 0.96	2.67 ± 1.02	2.99 ± 1.01	3.16 ± 1.06	3.04 ± 1.07	***
Housing that protects the birds from adverse natural conditions	3.28 ± 1.00	3.48 ± 0.96	3.13 ± 1.06	3.17 ± 0.93	3.34 ± 1.04	3.28 ± 0.98	*
Reducing the number of birds in a given area	2.78 ± 1.13	2.85 ± 1.07	2.45 ± 1.12	2.78 ± 1.11	2.95 ± 1.13	2.89 ± 1.15	***
Using antibiotics to treat sick birds	3.44 ± 1.02	3.58 ± 0.91	3.35 ± 1.15	3.56 ± 1.01	3.23 ± 1.02	3.49 ± 0.96	**
The use of vaccination	3.44 ± 0.98	3.49 ± 0.82	3.41 ± 1.08	3.54 ± 0.95	3.33 ± 1.05	3.42 ± 0.98	
Doing nothing	3.04 ± 1.25	2.70 ± 1.09	3.28 ± 1.30	3.28 ± 1.24	3.01 ± 1.29	2.94 ± 1.25	***

Pigs

How likely do you think these interventions will be used?	Overall	Finland	Germany	Poland	Spain	UK	Chi square
Enhanced hygiene and disease prevention measures	3.32 ± 1.03	3.53 ± 0.92	2.99 ± 1.12	3.28 ± 1.01	3.40 ± 1.04	3.37 ± 0.99	***
Using medicines and antibiotics to treat sick picks	3.75 ± 0.97	3.80 ± 0.85	3.89 ± 1.05	3.62 ± 0.97	3.69 ± 1.02	3.78 ± 0.95	
The preventive use of veterinary drugs including antibiotics	3.63 ± 1.02	3.38 ± 1.08	3.86 ± 1.03	3.56 ± 1.04	3.70 ± 0.96	3.64 ± 0.95	***
Use of feed supplements e.g. probiotics	3.65 ± 0.99	3.69 ± 0.88	3.88 ± 1.06	3.50 ± 1.98	3.63 ± 0.98	3.56 ± 1.00	**
The use of vaccination	3.76 ± 0.95	3.73 ± 0.88	3.83 ± 1.08	3.60 ± 0.95	3.84 ± 0.93	3.81 ± 0.89	
Efficient monitoring of pigs and pig housing conditions	3.24 ± 1.04	3.46 ± 0.95	3.02 ± 1.11	3.18 ± 1.00	3.26 ± 1.11	3.29 ± 0.97	**
Enhanced control of air movement in pig houses	3.05 ± 1.03	3.23 ± 0.99	2.88 ± 1.04	2.99 ± 0.98	3.06 ± 1.08	3.09 ± 1.04	*
Improvements in pigs' diet composition	3.11 ± 1.05	3.39 ± 0.96	2.97 ± 1.08	2.97 ± 0.98	3.05 ± 1.14	3.16 ± 1.02	**
Adjustments in the quantity of pig feed available	3.16 ± 1.01	3.37 ± 0.87	2.89 ± 1.07	3.15 ± 0.96	3.20 ± 1.09	3.18 ± 1.00	**
Breeding for genetically tougher or more resilient pigs	3.52 ± 0.99	3.69 ± 0.91	3.57 ± 0.95	3.37 ± 1.05	3.48 ± 1.00	3.47 ± 1.00	
Improvements in housing design	3.13 ± 1.05	3.47 ± 1.01	2.84 ± 1.05	3.01 ± 0.98	3.11 ± 1.11	3.20 ± 1.02	***
Housing that protects pigs from adverse natural conditions	3.29 ± 1.02	3.55 ± 0.93	3.21 ± 1.00	3.09 ± 1.00	3.23 ± 1.09	3.35 ± 1.05	**
Reducing the number of pigs in a given area	2.71 ± 1.14	2.77 ± 1.18	2.43 ± 1.14	2.70 ± 1.08	2.88 ± 1.17	2.78 ± 1.06	**
Providing enrichment materials so pigs can perform natural behaviours	2.83 ± 1.10	2.92 ± 1.13	2.65 ± 1.07	2.85 ± 0.98	2.97 ± 1.15	2.85 ± 1.13	***
Providing farmers with a price premium that encourages enhanced animal health	2.83 ± 1.10	2.82 ± 1.13	2.65 ± 1.07	2.85 ± 0.98	2.97 ± .15	2.85 ± 1.13	
Doing nothing	3.24 ± 1.30	2.95 ± 1.17	3.31 ± 1.34	3.28 ± 1.30	3.26 ± 1.33	3.39 ± 1.30	*

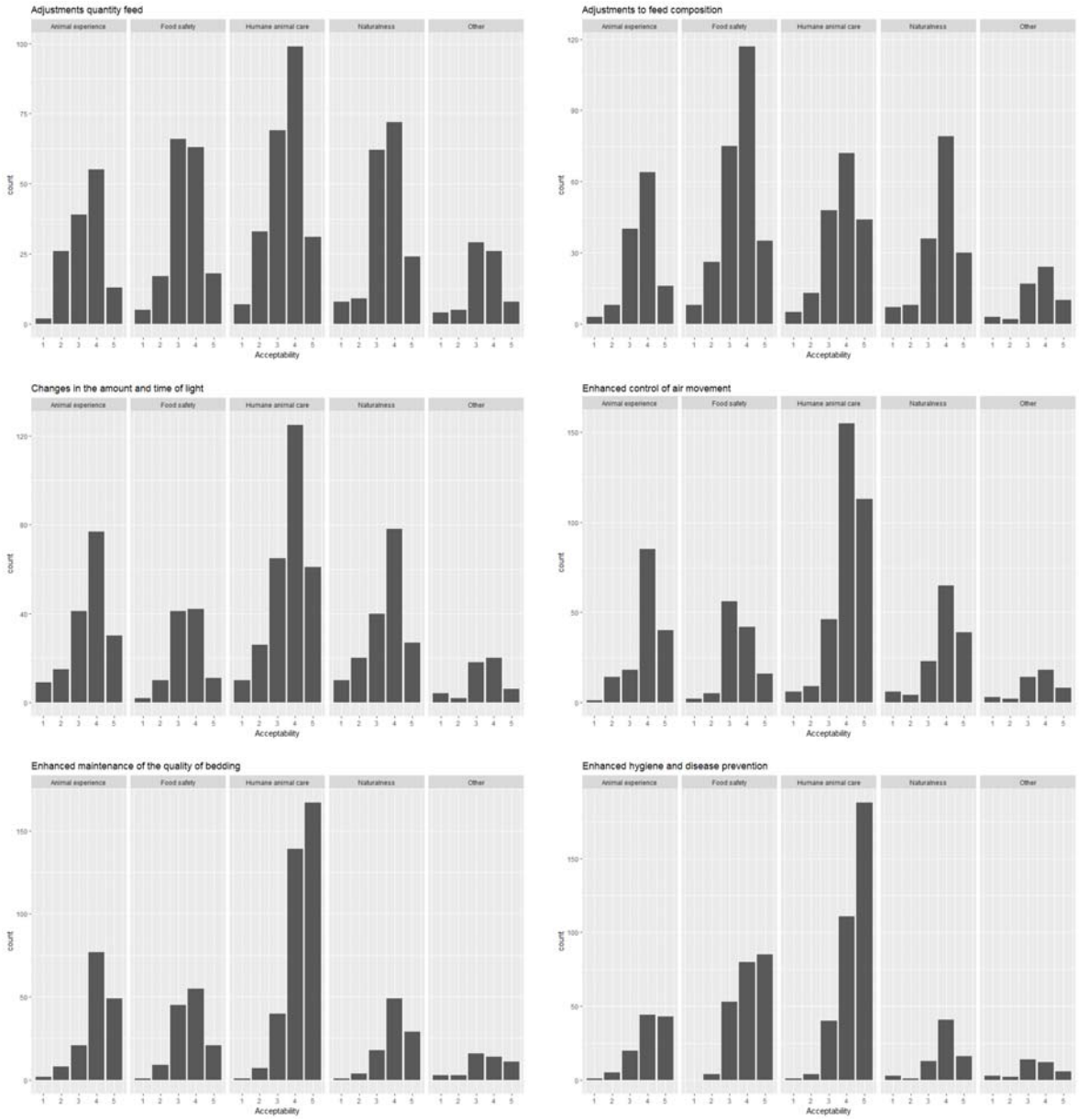
1.1.10 Intervention preferences

All responses are reported as count of responses for each scale response.

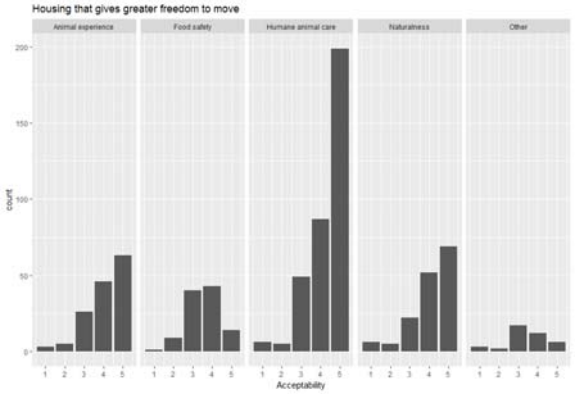
Responses are based on a 1 (strongly disagree) to 5(strongly agree) Likert scale.

Categories (x axis) are based on Q14, reason for the acceptability rating given.

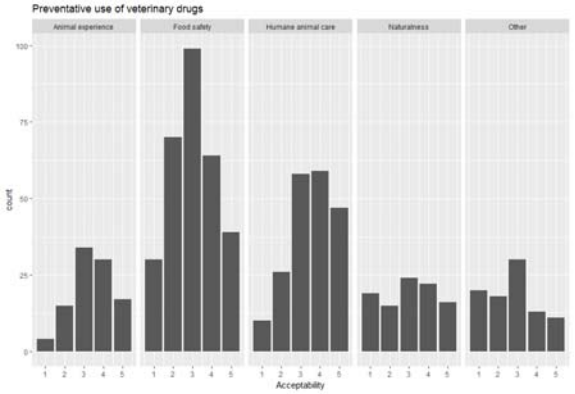
Layers



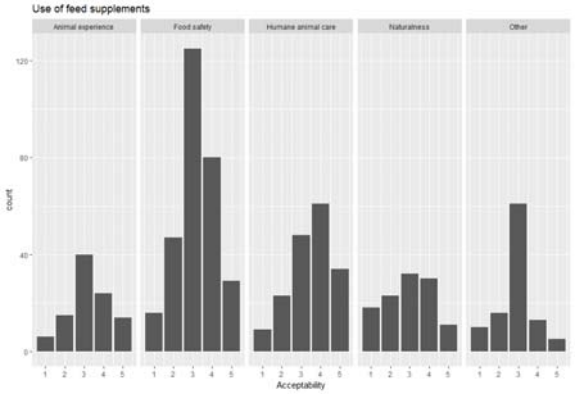
Housing that gives greater freedom to move



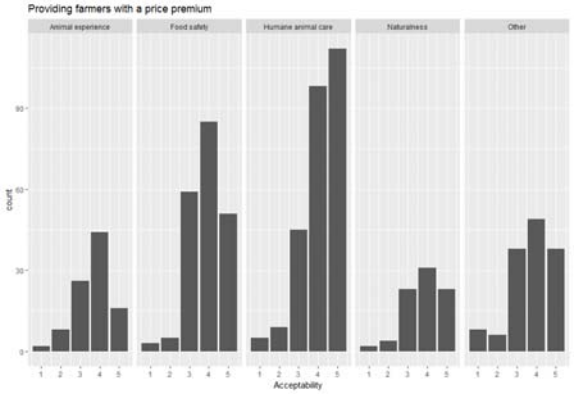
Preventative use of veterinary drugs



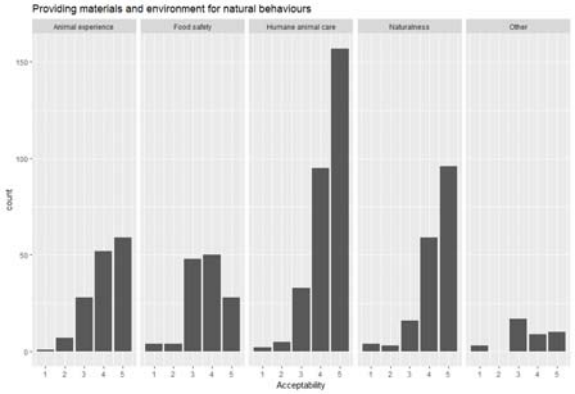
Use of feed supplements



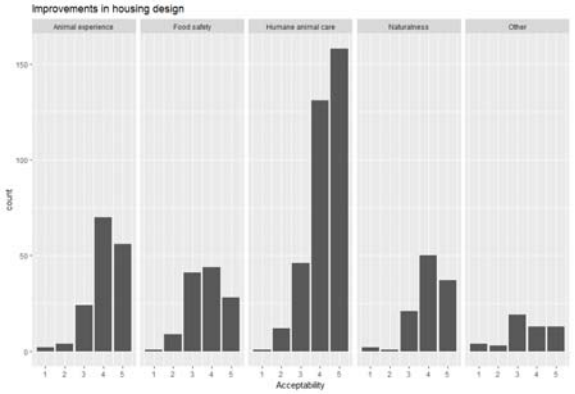
Providing farmers with a price premium



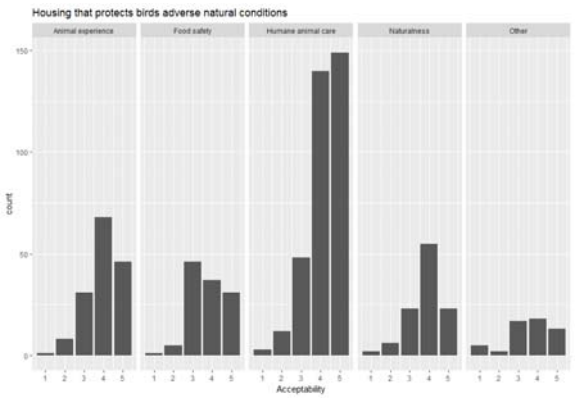
Providing materials and environment for natural behaviours



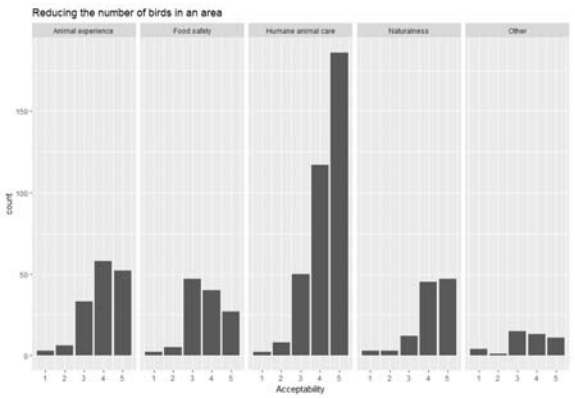
Improvements in housing design

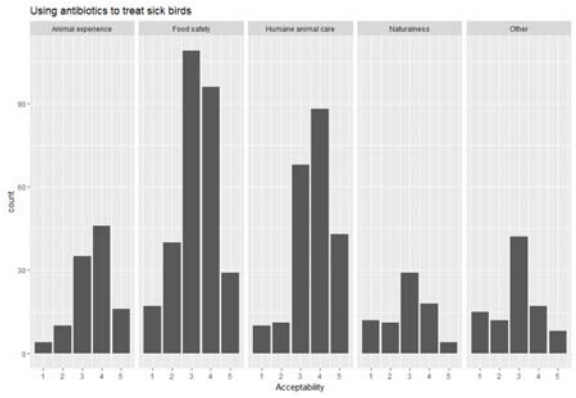


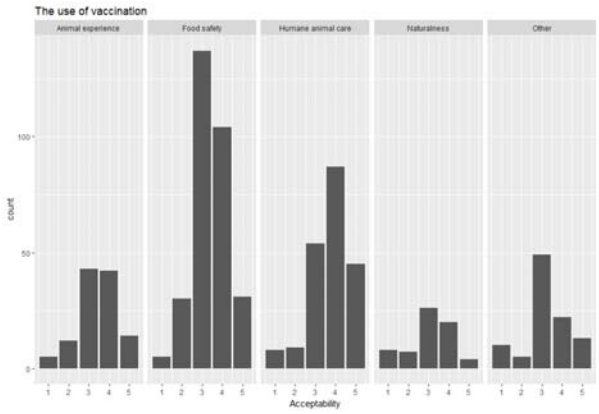
Housing that protects birds adverse natural conditions

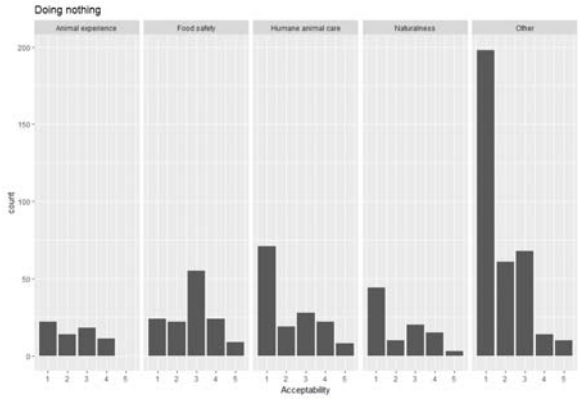


Reducing the number of birds in an area

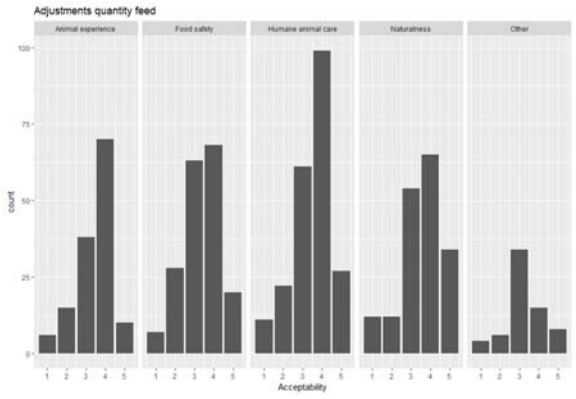


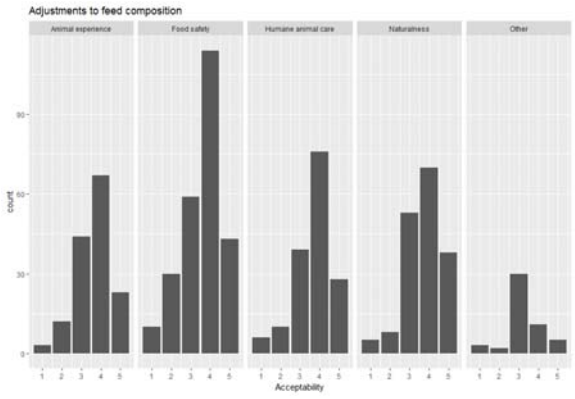

Using antibiotics to treat sick birds
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

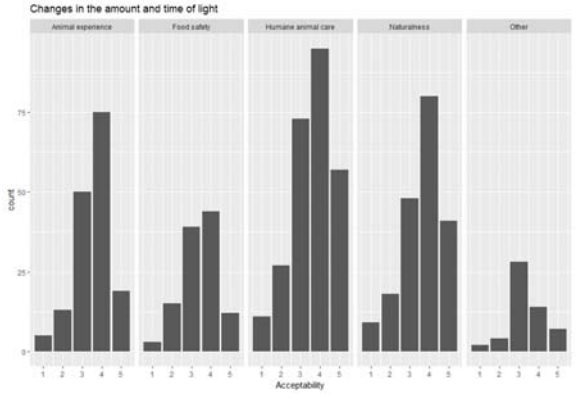

The use of vaccination
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

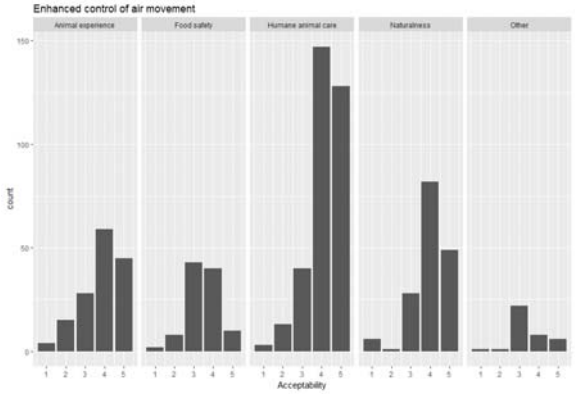

Doing nothing
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

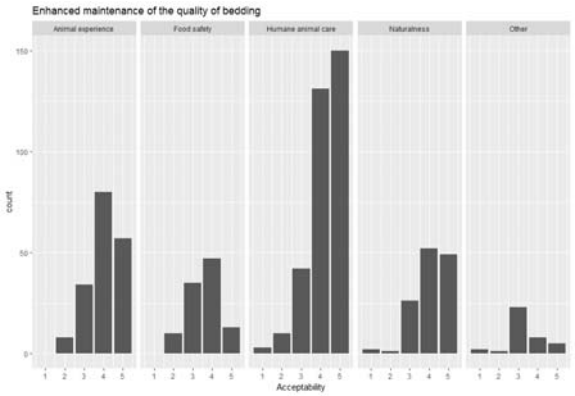
Broilers

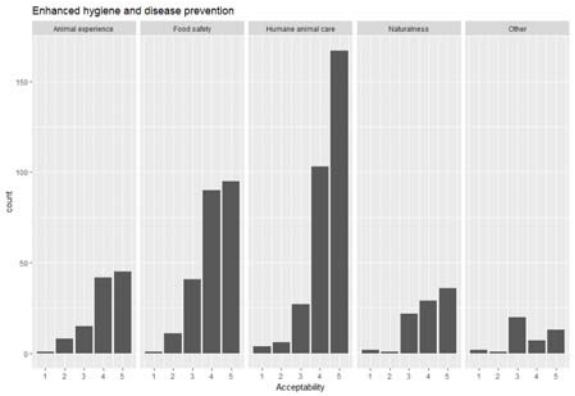

Adjustments quantity feed
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

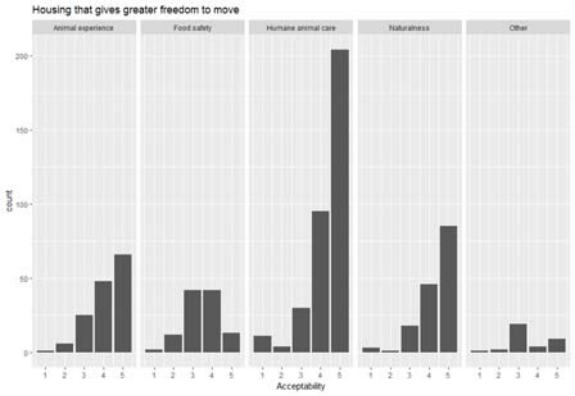

Adjustments to feed composition
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

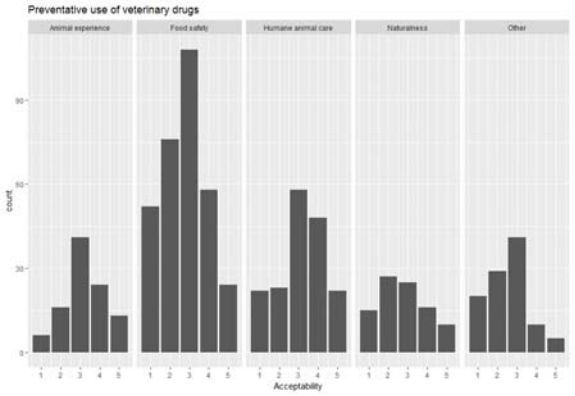

Changes in the amount and time of light
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

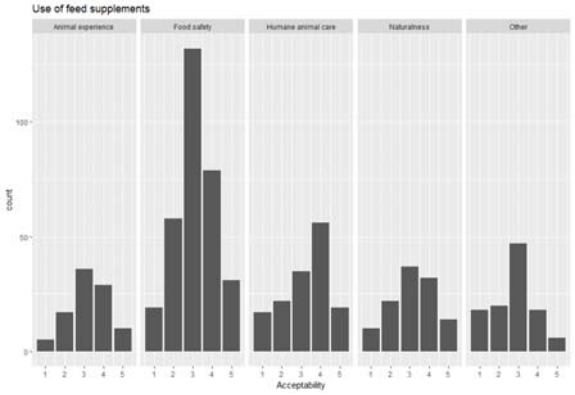

Enhanced control of air movement
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

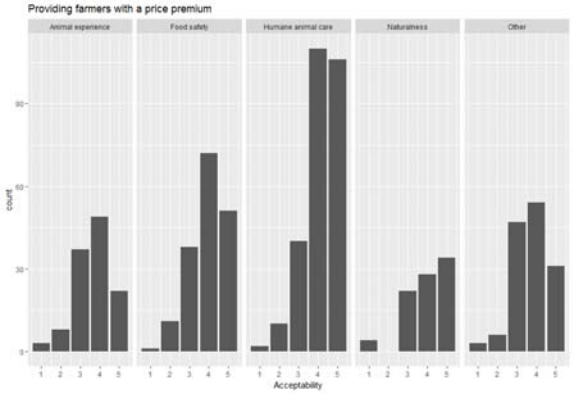

Enhanced maintenance of the quality of bedding
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

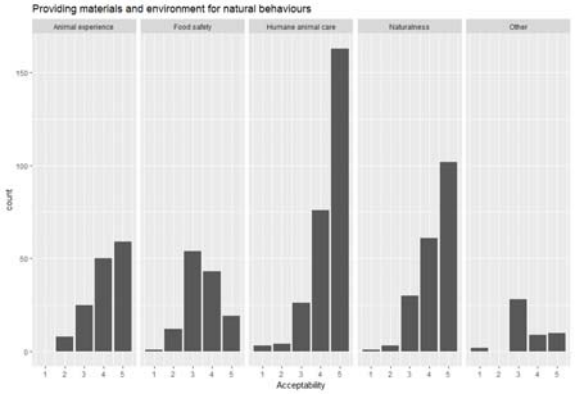

Enhanced hygiene and disease prevention
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

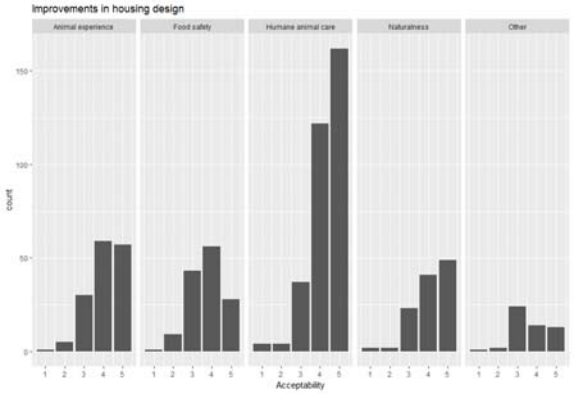

Housing that gives greater freedom to move
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

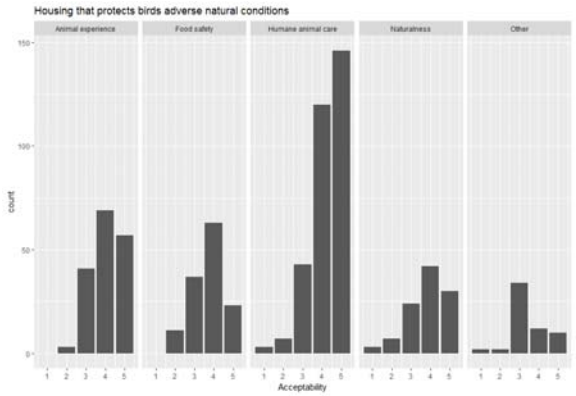

Preventative use of veterinary drugs
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

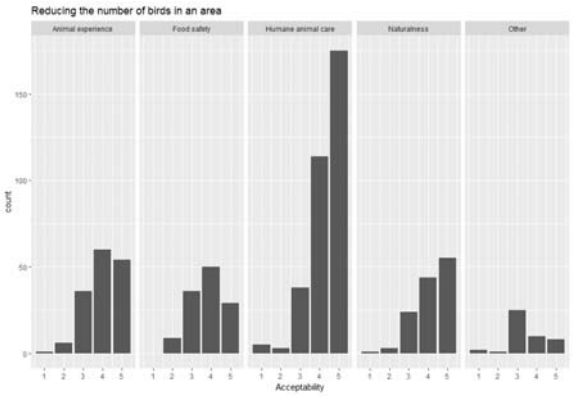

Use of feed supplements
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

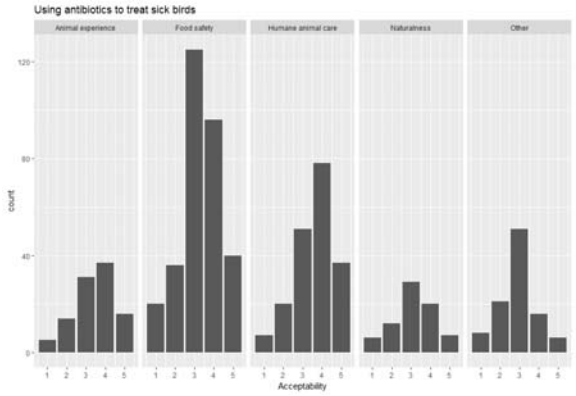

Providing farmers with a price premium
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

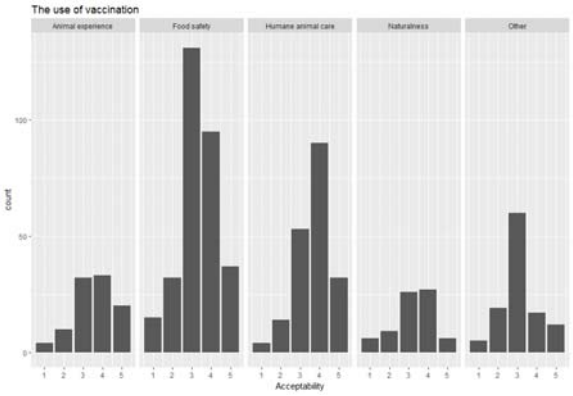

Providing materials and environment for natural behaviours
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

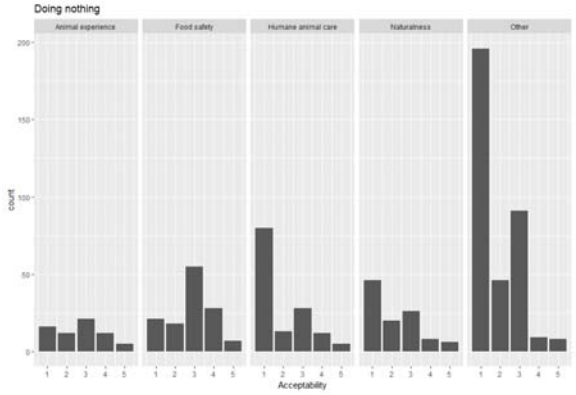

Improvements in housing design
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Housing that protects birds adverse natural conditions
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

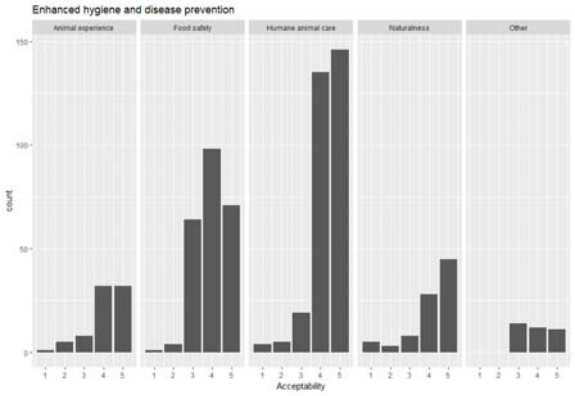

Reducing the number of birds in an area
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

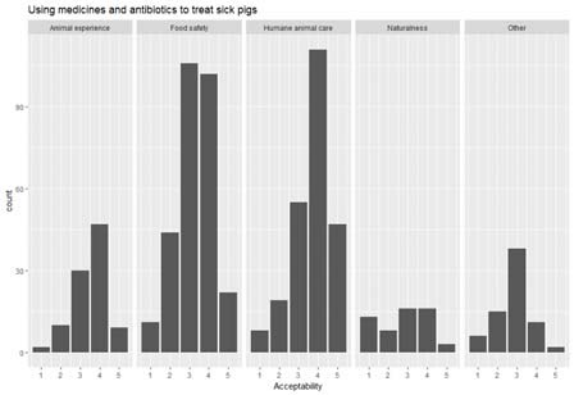

Using antibiotics to treat sick birds
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

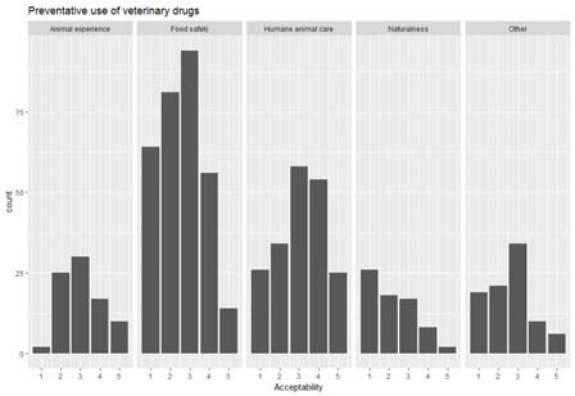

The use of vaccination
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

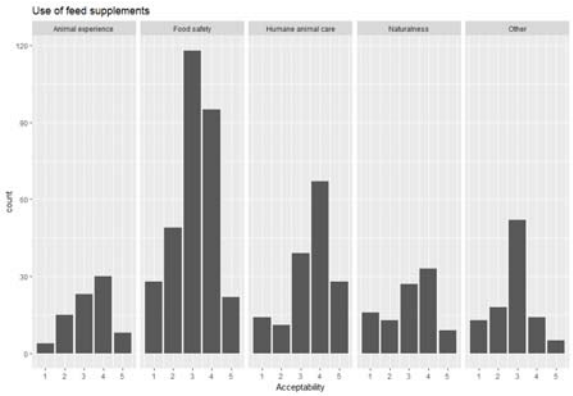

Doing nothing
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

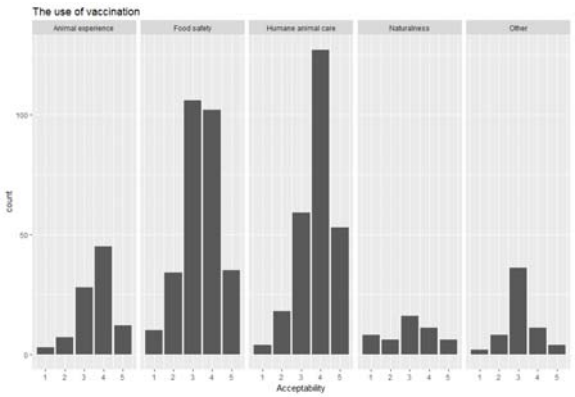
Pigs

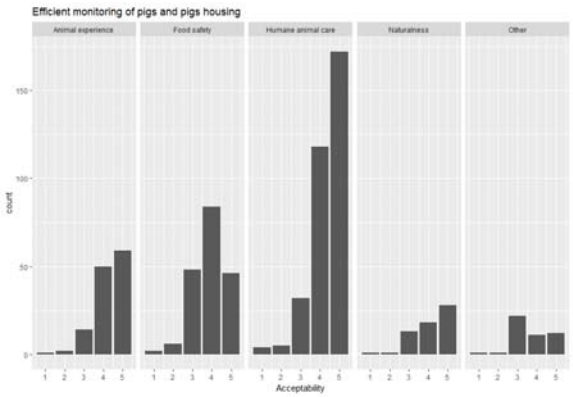

Enhanced hygiene and disease prevention
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

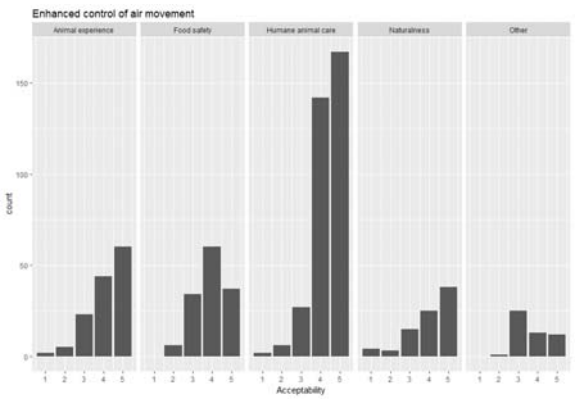

Using medicines and antibiotics to treat sick pigs
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

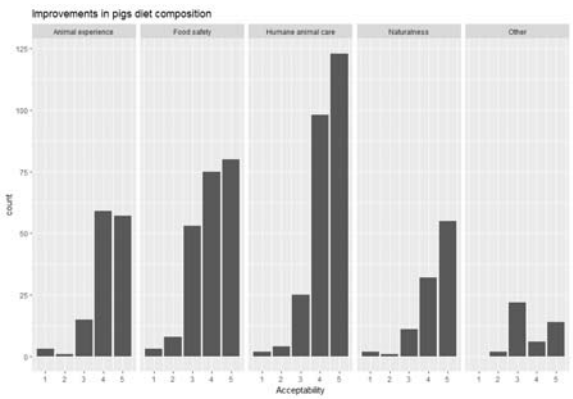

Preventative use of veterinary drugs
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

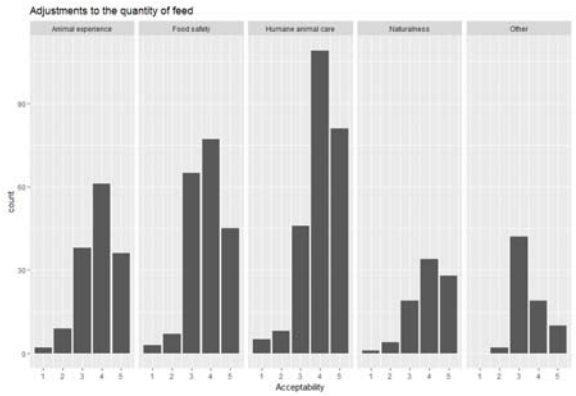

Use of feed supplements
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

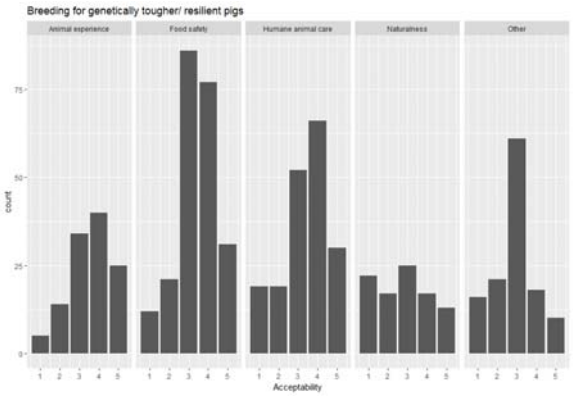

The use of vaccination
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

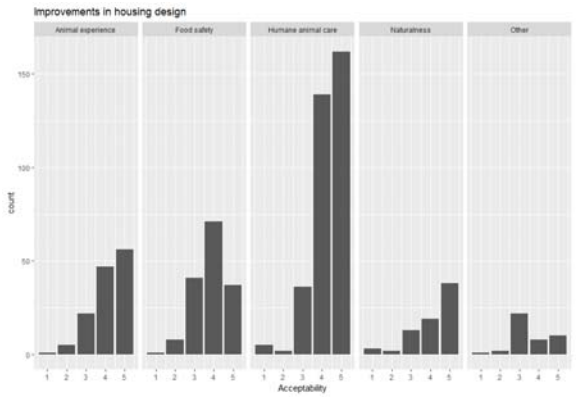

Efficient monitoring of pigs and pigs housing
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

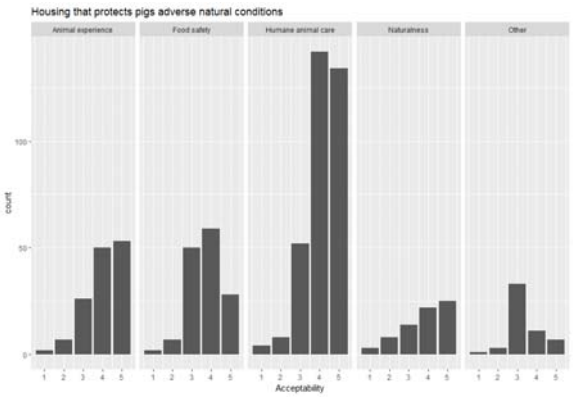

Enhanced control of air movement
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

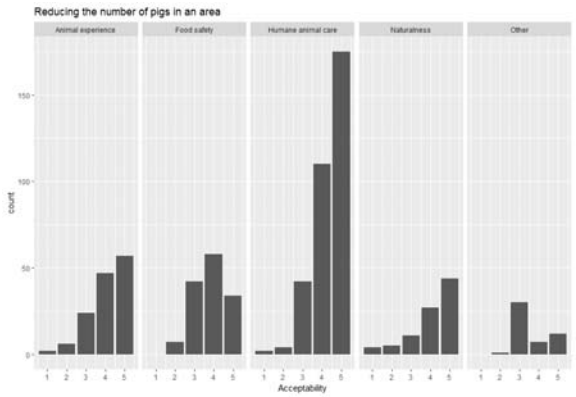

Improvements in pigs diet composition
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

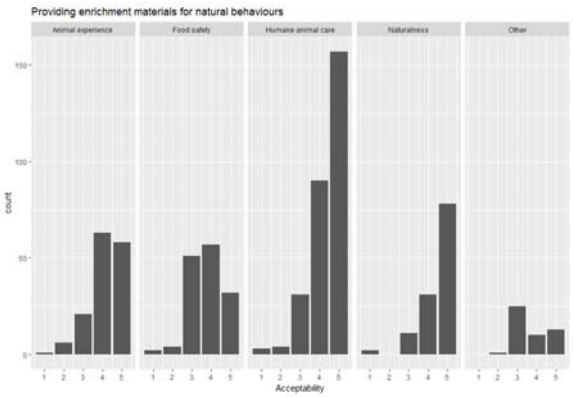

Adjustments to the quantity of feed
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

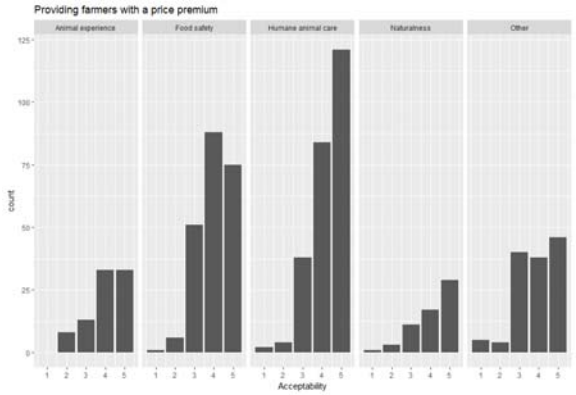

Breeding for genetically tougher/ resilient pigs
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

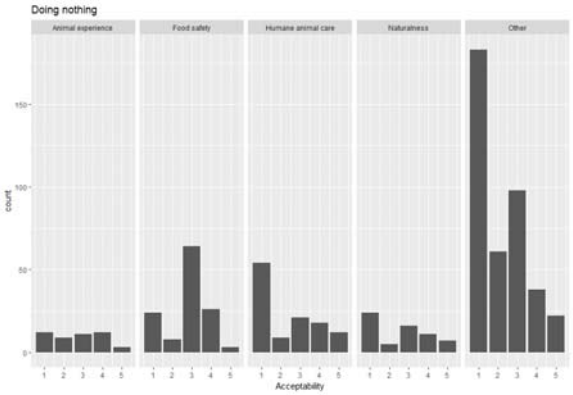

Improvements in housing design
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Housing that protects pigs adverse natural conditions
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Reducing the number of pigs in an area
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Providing enrichment materials for natural behaviours
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Providing farmers with a price premium
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability


Doing nothing
Animal experience
Food safety
Humane animal care
Naturalness
Other
count
Acceptability

Appendix T: Full EFA results

Broilers

	1	2	3
Lack of benefits			
Q8_6: Improved human food quality	0.847		
Q8_2: Reduced incidence of animal diseases	0.837		
Q8_8: Improved consumer health	0.836		
Q8_7: Improved nutritional quality of human food	0.828		
Q8_5: Improved human food safety	0.823		
Q8_4: Improved animal welfare monitoring	0.806		
Q8_1: Reduced animal stress	0.800		
Q8_21: Increased consumer trust in the food they buy	0.797		
Q8_22: A natural production method	0.766		
Q8_3: Faster treatment of animal diseases	0.757		
Q8_12: A more sustainable approach to animal production	0.708		
Q8_19: Benefits to your family	0.685		
Q8_11: Benefits to the environment e.g. reduced CO2 footprint	0.683		
Q8_18: Benefits to you personally	0.681		
Q8_20: Benefits to consumers	0.669		
Q8_16: More professionally run livestock farms	0.645		
Q8_17: Benefits to agriculture	0.528		
Concern			
Q10_12: Impacts of animal diseases on food quality		0.852	
Q10_13: Impacts of animal diseases on food safety		0.815	
Q10_10: Impacts of animal diseases on human health		0.796	
Q10_16: Animal production diseases in general		0.715	
Q10_15: Antibiotic resistance as a result of the use of antibiotics in animals		0.711	
Q10_14: Impact of animal diseases on the environment		0.696	
Q10_11: Impacts of animal diseases on animal welfare		0.680	
Q10_9: Antibiotic residues in food		0.674	
Q10_3: Use of antibiotics in production animals as a growth promoter		0.670	
Q10_2: Whether animal welfare standards are actually achieved in broiler chicken production		0.495	
Q10_4: Use of antibiotics in production animals to prevent diseases		0.452	
Proactive			
Q13_12: Improvements in housing design			0.808
Q13_11: Providing materials and an environment where birds can perform natural behaviours			0.780
Q13_14: Reducing the number of birds in a given area			0.748
Q13_13: Housing that protects the birds from adverse natural conditions			0.720
Q13_6: Enhanced hygiene and disease prevention measures			0.719
Q13_5: Enhanced maintenance of the quality of the bedding			0.714
Q13_10: Providing farmers with a price premium that encourages enhanced bird health			0.703
Q13_7: Housing that allows birds greater freedom to move			0.696
Q13_4: Enhanced control of air movement in chicken houses			0.565
Cronbach's alpha	0.975	0.944	0.930

	4	5	6	7	8	9
Distrust						
Q6_12: Slaughterhouses	-0.865					
Q6_7: Animal breeding companies	-0.854					
Q6_8: Animal feed producers	-0.815					
Q6_14: Food manufacturers	-0.804					
Q6_11: Animal transporters	-0.796					
Q6_10: Farmers	-0.790					
Q6_15: Food retailers	-0.717					
Q6_9: Animal housing manufacturers	-0.683					
Q6_6: Veterinary medicine producers	-0.591					
Q6_3: National government	-0.534					
Personal risks						
Q9_19: Risks to your family		0.757				
Q9_18: Risks to you personally		0.735				
Q9_20: Risks to consumers		0.732				
Q9_17: Risks to agriculture		0.405				
Perceived benefit						
Q8_13: A more cost efficient production method			0.727			
Q8_9: Cheaper food of animal origin			0.723			
Q8_10: Increased availability of animal based products			0.700			
Q8_14: Greater protection from predators			0.636			
Q8_15: Greater protection from bad weather			0.633			
Pro-consumption						
Q16_2: I intend to purchase foods produced using intensive production sytems				0.871		
Q16_1: I purchase foods produced using intensive production systems				0.831		
Q16_3: I would consider purchasing foods produced by intensive production systems				0.769		
Attitude						
Q7_1: unpleasant/ pleasant					0.750	
Q7_2: bad/ good					0.710	
Q7_6: unethical/ ethical					0.670	
Q7_5: unsafe/ safe					0.603	
Q7_3: worthless/ valuable					0.599	
Q7_4: useless/ useful					0.520	
Treatment						
Q13_15: Using antibiotics and medicines to treat sick birds						-0.653
Q13_8: The preventative use of veterinary drugs including antibiotics						-0.582
Q13_16: The use of vaccination						-0.554
Cronbach's alpha	**0.925**	**0.927**	**0.865**	**0.897**	**0.880**	**0.708**

	10	11	12	13	14	15	16
Medicine concerns							
Q10_7: Use of other veterinary medicines to treat animal diseases	0.798						
Q10_6: Use of vaccinations to prevent animal diseases	0.773						
Q10_8: Use of probiotics to prevent animal diseases	0.639						
Q10_5: Use of antibiotics in production animals to treat diseases	0.624						
Governance							
Q6_5: Animal health authorities		-0.435					
Anti-consumption							
Q16_8: I think of myself as someone who is concerned about intensive systems			0.736				
Q16_9: I think of myself as someone who is concerned about FAW			0.729				
Q16_7: I feel that I have an ethical obligation to avoid animal products systems			0.703				
Q16_5: I avoid purchasing foods from intensive production systems			0.566				
Q16_4: I plan to reduce my consumption of foods from intensive systems			0.534				
Perceived risk							
Q9_2: Increased incidence of animal diseases				0.770			
Q9_5: Reduced human food safety				0.666			
Q9_7: Reduced nutritional quality of human food				0.657			
Q9_3: Slower treatment of animal diseases				0.652			
Q9_6: Reduced human food quality				0.649			
Q9_4: Compromised animal welfare monitoring				0.637			
Q9_8: Negative effects on consumer health				0.625			
Q9_1: Increased animal stress				0.594			
Non-risks							
Q9_15: Less protection from bad weather					0.602		
Q9_14: Less protection from predators					0.599		
Q9_13: A non-cost efficient production method					0.559		
Q9_10: Decreased availability of animal based foods					0.497		
Q9_9: More expensive food of animal origin					0.441		
Feed and light							
Q13_2: Adjustments to feed composition						-0.760	
Q13_1: Adjustments in the quantity of feed available						-0.708	
Q13_3: Changes in the amount and time of light provision						-0.682	
Media							
Q6_19: Social media							0.533
Q6_20: Traditional media							0.516
Cronbach's alpha	0.854	*	0.864	0.937	0.883	0.820	0.622

Table 0.8 EFA results for the broiler survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.945 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5995)=75035.232$, p=0.000, indicating that there was sufficient correlation in the data to proceed with factor analysis.

**Cronbach's alpha was not calculated for scales with only 1 item*

Layers

	1	2	3	4
Lack of benefits				
Q8_6: Improved human food quality	0.835			
Q8_1: Reduced animal stress	0.832			
Q8_7: Improved nutritional quality of human food	0.814			
Q8_8: Improved consumer health	0.810			
Q8_2: Reduced incidence of animal diseases	0.795			
Q8_21: Increased consumer trust in the food they buy	0.791			
Q8_5: Improved human food safety	0.788			
Q8_22: A natural production method	0.774			
Q8_4: Improved animal welfare monitoring	0.771			
Q8_3: Faster treatment of animal diseases	0.696			
Q8_19: Benefits to your family	0.688			
Q8_12: A more sustainable approach to animal production	0.680			
Q8_18: Benefits to you personally	0.669			
Q8_20: Benefits to consumers	0.618			
Q8_11: Benefits to the environment e.g. reduced CO2 footprint	0.615			
Q8_16: More professionally run livestock farms	0.491			
Q8_17: Benefits to agriculture	0.415			
Concern				
Q10_13: Impacts of animal diseases on food safety		0.855		
Q10_12: Impacts of animal diseases on food quality		0.835		
Q10_10: Impacts of animal diseases on human health		0.815		
Q10_11: Impacts of animal diseases on animal welfare		0.756		
Q10_16: Animal production diseases in general		0.640		
Q10_14: Impact of animal diseases on the environment		0.601		
Q10_9: Antibiotic residues in food		0.564		
Q10_15: Antibiotic resistance as a result of the use of antibiotics in animals		0.537		
Q10_3: Use of antibiotics in production animals as a growth promoter		0.491		
Non-risks				
Q9_9: More expensive food of animal origin			-0.669	
Q9_15: Less protection from bad weather			-0.654	
Q9_10: Decreased availability of animal based foods			-0.647	
Q9_14: Less protection from predators			-0.583	
Q9_13: A non-cost efficient production method			-0.534	
Distrust				
Q6_8: Animal feed manufacturers				-0.841
Q6_10: Farmers				-0.817
Q6_11: Animal transporters				-0.808
Q6_14: Food manufacturers				-0.805
Q6_15: Food retailers				-0.796
Q6_7: Animal breeding companies				-0.757
Q6_12: Slaughterhouses				-0.736
Q6_9: Animal housing manufacturers				-0.698
Q6_6: Veterinary medicine producers				-0.588
Q6_13: Quality assurance schemes				-0.470
Q6_3: National government				-0.410
Cronbach's alpha	0.931	0.936	0.889	0.944

	5	6	7	8	9	10	11
Medicine concerns							
Q10_6: Use of vaccinations to prevent animal diseases	-0.862						
Q10_7: Use of other veterinary medicines to treat animal diseases	-0.815						
Q10_8: Use of probiotics to prevent animal diseases	-0.692						
Q10_5: Use of antibiotics in production animals to treat diseases	-0.684						
Q10_4: Use of antibiotics in production animals to prevent diseases	-0.485						
Perceived benefit							
Q8_13: A more cost efficient production method		0.723					
Q8_10: Increased availability of animal based products		0.650					
Q8_14: Greater protection from predators		0.650					
Q8_9: Cheaper food of animal origin		0.646					
Q8_15: Greater protection from bad weather		0.628					
Anti-consumption							
Q16_8: I think of myself as someone who is concerned about intensive production systems			-0.732				
Q16_4: I plan to reduce my consumption of foods from intensive production systems			-0.653				
Q16_5: I avoid purchasing foods from intensive production systems			-0.648				
Q16_9: I think of myself as someone who is concerned about farm animal welfare			-0.639				
Q16_7: I feel that I have an ethical obligation to avoid products from intensive systems			-0.576				
Personal risk							
Q9_20: Risks to consumers					-0.886		
Q9_19: Risks to your family					-0.876		
Q9_18: Risks to you personally					-0.843		
Q9_21: Decreased consumer trust in the food they buy					-0.704		
Q9_17: Risks to agriculture					-0.541		
Q9_8: Negative effects on consumer health					-0.461		
Q9_22: An unnatural production method					-0.447		
Attitude							
Q7_3: worthless/ valuable						0.686	
Q7_2: bad/ good						0.647	
Q7_1: unpleasant/ pleasant						0.640	
Q7_6: unethical/ ethical						0.582	
Q7_5: unsafe/ safe						0.534	
Q7_4: useless/ useful						0.532	
Pro-consumption							
Q16_2: I intend to purchase foods produced using intensive production systems							-0.780
Q16_1: I purchase foods produced using intensive production systems							-0.755
Q16_3: I would consider purchasing foods produced by intensive production systems							-0.754
Cronbach's alpha	0.882	0.864	0.854	*	0.933	0.867	0.903

	12	13	14	15	16	17
Perceived risk						
Q9_4: Compromised animal welfare monitoring	0.606					
Q9_2: Increased incidence of animal diseases	0.602					
Q9_3: Slower treatment of animal diseases	0.572					
Q9_5: Reduced human food safety	0.499					
Q9_1: Increased animal stress	0.452					
Q9_6: Reduced human food quality	0.421					
Feed and light						
Q13_1: Adjustments to the quantity of feed available		0.775				
Q13_2: Adjustments to feed composition		0.703				
Q13_3: Changes in the amount and time of light provision		0.557				
Treatment						
Q13_16: The use of vaccination			0.621			
Q13_15: Using antibiotics to treat sick birds			0.589			
Q13_8: The preventative use of veterinary drugs including antibiotics			0.526			
Q13_9: Use of feed supplements e.g. probiotics			0.525			
Media						
Q6_20: Traditional media				0.577		
Q6_19: Social media				0.546		
Q6_16: Consumer organisations				0.484		
Proactive						
Q13_11: Providing materials and an environment where birds can perform natural behaviours					-0.838	
Q13_12: Improvements in housing design					-0.783	
Q13_6: Enhanced hygiene and disease prevention measures					-0.773	
Q13_14: Reducing the number of birds in a given area					-0.761	
Q13_5: Enhanced maintenance of the quality of the bedding					-0.699	
Q13_7: Housing that allows birds greater freedom to move					-0.686	
Q13_13: Housing that protects the birds from adverse natural conditions					-0.650	
Q13_10: Providing farmers with a price premium that encourages enhanced bird health					-0.542	
Q13_4: Enhanced control of air movement in chicken houses					-0.521	
Cronbach's alpha	0.906	0.775	0.733	0.668	0.929	*

EFA results for the layers survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.947 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5995) = 74906.485$, $p = 0.000$, indicating that there was sufficient correlation in the data to proceed with factor analysis.

**These factors had no items with factor loadings greater than 0.4 therefore Cronbach's alpha values were not calculated*

Pigs

	4	5	6	7	8
Distrust					
Q6_7: Animal breeding companies	0.868				
Q6_8: Animal feed producers	0.812				
Q6_12: Slaughterhouses	0.797				
Q6_14: Food manufacturers	0.791				
Q6_10: Farmers	0.784				
Q6_11: Animal transporters	0.729				
Q6_9: Animal housing manufacturers	0.696				
Q6_15: Food retailers	0.655				
Q6_6: Veterinary medicine producers	0.639				
Perceived risk					
Q9_6: Reduced human food quality		0.781			
Q9_20: Risks to consumers		0.777			
Q9_19: Risks to your family		0.768			
Q9_18: Risks to you personally		0.754			
Q9_7: Reduced nutritional quality of human food		0.742			
Q9_21: Decreased consumer trust in the food they buy		0.735			
Q9_8: Negative effects on consumer health		0.735			
Q9_5: Reduced human food safety		0.709			
Q9_2: Increased incidence of animal diseases		0.600			
Q9_11: Risks to the environment		0.598			
Q9_12: An unsustainable approach to animal production		0.594			
Q9_17: Risks to agriculture		0.593			
Q9_4: Compromised animal welfare monitoring		0.585			
Q9_1: Increased animal stress		0.575			
Q9_3: Slower treatment of animal diseases		0.560			
Q9_22: An unnatural production method		0.553			
Q9_16: Less professionally run livestock farms		0.430			
Perceived benefit					
Q8_9: Cheaper food of animal origin			0.672		
Q8_13: A more cost efficient production method			0.595		
Q8_10: Increased availability of animal based products			0.572		
Q8_14: Greater protection from predators			0.546		
Q8_15: Greater protection from bad weather			0.516		
Pro-consumption					
Q16_2: I intend to purchase foods produced using intensive production systems				0.804	
Q16_1: I purchase foods produced using intensive production systems				0.785	
Q16_3: I would consider purchasing foods produced by intensive production systems				0.743	
Anti-consumption					
Q16_8: I think of myself as someone who is concerned about intensive systems					0.789
Q16_9: I think of myself as someone who is concerned about farm animal welfare					0.691
Q16_7: I feel that I have an ethical obligation to avoid animal products from intensive systems					0.633
Q16_5: I avoid purchasing foods from intensive production systems					0.595
Q16_4: I plan to reduce my consumption of foods from intensive production systems					0.546
Cronbach's alpha	0.935	0.962	0.846	0.894	0.844

	9	10	11	12	13	14	15
Medicine concerns							
Q10_7: Use of other veterinary medicines to treat animal diseases	-0.827						
Q10_6: Use of vaccinations to prevent animal diseases	-0.799						
Q10_5: Use of antibiotics in production animals to treat diseases	-0.691						
Q10_8: Use of probiotics to prevent animal diseases	-0.687						
Q10_4: Use of antibiotics in production animals to prevent diseases	-0.471						
Independent assurance							
Q6_20: Traditional media		-0.669					
Q6_16: Consumer organisations		-0.608					
Q6_1: Animal welfare organisations		-0.573					
Q6_2: European commission		-0.560					
Q6_3: National government		-0.471					
Q6_19: Social media		-0.434					
Q6_13: Quality assurance schemes		-0.428					
Q6_5: Animal health authorities		-0.401					
Treatment							
Q13_3: The preventive use of veterinary drugs including antibiotics			-0.675				
Q13_2: Using medicines and antibiotics to treat sick picks			-0.638				
Q13_5: The use of vaccination			-0.605				
Q13_4: Use of feed supplements e.g. probiotics			-0.578				
Attitude							
Q7_2: bad/ good						0.649	
Q7_5: unsafe/ safe						0.644	
Q7_1: unpleasant/pleasant						0.622	
Q7_3: worthless/valuable						0.621	
Q7_6: unethical/ ethical						0.619	
Q7_4: useless/ useful						0.455	
Non-risks							
Q9_14: Less protection from predators							-0.666
Q9_15: Less protection from bad weather							-0.660
Q9_10: Decreased availability of animal based foods							-0.613
Q9_13: A non-cost efficient production method							-0.578
Q9_9: More expensive food of animal origin							-0.562
Cronbach's alpha	0.887	0.833	0.751	*	*	0.878	0.862

EFA results for the pigs survey

EFA was conducted using principle factor extraction and a direct-oblimin rotation. A KMO of 0.946 and Bartlett's test of sphericity led to the rejection of the null hypothesis ($\chi^2(5886) = 71867.560$, $p=0.000$, indicating that there was sufficient correlation in the data to proceed with factor analysis.

**These factors had no items with factor loadings greater than 0.4 therefore Cronbach's alpha values were not calculated*