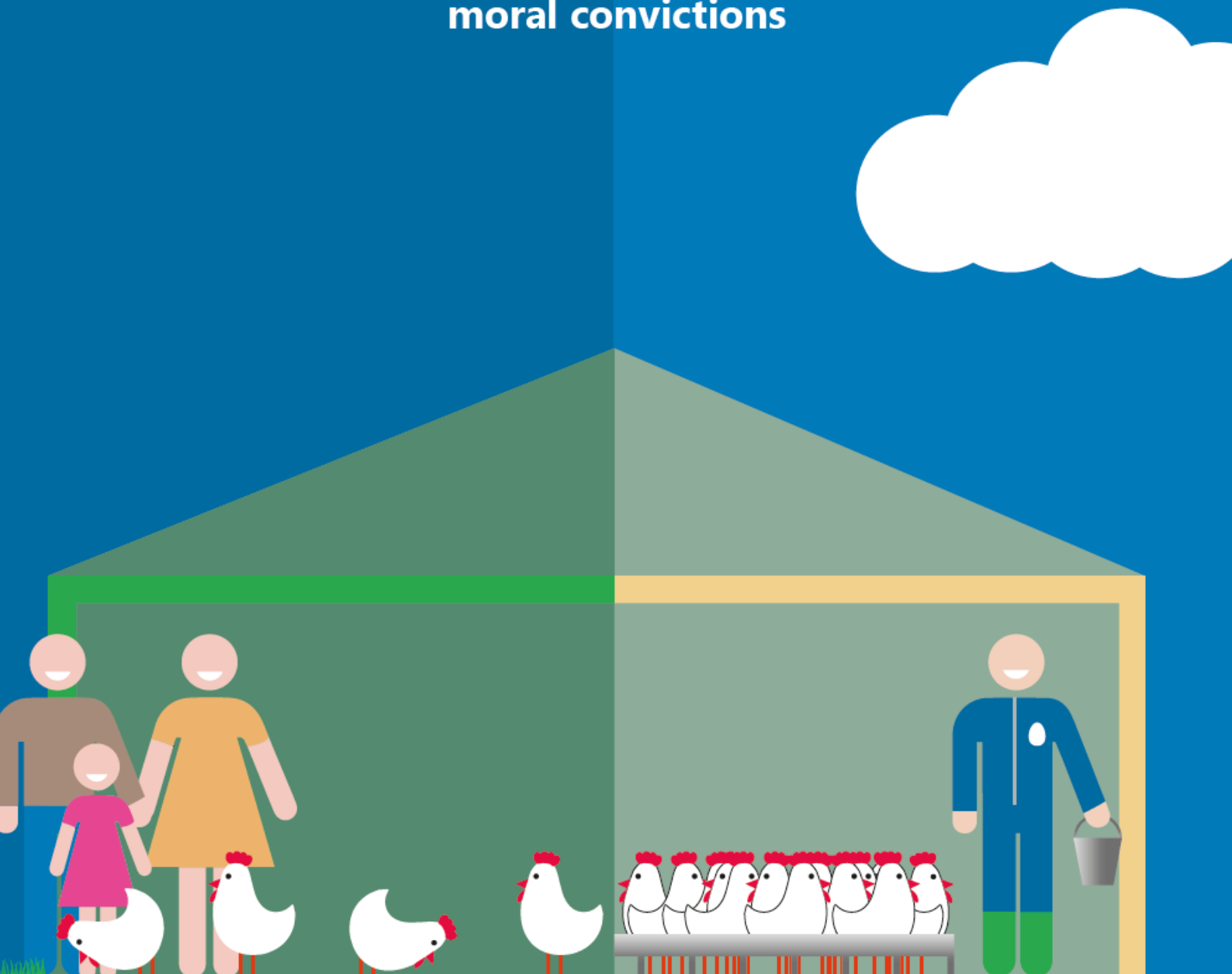


Conflicts between chicken welfare and public health risks in poultry husbandry

Stakeholders' perceptions and moral convictions



Mariska van Asselt

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Conflicts between chicken welfare and public health risks in poultry husbandry

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Mariska van Asselt

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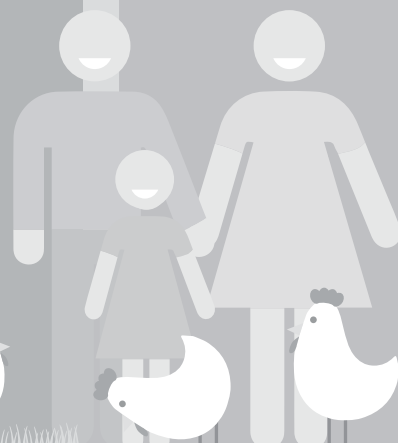
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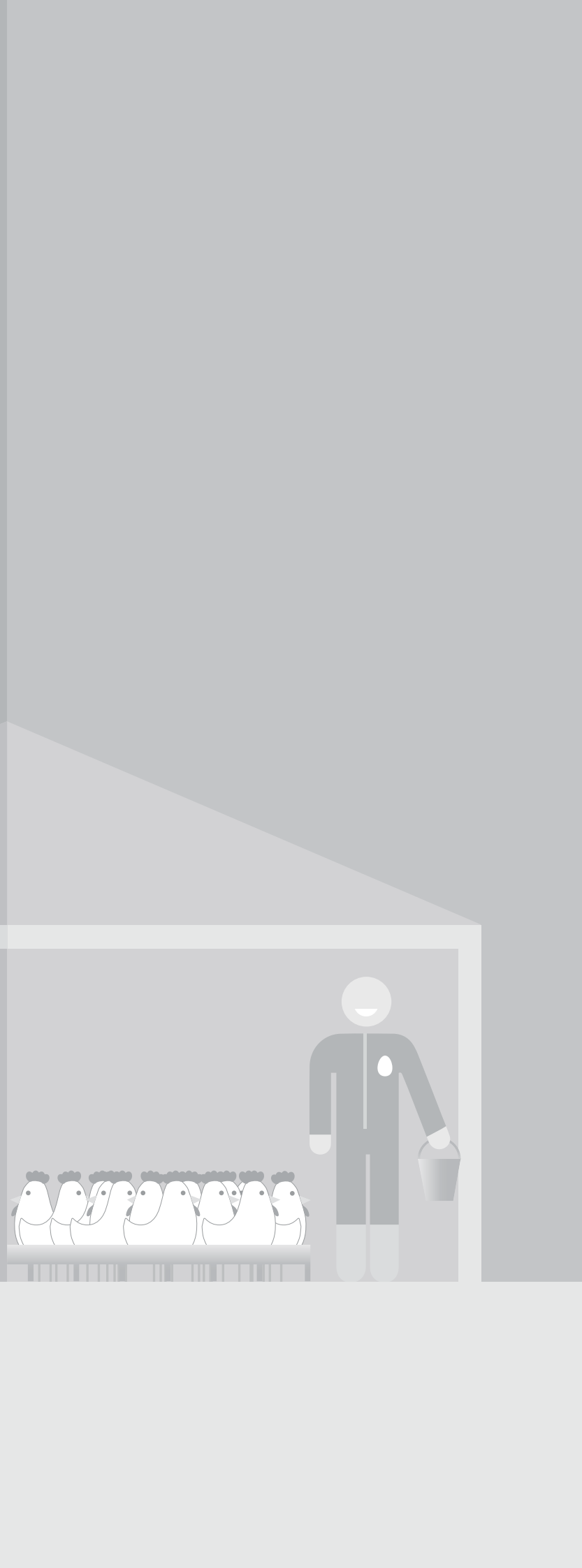
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General introduction

1





BACKGROUND

In order to ensure cheap and ample food, after World War II livestock husbandry systems were developed into increasingly intensive production systems with a focus on high production rates (Rollin, 2004). Farm animals such as poultry were no longer kept in backyard flocks on mixed family farms, but were kept on specialised farms in confined industrialised systems, such as battery cages for laying hens (Golden et al., 2012; Rollin, 2004; Spoelstra et al., 2013). Due to specialisation, intensification and the use of new technologies, the number of animals per farm and production rates increased, while the number of farms decreased (Rollin, 2004; Spoelstra et al., 2013). New production practices, such as preventive antibiotic use, beak-trimming in laying hens, high stocking densities, and battery cages for laying hens, became mainstream and made it possible to produce in an economically efficient manner. Animals were predominantly valued for their instrumental value, namely their productivity.

As a result of intensification, fewer people were involved in livestock production and the general public was often no longer aware of the production practices used in intensive animal husbandry. As early as the 1960s, the publication of Ruth Harrison's book, 'Animal machines: the new factory farming industry' (1964), made the general public aware of intensive management practices and the welfare problems of animals kept in those intensive systems. The book provoked intense public concerns about farm animal welfare in Europe (Van de Weerd et al., 2008). Protests by activists and animal welfare organisations brought home to governments that they had to address public concerns regarding animal welfare. In 1965, the Brambell committee reported the basic ethical and biological principles for farm animals (Brambell, 1965), which formed the bases for the formulation of the Five Freedoms in 1979 (Farm Animal Welfare Council, 2009). These developments have resulted in legislation to protect farm animal welfare at national and EU level. For example, in 1998, the Council Directive 98/58/EC concerning the protection of animals kept for farming purposes came into force in the EU (Council of the European Union, 1998). Meanwhile, other practices in society involving animals, such as keeping pets and livestock as a hobby, grew in importance, which gave rise to different human-animal relationships (Rollin, 2004). Animals were no longer merely valued for their instrumental value, but were also considered to have relational and intrinsic value (Cohen et al., 2009). These

developments have changed people's moral convictions regarding the treatment of animals (Cohen et al., 2009; Rollin, 2004, 2007).

To comply with these changed moral convictions regarding animals, but also forced by new legislation in the European Union, such as the ban on conventional battery cages for laying hens since January 2012 (Council of the European Union, 1999), new poultry husbandry systems have been introduced. The focus is no longer predominantly on production output, but also on chicken welfare. These alternative husbandry systems, such as non-cage systems, free-range or organic systems, are potentially beneficial to chicken welfare, because they offer more space and opportunities to express natural behaviour (Freire et al., 2013; Rodenburg et al., 2012; Shimmura et al., 2010).

However, the introduction of these new systems has brought different problems to the fore, such as other chicken diseases and other public health and food safety hazards. For example, outdoor systems are associated with higher public health risks for certain hazards, such as *Campylobacter*, avian influenza, and dioxin (Kijlstra et al., 2009). For broiler chickens, an older age at slaughter and outdoor access are risk factors for increased *Campylobacter* prevalence in broilers and on broiler meat (Backer et al., 2011; Bouwknecht et al., 2004; EFSA, 2011; Heuer et al., 2001; Rodenburg et al., 2004; Rosenquist et al., 2013; Sommer et al., 2013). Outdoor access for laying hens increases the risk of introducing avian influenza into flocks (EFSA Panel on Animal Health and Welfare et al., 2017; Gonzales et al., 2013; Koch et al., 2006) and increased dioxin levels in eggs (e.g. EFSA, 2012; Kijlstra et al., 2007; Pussemier et al., 2004; Schoeters et al., 2006; Van Overmeire et al., 2006; Van Overmeire et al., 2009). These examples show that adaptations in husbandry systems in order to improve chicken welfare, such as providing outdoor access to chickens, may result in increased risks to public health and food safety for certain hazards.

Societal debates on how to keep chickens are ongoing. The general public has expressed concerns regarding chicken welfare (Eurobarometer, 2005) and in reaction to this, husbandry systems have been developed to improve chicken welfare. However, these new systems have been developed without giving sufficient thought to public opinion. An example is the development of the enriched colony cages systems for laying hens. Although chicken welfare in these colony cages is better than in the battery cage systems (Appleby et al., 2002; Freire et al., 2013), these systems do not adequately address societal criticism regarding keeping chickens in cages (Weary et

al., 2016). Moreover, the general public has expressed concerns about the public health risks of livestock production and the safety of food (Bergstra et al., 2017; Hansen et al., 2003). In outdoor husbandry systems, the interests of humans, such as public health are not always in harmony with the interests of chickens, mainly chicken welfare. The general public is not always aware of the increased risks of certain hazards associated with outdoor husbandry systems (Kijlstra et al., 2009). These kinds of issues may go unnoticed for some time, until an animal welfare or public health issue comes to the surface and draws societal attention. For example, the reaction to the mass culling of healthy animals during a disease outbreak, like during the outbreak of the highly pathogenic avian influenza in 2003 in the Netherlands, showed that the general public no longer agreed with the culling of animals for predominantly economic reasons, which led to intense public debate regarding the treatment and keeping of animals (Cohen et al., 2009). Therefore, public opinions on hen husbandry and related dilemmas should be considered to maintain and increase societal support for poultry husbandry.

In their role as consumers, members of the public express their opinions on animal husbandry by increasingly purchasing organic and welfare-plus animal products. Moreover, the general public is currently influencing the debate on poultry husbandry by engaging in societal debates and through NGOs and political voting, for example in the Netherlands by voting for the ‘Animal Party’ (Partij voor de dieren). This implies that for responsible innovation of poultry husbandry systems, interaction is needed between society and the poultry sector in order to gain societal support and to retain a licence to produce in the future (Boogaard et al., 2011). Therefore, it would be valuable to know how those stakeholder groups perceive different poultry husbandry systems, hen welfare, public health risks, and how they balance the interests of chickens against those of human, when faced by a conflict between chicken welfare and public health risks.

PERCEPTIONS

Different people or groups of people may have differing perceptions of poultry husbandry systems and aspects such as animal welfare and public health risks, because perceptions depend on people’s knowledge, interests, and moral convictions

(Knight et al., 2008; Te Velde et al., 2002). Citizens perceive animal welfare differently from professionals working in animal husbandry, such as farmers and veterinarians. Professionals tend to focus on health and production indicators, while citizens focus on possibilities to express natural behaviour and lead natural lives (Bracke et al., 2005; Fraser et al., 1997; Te Velde et al., 2002; Vanhonacker et al., 2008). Likewise, citizens perceive public health and food safety risks differently from experts on public health (Hansen et al., 2003; Jensen et al., 2005). Non-experts assess risks more intuitively than experts do and take other aspects such as feelings and trust into account (Finucane et al., 2000; Slovic et al., 2007). These different perceptions of citizens and professionals working in poultry husbandry regarding animal welfare and public health risks will influence the perceptions of poultry husbandry systems in general, but will also affect the way in which chicken welfare is weighed against public health risks.

MORAL CONVICTIONS

In a society, people share a common morality, which has been constructed in that society over time and is shaped by knowledge and many social, religious, cultural, and technological aspects (Beauchamp et al., 2009; Cohen et al., 2009). The common morality is based on plural moral convictions explained by deontological and consequentialistic theories (Mepham, 2000b). Consequently, moral judgments of a dilemma involve multiple moral convictions regarding stakeholder groups, such as, farmers, citizens, and consumers of chicken products, and chickens. Relevant moral convictions from different ethical approaches are: autonomy, justice, wellbeing, and not harm (Beauchamp et al., 2009; Mepham, 2000a). Furthermore, the way in which people view the hierarchical position of humans compared with animals has been shown to play a role in dilemmas related to human-animal issues (Cohen et al., 2012). In order to form a judgment in the dilemma of improving chicken welfare or reducing public health risks, the interests of humans and chickens will be weighed against each other, and one will have to decide when convictions regarding either humans or chickens are sufficiently important to outweigh the others. Although in a society people share moral convictions, in practice people may approach a dilemma differently, because for different individuals, different convictions may weigh more heavily (Childress et al., 2002; Cohen et al., 2009; Cohen et al., 2012). For example, a

farmer may perceive his own autonomy to choose a certain husbandry system as more important than the behavioural freedom of chickens and providing chickens with outdoor access. Moreover, morality is continually changing, as are our convictions regarding keeping animals (Cohen et al., 2009). For example, the moral convictions regarding the value of animals has changed from a predominantly instrumental value to a relational and intrinsic value (Cohen et al., 2009).

Diverse issues such as animal welfare and public health risks have been assessed in various poultry husbandry systems (e.g. Bokma-Bakker et al., 2006; Holt et al., 2011; Lay Jr et al., 2011; Mollenhorst et al., 2006; Rodenburg et al., 2012; Rodenburg et al., 2008; Shimmura et al., 2010). The perceptions of diverse stakeholder groups regarding animal welfare (Bracke et al., 2005; De Jonge et al., 2013; Te Velde et al., 2002; Tuyttens et al., 2014; Vanhonacker et al., 2012; Vanhonacker et al., 2008) and public health risks (Fife-Schaw et al., 1996; Frewer et al., 1994; Hansen et al., 2003; Jensen et al., 2005) have also been studied. However, perceptions of chicken welfare and public health risks have not been studied in an integrated way in poultry husbandry. The dilemma of improving chicken welfare or reducing public health risks, as well as the moral convictions involved, have also not been the subject of integrated research.

OBJECTIVES

The main objective of this thesis was to study the conflict between chicken welfare, and public health and food safety risks. To do so, perceptions of three stakeholder groups – citizens, poultry farmers, and poultry veterinarians – were studied regarding hen husbandry systems, hen welfare, public health and food safety risks, moral convictions and opinions on the dilemma. After analyses of those results, we also found it valuable to study the views of citizens on an innovative laying hen farm, which considers aspects of hen welfare and public health, in real-life conditions. Therefore, a farm visit with citizens was done. Based on the results, implications for the development future poultry husbandry systems are formulated.

The objectives of this thesis were:

- 1) To determine the preferred hen husbandry system and its relation to the importance of husbandry issues for citizens, poultry farmers, and poultry veterinarians.
- 2) To determine the perceptions of citizens, poultry farmers, and poultry veterinarians regarding hen welfare in four different hen husbandry systems and valuation of welfare aspects.
- 3) To determine risk perceptions of citizens, poultry farmers, and poultry veterinarians regarding food safety and public health hazards in poultry husbandry systems, and factors explaining these risk perceptions.
- 4) To gain insight into the judgment of citizens and poultry farmers regarding three cases representing the dilemma of choosing between improved poultry welfare and reduced public health risks, and the moral convictions involved.
- 5) To study the views of citizens on a laying hen farm, which considers aspects of hen welfare and public health, in real-life conditions.

Outline of this thesis

Chapters 2, 3, 4 and 5 are based on a survey by means of an online questionnaire filled in by citizens, poultry farmers, and poultry veterinarians. The quantitative questionnaire was developed based on a literature review and input from a consulting group. The questionnaire included questions about preferred husbandry systems and the importance of poultry husbandry issues; knowledge of poultry husbandry; perceptions of chicken welfare in four husbandry systems and chicken welfare aspects. Also, perceptions of public health risks in four husbandry systems and factors of risk perception were asked. Moreover, questions were asked about moral convictions relating to the dilemma, three cases representing the dilemma of improving chicken welfare or reducing public health risks, and moral arguments relevant to the dilemma. The last part of the questionnaire regarded questions about socio-demographic characteristics. Chapter 2 describes the preferred hen husbandry systems for citizens, poultry farmers, and poultry veterinarians. Moreover, these stakeholders' views on the importance of 10 issues of hen husbandry are presented, as well as how they relate to the preferred system. In Chapter 3, the perceptions of citizens, poultry farmers, and poultry veterinarians regarding laying hen welfare in four different husbandry

systems are described. In addition, their perceptions of aspects of hen welfare and the relation between these aspects and the perceptions of hen welfare in four systems are presented. Chapter 4 presents the results of risk perceptions of citizens, poultry farmers, and poultry veterinarians regarding public health risks and food safety risks in four poultry husbandry systems, as well as factors that explain these risk perceptions. Chapter 5 presents the judgments of citizens and poultry farmers regarding three cases illustrating the dilemma of improving poultry welfare or reducing public health risks, and relevant moral conviction and arguments. The three cases involved *Campylobacter* contamination in broilers, avian influenza infection of laying hens, and increased dioxin levels in eggs. Moreover, the relationship between judgments, arguments and convictions, and the differences between citizens and poultry farmers are analysed. After analyses of the questionnaire and a further literature review, we also found it valuable to study the views of citizens on an innovative laying hen farm in real-life conditions. Therefore, during a farm visit, citizens filled in a questionnaire about the hen husbandry system, hen welfare, public health risks, and some specific farm and chicken aspects such as naturalness. Chapter 6 reports the results of this farm visit with citizens. Chapter 7, the general discussion, further discusses the results of the survey and farm visit, and their implications for future poultry husbandry.

REFERENCES

- Appleby, M. C., Walker, A. W., Nicol, C. J., Lindberg, A. C., Freire, R., Hughes, B. O., & Elson, H. A. (2002). Development of furnished cages for laying hens. *British Poultry Science*, 43(4), 489-500. doi:10.1080/0007166022000004390
- Backer, J., Bergevoet, R., Fischer, E., Nodelijk, G., Bosman, K., Saatkamp, H., & Roermund, H. v. (2011). *Control of highly pathogenic avian influenza: epidemiological and economic aspects*. Retrieved from Den Haag: <http://library.wur.nl/WebQuery/wurpubs/fulltext/173727>
- Beauchamp, T. L., & Childress, J. F. (2009). *Principles of biomedical ethics* (6th ed.). New York / Oxford: Oxford University Press.
- Bergstra, T. J., Hogeveen, H., Erno Kuiper, W., Oude Lansink, A. G. J. M., & Stassen, E. N. (2017). Attitudes of Dutch Citizens toward Sow Husbandry with Regard to Animals, Humans, and the Environment. *Anthrozoös*, 30(2), 195-211. doi:10.1080/08927936.2017.1310985
- Bokma-Bakker, M. H., Van Hierden, Y. M., Houwers, H. J. W., Rodenburg, T. B., & Kijlstra, A. (2006). *Animal friendly housing systems and food safety. A study on opportunities, threats and solutions*. Retrieved from
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, 5(9), 1458-1466. doi:10.1017/S1751731111000371
- Bouwknegt, M., Van De Giessen, A. W., Dam-Deisz, W. D. C., Havelaar, A. H., Nagelkerke, N. J. D., & Henken, A. M. (2004). Risk factors for the presence of *Campylobacter* spp. in Dutch broiler flocks. *Preventive Veterinary Medicine*, 62(1), 35-49. doi:10.1016/j.prevetmed.2003.09.003
- Bracke, M. B. M., de Greef, K. H., & Hopster, H. (2005). Qualitative stakeholder analysis for the development of sustainable monitoring systems for farm animal welfare. *Journal of Agricultural and Environmental Ethics*, 18(1), 27-56. doi:10.1007/s10806-004-3085-2
- Brambell, R. (1965). *Report of the technical committee to enquire into the welfare of animals kept under intensive livestock husbandry systems*. Retrieved from London:
- Childress, J. F., Faden, R. R., Gaare, R. D., Gostin, L. O., Kahn, J., Bonnie, R. J., . . . Nieburg, P. (2002). Public health ethics: Mapping the terrain. *Journal of Law, Medicine and Ethics*, 30(2), 170-178.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2009). Fundamental Moral Attitudes to Animals and Their Role in Judgment: An Empirical Model to Describe Fundamental Moral Attitudes to Animals and Their Role in Judgment on the Culling of Healthy Animals During an Animal Disease Epidemic. *Journal of Agricultural and Environmental Ethics*, 22(4), 341-359. doi:10.1007/s10806-009-9157-6
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, 25(3), 353-367. doi:10.2752/175303712x13403555186334
- Council of the European Union. (1998). Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes *Official Journal of the European Communities*, L 221 0023 - 0027.
- Council of the European Union. (1999). Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens. *Official Journal of the European Communities*, L 203, 53-57.
- De Jonge, J., & Van Trijp, J. C. M. (2013). The impact of broiler production system practices on consumer perceptions of animal welfare. *Poultry Science*, 92(12), 3080-3095. doi:10.3382/ps.2013-03334
- EFSA. (2011). Scientific Opinion on *Campylobacter* in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain. *EFSA Journal*, 9(4), 2105. doi:10.2903/j.efsa.2011.2105

- EFSA. (2012). Update of the monitoring of levels of dioxins and PCBs in food and feed. *EFSA Journal*, 10(7), 82. doi:10.2903/j.efsa.2012.2832
- EFSA Panel on Animal Health and Welfare, More, S., Bicoût, D., Bøtner, A., Butterworth, A., Calistri, P., . . . Stegeman, J. A. (2017). Avian influenza. *EFSA Journal*, 15(10), 4991. doi:10.2903/j.efsa.2017.4991
- Eurobarometer. (2005). *Attitudes of consumers towards the welfare of farmed animals* (229). Brussels, Belgium. Retrieved from: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_229_en.pdf
- Farm Animal Welfare Council. (2009) *Farm Animal Welfare in Great Britain: Past, Present and Future*; FAWC. London, UK. Retrieved from: <https://www.gov.uk/government/publications/fawc-report-on-farm-animal-welfare-in-great-britain-past-present-and-future>
- Fife-Schaw, C., & Rowe, G. (1996). Public Perceptions of Everyday Food Hazards: A Psychometric Study. *Risk Analysis*, 16(4), 487-500. doi:10.1111/j.1539-6924.1996.tb01095.x
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13(1), 1-17.
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6(3), 187-205.
- Freire, R., & Cowling, A. (2013). The welfare of laying hens in conventional cages and alternative systems: First steps towards a quantitative comparison. *Animal Welfare*, 22(1), 57-65. doi:10.7120/09627286.22.1.057
- Frewer, L. J., Shepherd, R., & Sparks, P. (1994). Biotechnology and food production: knowledge and perceived risk. *British Food Journal*, 96(9), 26-32.
- Golden, J. B., & Arbona, D. V. (2012). Intensive versus extensive management systems in commercial egg production. *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 7, 1-12. doi:10.1079/PAVSNR20127050
- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, 7(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, 41(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Harrison, R. (1964). *Animal machines: the new factory farming industry*. London: Vincent Stuart Ltd.
- Heuer, O. E., Pedersen, K., Andersen, J., & Madsen, M. (2001). Prevalence and antimicrobial susceptibility of thermophilic *Campylobacter* in organic and conventional broiler flocks. *Letters in Applied Microbiology*, 33(4), 269-274. doi:10.1046/j.1472-765X.2001.00994.x
- Holt, P. S., Davies, R. H., Dewulf, J., Gast, R. K., Huwe, J. K., Jones, D. R., . . . Willian, K. R. (2011). The impact of different housing systems on egg safety and quality. *Poultry Science*, 90(1), 251-262. doi:10.3382/ps.2010-00794
- Jensen, K. K., Lassen, J., Robinson, P., & Sandøe, P. (2005). Lay and expert perceptions of zoonotic risks: understanding conflicting perspectives in the light of moral theory. *International Journal of Food Microbiology*, 99(3), 245-255. doi:10.1016/j.ijfoodmicro.2004.09.004
- Kijlstra, A., Meerburg, B. G., & Bos, A. P. (2009). Food Safety in Free-Range and Organic Livestock Systems: Risk Management and Responsibility. *Journal of Food Protection*, 72(12), 2629-2637.
- Kijlstra, A., Traag, W. A., & Hoogenboom, L. A. P. (2007). Effect of Flock Size on Dioxin Levels in Eggs from Chickens Kept Outside. *Poultry Science*, 86(9), 2042-2048.
- Knight, S., & Barnett, L. (2008). Justifying attitudes toward animal use: A qualitative study of people's views and beliefs. *Anthrozoös*, 21(1), 31-42.

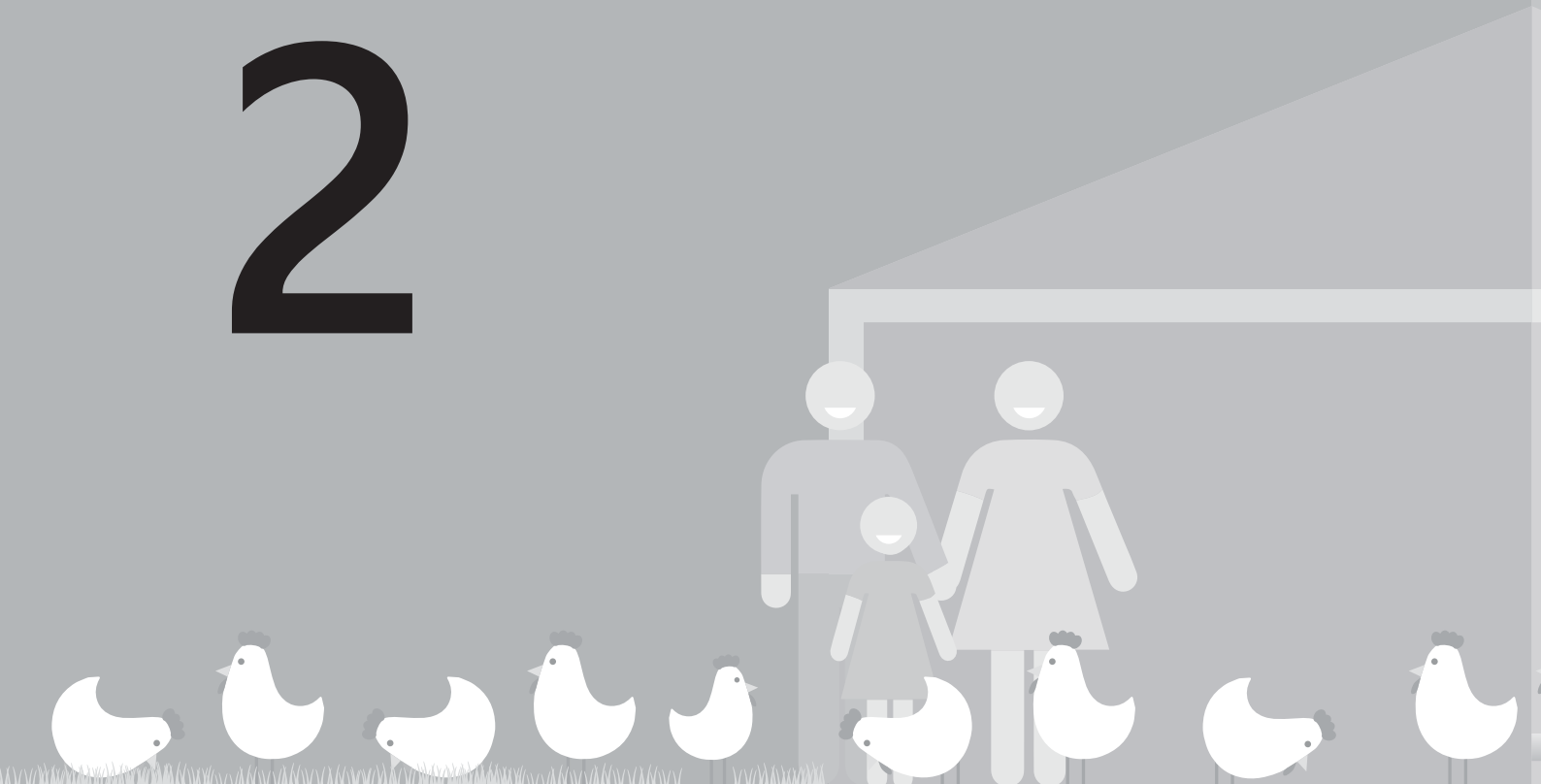
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 179-194. doi:10.1016/s1573-5214(06)80021-7
- Lay Jr, D. C., Fulton, R. M., Hester, P. Y., Karcher, D. M., Kjaer, J. B., Mench, J. A., . . . Porter, R. E. (2011). Hen welfare in different housing systems. *Poultry Science*, 90(1), 278-294. doi:10.3382/ps.2010-00962
- Mepham, B. (2000a). A framework for the ethical analysis of novel foods: The ethical matrix. *Journal of Agricultural and Environmental Ethics*, 12(2), 165-176.
- Mepham, B. (2000b). "Würde der kreatur" and the common morality. *Journal of Agricultural and Environmental Ethics*, 13(1-2), 65-78.
- Mollenhorst, H., Berentsen, P. B., & De Boer, I. J. (2006). On-farm quantification of sustainability indicators: an application to egg production systems. *British Poultry Science*, 47(4), 405-417. doi:10.1080/00071660600829282
- Pussemier, L., Mohimont, L., Huyghebaert, A., & Goeyens, L. (2004). Enhanced levels of dioxins in eggs from free range hens; a fast evaluation approach. *Talanta*, 63(5), 1273-1276. doi:10.1016/j.talanta.2004.05.031
- Rodenburg, T. B., De Reu, K., & Tuytens, F. A. M. (2012). Performance, welfare, health and hygiene of laying hens in non-cage systems in comparison with cage systems *Alternative Systems for Poultry: Health, Welfare and Productivity* (pp. 210-124).
- Rodenburg, T. B., Tuytens, F. A. M., de Reu, K., Herman, L., Zoons, J., & Sonck, B. (2008). Welfare assessment of laying hens in furnished cages and non-cage systems: Assimilating expert opinion. *Animal Welfare*, 17(4), 355-361.
- Rodenburg, T. B., Van Der Hulst-Van Arkel, M. C., & Kwakkel, R. P. (2004). Campylobacter and Salmonella infections on organic broiler farms. *NJAS - Wageningen Journal of Life Sciences*, 52(2), 101-108.
- Rollin, B. E. (2004). Annual Meeting Keynote Address: Animal agriculture and emerging social ethics for animals. *Journal of Animal Science*, 82(3), 955-964.
- Rollin, B. E. (2007). Cultural variation, animal welfare and telos. *Animal Welfare*, 16(SUPPL.), 129-133.
- Rosenquist, H., Boysen, L., Krogh, A. L., Jensen, A. N., & Nauta, M. (2013). Campylobacter contamination and the relative risk of illness from organic broiler meat in comparison with conventional broiler meat. *International Journal of Food Microbiology*, 162(3), 226-230. doi:10.1016/j.ijfoodmicro.2013.01.022
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Shimmura, T., Hirahara, S., Azuma, T., Suzuki, T., Eguchi, Y., Uetake, K., & Tanaka, T. (2010). Multi-factorial investigation of various housing systems for laying hens. *British Poultry Science*, 51(1), 31-42. doi:10.1080/0007166090342116
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177(3), 1333-1352. doi:10.1016/j.ejor.2005.04.006
- Sommer, H. M., Heuer, O. E., Sørensen, A. I. V., & Madsen, M. (2013). Analysis of factors important for the occurrence of Campylobacter in Danish broiler flocks. *Preventive Veterinary Medicine*, 111(1-2), 100-111. doi:10.1016/j.prevetmed.2013.04.004
- Spoelstra, S. F., Groot Koerkamp, P. W. G., Bos, A. P., Elzen, B., & Leenstra, F. R. (2013). Innovation for sustainable egg production: Realigning production with societal demands in The Netherlands. *World's Poultry Science Journal*, 69(2), 279-298. doi:10.1017/S0043933913000305
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331

- Tuytens, F., Vanhonacker, F., & Verbeke, W. (2014). Broiler production in Flanders, Belgium: Current situation and producers' opinions about animal welfare. *World's Poultry Science Journal*, 70(2), 343-354.
- Van de Weerd, H., & Sandilands, V. (2008). Bringing the issue of animal welfare to the public: A biography of Ruth Harrison (1920 - 2000). *Applied Animal Behaviour Science*, 113(4), 404-410. doi:10.1016/j.applanim.2008.01.014
- Van Overmeire, I., Pussemier, L., Hanot, V., De Temmerman, L., Hoenig, M., & Goeyens, L. (2006). Chemical contamination of free-range eggs from Belgium. *Food Additives & Contaminants*, 23(11), 1109-1122. doi:10.1080/02652030600699320
- Van Overmeire, I., Pussemier, L., Waegeneers, N., Hanot, V., Windal, I., Boxus, L., . . . Goeyens, L. (2009). Assessment of the chemical contamination in home-produced eggs in Belgium: General overview of the CONTEGG study. *Science of the Total Environment*, 407(15), 4403-4410. doi:10.1016/j.scitotenv.2008.10.066
- Vanhonacker, F., Verbeke, W., Van Poucke, E., Pieniak, Z., Nijs, G., & Tuytens, F. A. M. (2012). The Concept of Farm Animal Welfare: Citizen Perceptions and Stakeholder Opinion in Flanders, Belgium. *Journal of Agricultural and Environmental Ethics*, 25(1), 79-101. doi:10.1007/s10806-010-9299-6
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Weary, D. M., Ventura, B. A., & Von Keyserlingk, M. A. G. (2016). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal*, 10(2), 309-317. doi:10.1017/S1751731115001160

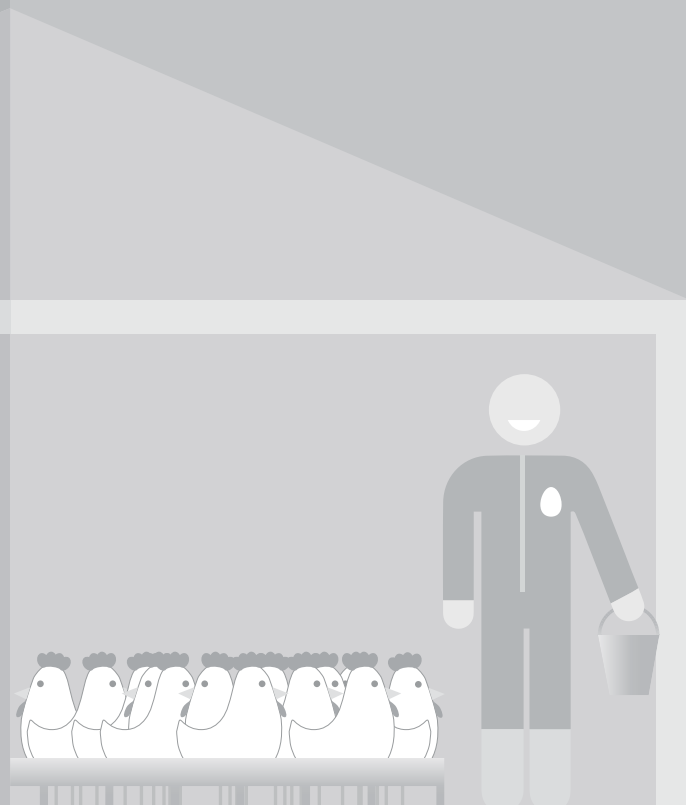


Perceptions of laying hen husbandry: a survey among citizens, poultry farmers and veterinarians

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To be submitted



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ABSTRACT

Different perceptions of issues, such as hen welfare and public health risks, may lead to conflicting perceptions of the best husbandry system for laying hens. Insight into these perceptions may help to address societal concerns about hen husbandry. To this end, perceptions of the best hen husbandry system and the importance of 10 issues of laying hen husbandry were studied in three stakeholder groups in the Netherlands: poultry farmers (n = 100), poultry veterinarians (n = 41) and citizens (n = 2259). Most citizens (73%) perceived an outdoor system as the best system, while most farmers (71%) and veterinarians (93%) perceived an indoor system as the best husbandry system. Citizens perceived the issues 'natural needs of hens' and 'environmentally friendly' as more important and the issues 'hen health', 'farmer income' and 'hens lay many eggs' as less important than did farmers and veterinarians. The issues 'food safety' and 'public health' were perceived important by the three groups. Citizens' preference for a more extensive system was associated with a higher importance of 'hen welfare', 'natural needs of hens' and 'environmentally friendly', and a lower importance of 'hens lay many eggs', 'farmer income' and 'hens lay many eggs'. Being female citizen and experience with animals was associated with the preference for an outdoor system. Moral values may underlie the different perceptions within and between stakeholder groups. Interactive multi-stakeholder design methods, which addresses stakeholders' perceptions and values, seem a suitable way to design husbandry systems which address societal concerns.

Key words: animal welfare, laying hen husbandry, perceptions, public health, stakeholders, survey

INTRODUCTION

From the 1950s onwards, more intensive husbandry systems for farm animals were developed to produce sufficient amounts of food at low cost prices. Keeping laying hens evolved from hens kept in backyard flocks on mixed family farms to hens kept in indoor battery cages on specialised farms (Golden et al., 2012; Rollin, 2004). The number of hens per farm and egg production rates increased substantially (Golden et al., 2012; Spoelstra et al., 2013). From the 1970s onwards, as a consequence of the changed way of keeping and treating production animals, attitudes in society regarding animals changed (Rollin, 2004). People became more concerned about animal welfare (Harper et al., 2001; Rollin, 2007) and specifically about animals, such as laying hens, kept in intensive systems (European Commission, 2005).

These public concerns gave rise to a ban on conventional battery cages in the European Union from January 2012, and stimulated the development of alternative and more animal-friendly husbandry systems for laying hens. Current laying hen husbandry systems in the EU range from intensive, indoor systems, such as furnished cages and non-cage systems, to more extensive systems, such as free-range systems and organic systems with outdoor access. These various husbandry systems perform differently on issues such as public health, food safety, environmental impact and animal welfare (Mollenhorst et al., 2006).

Animal welfare is a multidimensional concept and various definitions are used to define good animal welfare (Fraser, 1995). Concepts of animal welfare often refer to the five freedoms, based on the Brambell report (1965). The five freedoms are basic principles to ensure a minimal level of animal welfare and are often used as a framework for animal welfare legislation and welfare assessment methods (Botreau et al., 2007). Several assessment methods have been developed and used to assess hen welfare in different husbandry systems (Botreau et al., 2007; Rodenburg et al., 2008; Shimmura et al., 2011). According to welfare assessments, hens kept in furnished cages and in indoor non-cage systems score better on freedom from pain, injuries, and diseases than those kept in outdoor systems (Lay Jr et al., 2011; Shimmura et al., 2011; Shimmura et al., 2010). However, hens in indoor systems, especially in cage systems, have restricted space and choice (Freire et al., 2013; Lay Jr et al., 2011; Mollenhorst et al., 2006). Hens with outdoor access have more opportunities to perform natural

behaviour and they show for example more comfort behaviour, such as wing flapping, tail-flapping, leg-stretching and dust-bathing than hens in kept in indoor systems (Freire et al., 2013; Lay Jr et al., 2011; Shimmura et al., 2010). Although various husbandry systems perform on different welfare aspects as the best, the more extensive systems, especially those with outdoor access, could benefit hen welfare (Hegelund et al., 2006; Knierim, 2006; Shimmura et al., 2011; Shimmura et al., 2010).

Questions have been raised about public health and food safety risks related to keeping hens in outdoor systems (Hovi et al., 2003; Kijlstra et al., 2006; Kijlstra et al., 2009). Hens in outdoor runs have more contact with the outdoor environment and with domestic or wild animals. The use of outdoor runs therefore, results firstly in an increased risk of transmission of pathogens, such as the zoonotic pathogen Avian Influenza, from wild birds to laying hens (Gonzales et al., 2013; Koch et al., 2006). Secondly, in outdoors runs there is an increased risk of an uptake by hens of contaminants such as dioxin, causing higher dioxin levels in eggs (De Vries et al., 2006; Schoeters et al., 2006).

Moreover, there is controversy about the environmental impact of both intensive and extensive systems relating to issues such as global warming, energy use, land occupation, phosphorus balance, nitrogen balance, acidification, and feed conversion (Dekker et al., 2011; Leinonen et al., 2014). For example, cage system perform better on land occupation, and phosphorus balance than outdoor systems, while outdoor systems perform better on global warming potential and energy use than indoor systems (Dekker et al., 2011). It may be concluded that each husbandry system has strengths and weaknesses regarding issues such as hen health and welfare, food safety, public health and environmental impact (Mollenhorst et al., 2006). On top of that, these issues are subject of societal concern (Hansen et al., 2003; Harper et al., 2001; Verbeke et al., 2000).

Current husbandry systems are developed based on input from animal scientists taking into account economic, environmental and social issues, such as farmer income, environmental impact, animal health and welfare, product quality and public concerns (Mollenhorst et al., 2006). The various husbandry systems for laying hens as mentioned above have evolved based on variations in how these issues of laying hen husbandry are balanced, which in turn depends on the importance of the individual

issues. People form their perceptions of such issues corresponding to their frame of reference. Frames of reference are shaped by people's values, convictions, norms, experience and knowledge (Te Velde et al., 2002), which results in different perceptions among people, such as farmers and citizens. For example, it has been shown that citizens and farmers differ in their perceptions of animal welfare (Te Velde et al., 2002; Vanhonacker et al., 2008). Consequently, they perceive the importance of aspects of animal welfare, such as animal health, growth and production rate, and natural behaviour, differently (Fraser et al., 1997; Vanhonacker et al., 2012). Likewise, citizens and experts on public health, such as veterinarians, perceive public health and food safety risks differently (Hansen et al., 2003; Jensen et al., 2005). Thus, the perception of the importance of various issues of hen husbandry may differ between citizens and those involved in hen husbandry, such as farmers and veterinarians. These different perceptions may lead to conflicting views on which husbandry system is the best system for laying hen husbandry.

Taking into consideration stakeholder views is a prerequisite for adjusting or designing animal husbandry systems that are supported by society (Boogaard et al., 2011; Weary et al., 2016). Current laying hen husbandry systems do not address in an integrated way the various concerns of stakeholder groups such as farmers, veterinarians and citizens (Weary et al., 2016). Insight into stakeholder perceptions regarding hen husbandry could provide knowledge that may help to address the concerns on hen husbandry. In the context of laying hen husbandry, no studies have analysed how multiple stakeholder groups perceive multiple issues of hen husbandry and whether these issues can explain the preference for a certain husbandry system. Therefore, the objective of this study was to get insight into current perceptions of laying hen husbandry of three stakeholder groups: citizens, poultry farmers, and poultry veterinarians. This paper first explores which system the three stakeholder groups perceive as the best system for laying hen husbandry, based on their current knowledge. Secondly, it examines the importance given to issues of laying hen husbandry by the three stakeholder groups. Thirdly, it analyses the relation between the perceived best husbandry system and the perceived importance of issues of laying hen husbandry. Finally, the study explores the influence of socio-demographic characteristics of citizens on their preference for a certain husbandry system.

MATERIAL AND METHODS

Questionnaire

A quantitative survey was conducted by means of an online questionnaire to collect data concerning perceptions of laying hen husbandry from three stakeholder groups. The questionnaire included a question regarding the best laying hen husbandry system, a question regarding the importance of issues of laying husbandry, and questions regarding socio-demographic characteristics of the respondents. The questionnaire was developed based on literature review and stakeholder input. Stakeholder input was provided by a consulting group consisting of experts and representatives of different stakeholder groups (citizens, poultry farmers and poultry veterinarians), which gave input on the questionnaire.

The first question was 'Which laying hen husbandry system do you think is the best?'. Participants could choose the best system from four EU-recognized husbandry systems common in the Netherlands: indoor colony cages for groups of hens, an indoor non-cage system, a free-range system with outdoor access, and an organic system with outdoor access. The participants were not provided with any descriptions of the husbandry systems, because the objective was to get insight into current perceptions, regardless these perceptions were based on detailed knowledge about laying hen husbandry. Providing new information might change the existing perceptions of the participants (Boogaard et al., 2011; Sturgis et al., 2010; Te Velde et al., 2002) and will cause a higher drop-out of less educated people (Sturgis et al., 2010). The names for the systems used in the questionnaire are the names that EU egg codes on eggs refer to. In the Netherlands, these names are commonly used in the communication about hen husbandry or the origin of eggs. The consulting group gave input on the formulation of the question and the husbandry systems. A pilot study revealed that the respondents were familiar with these names and the husbandry systems. Nevertheless, some respondents might not be acquainted with the husbandry systems or might not be able to decide which system is the best, and therefore an answer option 'I do not know' was included.

The second question concerned the importance of 10 issues related to different aspects of laying hen husbandry. Two criteria were used to select the issues from literature. Firstly, the issue has been considered a subject of societal concern, and secondly,

according to literature the issue has been considered as important for sustainable development (Bergstra et al., 2015; Bergstra et al., 2017; Castellini et al., 2012; De Boer et al., 2002; Dekker et al., 2011; Harper et al., 2001; Heng et al., 2013; Kanis et al., 2003; Lebacqz et al., 2013; Leinonen et al., 2014; McGlone, 2001; Meuwissen et al., 2005; Mollenhorst et al., 2006; Mollenhorst et al., 2004; Thompson et al., 2011; Vanhonacker et al., 2009; Verbeke et al., 2000; Xin et al., 2011). The consulting group provided input on the selected issues. As a result, 10 issues were included in the questionnaire (Table 2.3). The question was: “How important do you think the following issues are for laying hen husbandry?” The participants could rate the importance of the 10 issues on a five-point Likert scale ranging from very unimportant (-2) to very important (2).

The last part of the questionnaire consisted of questions on the socio-demographic characteristics of the participants. Socio-demographic characteristics, which according to literature are associated with perceptions of animal husbandry, were selected from literature. The following variables were included: gender, age, educational level, urbanization level of current residence, childhood residence, having children, pet ownership, frequency of meat consumption and whether they donate to a nature or animal welfare organisation (Bergstra et al., 2017; Boogaard et al., 2006; Cohen et al., 2012; Harper et al., 2001; Kendall et al., 2006; Knight et al., 2004; Liu et al., 2014; Slovic, 1999; Tuytens et al., 2010; Vanhonacker et al., 2010; Vanhonacker et al., 2009; Vanhonacker et al., 2007; Xiao et al., 2015). Before the survey was carried out, the questionnaire was pilot tested for comprehensibility and clarity of the questions in three citizens, two poultry farmers, and two veterinarians. The questionnaire was then further optimised based on these results.

Participants

The survey was done among Dutch citizens, poultry farmers, and poultry veterinarians through March and April 2014. Because citizens, without being necessarily consumers, participate in the public debate about the laying hen husbandry (Harvey et al., 2013), we researched people in their role of citizen. Citizens were approached by CentERdata (www.centerdata.nl), a research institute specialised in online survey research by means of the CentERpanel. The CentERpanel is a representative sample of the Dutch population. CentERdata approached 3344 CentERpanel citizens, of whom 2373 (71.0%)

started to fill in the questionnaire and 2259 citizens (67.6%) completed the questionnaire. Veterinarians registered with the Section Poultry Health (VGP) of the Royal Veterinary Association of the Netherlands (n=144) were invited in an e-mail from CentERdata to fill in the online questionnaire. Of this registered group 51 (35.4%) completed the questionnaire. Of these 51 respondents, 40 met our definition of poultry veterinarian – someone working more than 30% of their time as a veterinarian in the poultry sector – and were included for analysis. Poultry farmers were invited to fill in the questionnaire by a digital newsletter of the Dutch organization of poultry farmers (NOP), which was sent to approximately 3,000 people interested in poultry production. We also posted articles on websites dealing with poultry production, such as the website of the Dutch poultry magazine (Pluimveehouderij¹) and a website on agriculture in general. These newsletter and websites were freely available. One hundred poultry farmers completed the questionnaire.

The socio-demographic characteristics of the participants are presented in Table 2.1. The citizen sample has been compared with the data of the CBS Statistics Netherlands (2014). The citizen sample had a slightly higher proportion of males, in the over-55 age group, and of highly educated people. Poultry farmers and veterinarians were mainly male, which is a normal representation for these professional groups.

Table 2.1 Socio-demographic characteristics of the respondents from the three stakeholder groups

	Citizens (n = 2259)	Poultry farmers (n= 100)	Poultry veterinarians (n = 41)	CBS ¹
Gender (%)				
Male	52.2	88.0	80.5	49.2
Female	47.8	12.0	19.5	50.8
Age (%)				
15 - 34 years	16.6	11.0	12.2	29.3
35 - 54 years	36.8	73.0	51.2	34.2
> 55 years	46.6	16.0	36.6	36.5
Education (%)				
Low	26.7	28.0	0.0	30.9
Intermediate	29.3	43.0	0.0	41.0
High (Bachelor / Master)	44.0	29.0	100.0	28.1

¹ Data from CBS Statistics Netherlands dated 01-03-2014

¹ Poultry production: a professional journal for the poultry production sector.

Data analyses

Data were analysed using SPSS 19.0. The effect of the three stakeholder groups and of the socio-demographic characteristics on the perceived best husbandry system were analysed by calculating Pearson's Chi-square. The association between mean importance scores for the 10 issues and (1) stakeholder group, and (2) the perceived best system was explored by analysis of variances (ANOVA). We assumed that intervals between each item category of the Likert-scales (ranging from -2 to 2) is equal and therefore, calculation of means and One-way ANOVA was done (Carifio et al., 2008). ANOVA was performed if variances were homogeneous according to Levene's test. If variances were not homogeneous, the Welch test was used instead. If the effect of the stakeholder groups or the best husbandry system on the mean importance scores was significant, the post-hoc Games-Howell test for multiple comparisons was done to analyse differences between individual stakeholder groups or husbandry systems.

To further analyse the importance of the 10 issues on shared variance and the presence of latent underlying constructs an explanatory factor analysis, Principal Axis with Direct Oblimin rotation, was performed. A Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) above 0.5 was considered adequate (Field, 2013). Constructs with eigenvalue of 1.0 or higher (Kaiser Criterion) were considered important and included in the analysis. The rotated factor loadings were used to value the constructs. In case of a high rotated factor loading of an issue for a construct, the issue was assigned to that construct. It resulted in three constructs: two constructs consisting of three and one construct consisting of four issues. To analyse the reliability of these three constructs, the Cronbach's alpha was calculated. We created new values for the constructs by computing the importance scores for the individual issues assigned to a specific construct and dividing this total by the number of issues (three or four) assigned to the construct.

RESULTS

Best laying hen husbandry system

The citizens' stakeholder group selected a different husbandry system from the other two groups as the best system for laying hen husbandry ($\chi^2(8) = 494.52, p < 0.001$, Table 2.2). About half of the citizens selected the free-range system as the best system, whereas about half of the poultry farmers and poultry veterinarians selected the indoor non-cage system as the best system. Of the citizens, 12.3% indicated not to know which system is the best husbandry system. One farmer indicated not to know which system is the best. Most farmers selected the husbandry system that they practise themselves (64%).

Table 2.2 Best laying hen husbandry system according to citizens (n = 2259), poultry farmers (n = 100) and poultry veterinarians (n = 41)

	Citizens		Poultry farmers		Poultry veterinarians	
	n	%	n	%	n	%
Colony cages	62	2.7	28	28.0	18	43.9
Indoor non-cage	272	12.0	51	51.0	20	48.8
Free-range	1162	51.4	10	10.0	3	7.3
Organic	485	21.5	10	10.0	0	-
I do not know	278	12.3	1	1.0	0	-

Importance of issues

Table 2.3 shows how respondents rated the importance of 10 issues of laying hen husbandry. Mean scores for the 10 issues varied from - 0.26 to 1.80. The three stakeholder groups perceived 'cheap eggs' equally as the least important issue and 'food safety' and 'hen health' as the most important issues. The mean scores of citizens for 'hen welfare' and for 'food safety' did not differ from the mean scores of farmers and veterinarians for the same issues. Compared to farmers and veterinarians, citizens scored 'hen health', 'farmer income' and 'hens lay many eggs' significantly lower, and 'environmentally friendly' significantly higher. The mean scores for the issues 'taste of eggs' and 'risks to human health' differed significantly between citizens and farmers, but did not differ between citizens and veterinarians.

Table 2.3 Mean importance of 10 issues of laying hen husbandry according to citizens, poultry farmers, and poultry veterinarians (-2 = very unimportant; 2 = very important)

Issues	Citizens n = 2259	Farmers n = 100	Veterinarians n = 41	Test statistics	p-value
Hen health	1.33 ^a	1.77 ^b	1.80 ^b	$F(2, 84.40) = 45.43$	< 0.001
Hen welfare	1.16	1.13	1.17	$F(2, 2379) = 0.06$	0.944
Meet natural needs of hens	1.02 ^a	0.72 ^b	0.51 ^b	$F(2, 79.08) = 11.45$	< 0.001
Environmental friendly	1.05 ^a	0.66 ^b	0.61 ^b	$F(2, 78.96) = 12.34$	< 0.001
Food safety	1.51	1.67	1.68	$F(2, 80.95) = 4.31$	0.017
Risks to human health	1.21 ^a	0.86 ^b	0.88	$F(2, 78.15) = 6.04$	0.004
Taste of eggs	1.17 ^a	1.40 ^b	0.98 ^a	$F(2, 80.17) = 5.46$	0.004
Cheap eggs	- 0.09	- 0.26	- 0.12	$F(2, 2379) = 0.86$	0.429
Farmer income	0.48 ^a	1.51 ^b	1.22 ^c	$F(2, 82.97) = 140.11$	< 0.001
Hens lay many eggs	0.07 ^a	1.22 ^b	1.17 ^b	$F(2, 2379) = 100.26$	< 0.001

^{a,b,c} Means within rows with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test)

Relation between issues and the best system

Table 2.4 provides insight into the relation between the choice of the best husbandry system and how citizens perceive the importance of the issues of laying hen husbandry. Because the number of poultry farmers and veterinarians in the sample was limited and their view was predominantly that indoor systems were the best, this relation was not analysed for these two stakeholder groups. There was a significant effect of the importance scores on the chosen best system for all 10 issues. The mean importance given by citizens for ‘hen health’, ‘hen welfare’, ‘system meets natural needs of hens’ and ‘environmentally friendly’ was higher when they chose a less intensive system to be the best. In contrast, mean scores for the issues ‘cheap eggs’, ‘farmer income’, and ‘hens lay many eggs’ were lower when citizens considered a less intensive system to be the best. The mean scores for the issues ‘food safety’ and ‘taste of eggs’ did not differ significantly among the groups that chose a best system. The mean score for ‘risks to human health’ did not differ among citizens who favoured the colony cages, the indoor non-cage system, the free-range system or indicated not to know which system was the best, but citizens who favoured the organic system scored ‘risks to human health’ higher than the other groups. The group, which indicated not to know which of the husbandry systems was the best, had a smaller range in scores than groups that chose a system. This ‘I do not know’ group scored the importance of the issues similar to the two groups of citizens who indicated the colony cages respectively the indoor non-cage system as the best system.

Table 2.4 Mean importance of 10 issues of laying hen husbandry in relation to perceived best husbandry systems in citizens (-2 = very unimportant; 2 = very important)

Issues	Colony cages n = 62	Indoor non-cage n = 272	Free-range n = 1162	Organic n = 485	I do not know n = 278	Test statistics	p-value
Hen health	0.55 ^a	1.12 ^b	1.37 ^c	1.66 ^d	0.97 ^{ab}	$F(4, 342.07) = 62.69$	< 0.001
Hen welfare	0.08 ^a	0.83 ^b	1.21 ^c	1.55 ^d	0.81 ^b	$F(4, 345.18) = 89.16$	< 0.001
Meet natural needs of hens	0.02 ^a	0.64 ^b	1.08 ^c	1.41 ^d	0.72 ^b	$F(4, 346.96) = 89.16$	< 0.001
Environmentally friendly	0.34 ^a	0.71 ^b	1.07 ^c	1.47 ^d	0.73 ^b	$F(4, 350.44) = 79.59$	< 0.001
Food safety	1.40	1.47 ^a	1.56 ^a	1.58 ^a	1.27 ^b	$F(4, 344.33) = 8.18$	< 0.001
Risks to human health	0.90 ^a	1.13 ^a	1.21 ^a	1.36 ^b	1.05 ^a	$F(4, 2254) = 9.24$	< 0.001
Taste of eggs	0.94	1.21 ^a	1.21 ^a	1.23 ^a	0.95 ^b	$F(4, 2254) = 8.51$	< 0.001
Cheap eggs	0.97 ^a	0.39 ^b	-0.10 ^c	-0.66 ^d	0.24 ^b	$F(4, 2254) = 83.45$	< 0.001
Farmer income	0.45	0.62 ^a	0.54 ^a	0.36 ^b	0.33 ^b	$F(4, 2254) = 8.01$	< 0.001
Hens lay many eggs	0.89 ^a	0.40 ^b	0.10 ^c	-0.35 ^d	0.19 ^c	$F(4, 355.70) = 49.31$	< 0.001

^{a, b, c, d} Means within rows with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test)

Constructs

To explore whether the issues cluster on underlying latent constructs, a factor analysis was performed on the 10 issues. Sufficient data were available only for citizens, therefore the factor analysis was only done on those data (Table 2.5). The constructs met the statistical criteria (Field, 2013): total Kaiser-Meyer-Olkin Measure of sample adequacy was above 0.5 (0.83), Bartlett's test of sphericity was significant $p < 0.001$, and the individual KMO values for the issues were above 0.5 (minimum 0.61). Three constructs with an eigenvalue equal to or above 1.0 (Kaiser's criterion) could be selected. Together, these three constructs explained 66.5% of the variance.

The first construct, *animal and environmental interests*, including 'hen welfare', 'meet natural needs of hens', 'hen health' and 'environmentally friendly', explained 38.4% of the variance. The second construct, consisting of the *economic interests*, clusters 'hens lay many eggs', 'cheap eggs' and 'farmer income', explained 18.0% of the variance. The third construct, *consumer interests*, clustering 'food safety', 'risk to human health' and 'taste of eggs' explained 10.0% of the variance. Reliability was good for the construct 'animal and environment interests' ($\alpha = 0.88$), reasonable for the construct 'consumer interests' ($\alpha = 0.70$), and weak for the construct 'economic interests' ($\alpha = 0.56$).

Table 2.5 Rotated factor loadings of importance of 10 issues of laying hen husbandry for three constructs, percentage of variance explained, and Cronbach's alpha

	Rotated factor loadings		
	Animal and environmental interests	Economic interests	Consumer Interests
Issues			
Hen welfare	0.91¹	-0.02	0.02
Meets natural needs of hens	0.81	-0.03	-0.01
Hen health	0.67	-0.01	-0.19
Environmentally friendly	0.67	-0.02	-0.12
Hens lay many eggs	-0.07	0.73	0.03
Cheap eggs	-0.30	0.57	-0.06
Farmer income	0.20	0.37	-0.01
Food safety	-0.09	-0.06	-0.96
Risks to human health	0.08	-0.02	-0.55
Taste of eggs	0.15	0.17	-0.45
Statistical criteria			
Eigenvalues	3.85	1.80	1.00
Percentage of total variance explained	38.5	18.0	10.0
Cumulative percentage of variance explained	38.5	56.5	66.5
Cronbach's α	0.88	0.56	0.70

¹ Issues with factor loadings above 0.30 load strongly on a factor and are in bold

Relation between constructs and the best system

The relation between the importance scores for the three constructs and the preference for a certain husbandry system as explored in citizens is presented in Figure 2.1. The mean scores for the constructs 'animal and environment', and 'economic interests' differed significantly between the husbandry systems. The construct 'animal and environment' is positively associated with the perception that a more extensive husbandry system is the best system. The construct 'economic interests' is negatively associated with the perception that a more extensive husbandry system is the best. The scores for the construct 'consumer interests' only differed significantly between organic on the one hand and colony cage and free-range on the other. The scores for the construct 'consumer interests' did not differ significantly between colony cages, indoor non-cage systems, and free-range systems.

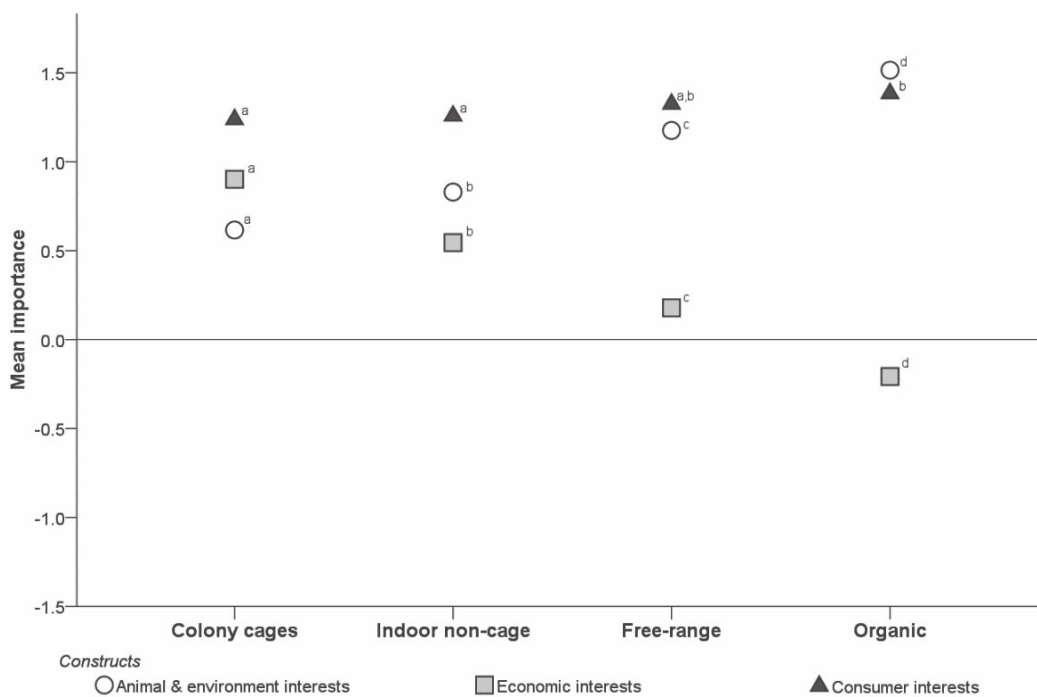


Figure 2.1 Mean importance scores of three constructs in relation to the preferred husbandry system by citizens (-2 = very unimportant, 2 = very important)

^{a, b, c, d} Means within a construct with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test)

Socio-demographic characteristics

To determine the role of socio-demographic characteristics, the influence of such characteristics on the choice of the best system was analysed (Table 2.6). This was only presented for citizens, because the numbers of farmers and veterinarians were small, and variation in their socio-demographic characteristics and perceptions, were limited. All socio-demographic characteristics in citizens, except for that of ‘having children’, were significantly associated with the perceived best system. Being female, highly educated, consuming meat less than six times a week, and donating to a nature or animal welfare organization were associated with the choice for a less intensive system. Age, urbanization, childhood residence, having children or not, and pet ownership were found to be significantly associated with the perceived best system, However, the effect of these socio-demographic characteristics on the perceived best system did not point into one clear direction and were difficult to interpret.

Table 2.6 Best laying hen husbandry system and socio-demographic characteristics of citizens (%)

	Total sample n = 2259	Indoor				I do not know n = 278	Test statistics	p-value
		Colony cages n = 62	non-cage n = 272	Free-range n = 1162	Organic n = 485			
Gender (%)						$\chi^2(4) = 63.09$	< 0.001	
Male	52.2	80.6	59.6	54.7	51.4			
Female	47.8	19.4	40.4	45.3	48.6			
Age (%)						$\chi^2(20) = 106.17$	< 0.001	
15 - 24 years	2.7	6.5	3.7	1.5	6.1			
25 - 34 years	13.9	21.0	12.9	11.0	14.0			
35 - 44 years	23.4	22.6	25.4	20.9	19.4			
45 - 54 years	13.5	12.9	13.6	13.4	18.0			
55 - 64 years	19.3	9.7	16.9	20.8	19.1			
>65 years	27.3	27.4	27.6	32.4	23.4			
Education (%)						$\chi^2(20) = 104.16$	< 0.001	
Primary school	4.2	8.1	4.0	4.2	5.8			
Lower secondary	22.5	14.5	32.4	25.4	22.3			
Higher secondary	11.2	9.7	12.1	10.2	11.2			
Vocational	18.1	17.7	18.0	19.0	19.4			
Bachelor	28.8	27.4	23.9	28.4	28.4			
Master	15.2	22.6	9.6	12.7	12.9			
Urbanization (%)						$\chi^2(16) = 51.19$	< 0.001	
Very high urbanization ¹	15.1	11.3	10.0	12.9	19.5			
High urbanization	26.0	19.4	22.3	26.6	28.3			
Moderate urbanization	20.0	27.4	20.4	19.7	15.8			
Little urbanization	21.1	29.0	26.0	21.3	19.9			
No urbanization	17.8	12.9	21.2	19.4	16.5			
Childhood residence (%)						$\chi^2(16) = 102.66$	< 0.001	
City ² (>100000)	25.1	19.4	19.9	26.4	28.1			
Town (>25000)	23.4	19.4	19.5	20.7	24.8			
Village (<25000)	37.3	29.0	39.7	37.3	36.3			
Countryside (not on farm)	8.6	8.1	12.1	9.6	8.3			
Farm	5.5	24.2	8.8	5.9	2.5			

Children (%)									$\chi^2(4) = 6.45$	0.148
Yes	37.8	41.9	40.8	35.3	40.2	40.6				
No	62.2	58.1	59.2	64.7	59.8	59.4				
Has pets (%)									$\chi^2(4) = 31.26$	<0.001
Yes	47.0	48.4	42.3	48.4	53.6	33.8				
No	53.0	51.6	57.7	51.6	46.4	66.2				
Frequency of meat consumption (%)									$\chi^2(8) = 126.71$	<0.001
6-7 times a week	41.7	66.1	56.3	41.7	28.7	45.0				
2-5 times a week	48.5	30.6	39.7	50.7	51.1	47.5				
0-1 time a week	9.7	3.2	4.0	7.6	20.2	7.6				
Donates to nature or animal welfare organization (%)									$\chi^2(4) = 76.23$	<0.001
Yes	37.8	17.7	24.6	38.7	50.9	28.8				
No	62.2	82.3	75.4	61.3	49.1	71.2				

¹ Number of inhabitants per square kilometre (Very high urbanization: > 2500, High urbanization: 1500 - 2500, Moderate urbanization: 1000 - 1500, Little urbanization: 500 - 1000, No urbanization: less than 500)

² Number of inhabitants per residence

DISCUSSION

Introduction

Stakeholders' perceptions of the best laying hen husbandry system were studied by means of a survey among citizens, poultry farmers, and poultry veterinarians. Additionally, the importance of issues of laying hen husbandry, both subject of societal concern and important for sustainable development, and the association with the perceived best system, was analysed. The objective was to get insight into current perceptions of laying hen husbandry based on their current knowledge. New information may influence perceptions and therefore no information about laying hen husbandry was provided to the participants in the questionnaire. It implies that answers may have been based on limited knowledge about laying hen husbandry. However, lack of knowledge does neither mean that people do not have opinions (Frewer et al., 1994), nor that perceptions are incorrect (Boogaard et al., 2011). People shape their perceptions according to their frame of reference, which is influenced by knowledge and experiences, but also by convictions, values, norms, and interests (Boogaard et al., 2011; Te Velde et al., 2002). Respondents answered the questions corresponding to their current frame of reference, which has been enhanced by the fact that we did not describe a context for the questions. Consequently, different participants may have considered the interests of laying hens, farmers, consumers, and / or environment in a different way. This approach was chosen because the public debate about laying hen husbandry is based on current perceptions of stakeholders. The outcome of the public debate may influence adaptations of current hen husbandry systems and the development of new husbandry systems.

Preferred husbandry system

Most citizens perceived an outdoor system, free-range or an organic system, as the best husbandry system. In contrast, most poultry farmers and poultry veterinarians perceived an indoor system, colony cages, or an indoor non-cage system, as the best husbandry system. When interpreting the results, it should be considered that respondents who are not familiar with the systems might have answered the question based on the names of the systems and not based on the characteristics of the systems. However, by adding the answer option 'I do not know' we encouraged respondents who did not know the systems or had no opinion to choose for this option. Moreover,

the names of the husbandry systems used in the questionnaire are the conventional names used in the Netherlands. Therefore, most respondents who did choose a best system may have had some knowledge about the systems. The names of the systems refer to how the hens are kept: in a cage, indoor non-cage, free-range or organic with outdoor access. Therefore, it may be expected that especially citizens answered the question focused on the interests of hens. However, further analyses suggest that citizens considered multiple issues of hen husbandry when they selected the preferred system.

Farmers and veterinarians, well acquainted with the husbandry systems, preferred the indoor systems. Farmers focus on economic interests (Gocsik et al., 2015; Hansson et al., 2014) and they prefer the husbandry system that they practise themselves (Benard et al., 2013; Stadig et al., 2016; Stadig et al., 2015). In the Netherlands, most hens are kept in indoor non-cage systems and this might explain why farmers mainly preferred indoor systems. Compared to farmers, veterinarians selected a colony cage system as the best system more often and, an outdoor system less often. Veterinarians' perceptions of the systems may be based mainly on health considerations and they may have selected the colony cage systems more often because these are considered more hygienic than non-cage systems (Lay Jr et al., 2011). It may be concluded that the frame of reference of the respondents of all three stakeholder groups has determined to what extent issues were taken into account when selecting the best husbandry system. Insight into which issues respondents perceived important may provide information about their frame of reference.

Importance of issues

Citizens scored the importance of most issues differently from poultry farmers and poultry veterinarians. The mean scores of citizens for the issues 'hen welfare', 'food safety' and 'cheap eggs', however, did not differ from the mean scores of farmers and veterinarians for these issues. Although all three stakeholder groups scored 'hen welfare' not differently, citizens scored aspects of hen welfare, 'hen health', 'hens lay many eggs' and 'natural needs', differently from farmers and veterinarians. Citizens perceived the 'natural needs of hens' absolutely and relatively as more important than farmers and veterinarians did, and 'hen health' and 'hens lay many eggs' as less important than farmers and veterinarians. Regarding animal welfare, the differences

between the perceptions of citizens, and farmers and veterinarians are in accordance with previous studies. Citizens view predominantly opportunities to express natural behaviour important for animal welfare, while farmers and veterinarians perceive good animal health and high production rate important for animal welfare (Fraser et al., 1997; Te Velde et al., 2002; Vanhonacker et al., 2008). Farmers and veterinarians view laying hen welfare in the broader context of laying hen husbandry and for them hen welfare might be a way to achieve economic results (Hansson et al., 2014). Citizens may have valued hen welfare for its own sake and focused on the interests of the animals, such as the natural needs of the hens. Therefore, even though citizens, farmers, and veterinarians in this study accorded the same importance to animal welfare, they may hold different views on what is good or bad hen welfare. These differences in the perceived importance of aspects of hen welfare might explain why most citizens perceived the free-range system as the best system and poultry farmers and veterinarians perceived the indoor non-cage system as the best system. Moreover, citizens considered 'environmentally friendly' to be more important than did the other groups, which might be related to the preference of citizens for the organic husbandry system.

The three stakeholder groups perceived the issues 'food safety' and 'risks to human health' as important. Previous research has shown that lay people – the predominant group among citizens – perceive zoonotic food risks differently from food producers and experts on food hazards (Hansen et al., 2003; Jensen et al., 2005). When looking at aspects of food safety in practice, such as the use of antibiotics, stakeholders have been shown to hold different views on the risks (Bergstra et al., 2015). For example, in the study by Bergstra *et al.* (2015) regarding sow husbandry, farmers did not perceive the use of antibiotics as a considerable risk. Although three groups gave the same score to food safety, it does neither imply that citizens, farmers and veterinarians perceive food safety equally, nor that they perceive the same level of food-related risks as acceptable (Hansen et al., 2003).

Relation issues and best system

The analysis of the relation between the importance of ten issues of hen husbandry and the best husbandry system shows that citizens cannot be regarded as one group. On the one hand, citizens who viewed a more intensive system as the best system

perceived the issues related to economics, 'cheap eggs', farmer income,' and 'hens lay many eggs', as more important than citizens who chose a less intensive system as the best system. On the other hand, citizens who viewed a less intensive system as the best husbandry system perceived the issues 'hen health', 'hen welfare', 'natural needs of hens' and 'environmentally friendly' as more important than citizens who selected a more intensive system as the best husbandry system. The importance of the issues 'risk to human health', 'food safety', and 'taste of eggs' did not differ between the systems, which means that these issues are not decisive for the choice of the best system. The importance scores for the issues 'hen health', 'hen welfare', 'natural needs of hens' and 'environmental friendliness' were inter-correlated and together they constitute the construct 'animal and environmental interests'. The importance scores for the issues 'hens lay many eggs', 'cheap eggs' and 'farmer income' were also inter-correlated and constitute the construct 'economic interests'. The issues, which constitute together a construct, may have a shared underlying value. Because perceptions of animal husbandry, among other things, are influenced by moral values (Fraser et al., 1997; Te Velde et al., 2002), moral values related to the interests of animals, environment and producer might have been the underlying incentives to select a particular husbandry system and to rate the importance of the issues of laying hen husbandry.

Influence of socio-demographic characteristics

Female citizens selected an outdoor system as the best system more often than did male citizens. This gender effect is in accordance with literature that consistently indicates that more females than males are concerned about animal welfare (Cohen et al., 2012; Kendall et al., 2006), and about environmental issues (Liu et al., 2014). It has been suggested that females consider issues more from an emotional point of view and value hens as living beings, whereas males view issues more from an economic point of view (Cohen et al., 2012). It may indicate that, more than males, females prioritize the interests of hens and the environment above the economic issues and therefore more often selected an organic system as the best system. In contrast, males may have put economic interests above the interests of animals and the environment, and therefore more often viewed a more intensive, indoor system as the best system. The literature indicates that perceptions people hold regarding animals are also influenced by their experiences with animals (Boogaard et al., 2006; Te Velde et al.,

2002). This is confirmed in our study, which showed that pet ownership was associated with selecting an outdoor system as the best system. Farming experiences, such as grown up on a farm, was associated with the choice of an indoor system as the best system. Regarding other socio-demographic factors, such as age, educational level, urbanization level of residence or having children, the literature is not consistent (Vanhonacker et al., 2009).

Conclusion and implications

This study showed that respondents from the three stakeholder groups had conflicting opinions on the best husbandry system, which could be explained by the importance given to issues of hen husbandry and by socio-demographic characteristics. Citizens cannot be seen as one stakeholder group, but need to be considered as different groups with affine perceptions. This suggests that various husbandry systems, considering more or less the interests of hens, environment, farmers, and consumers, could exist alongside with support of society. In the Netherlands, most laying hen husbandry systems are indoor non-cage systems, but this study showed that most citizens perceived a system with outdoor access as the best hen husbandry system. Citizens who perceived an outdoor system as the best system, perceived aspects of hen welfare as more important than did citizens who perceive indoor systems as the best system. However, in the outdoor systems food safety might be compromised and public health risks increased (Kijlstra et al., 2009). Future research should explore how alternative systems could be designed, which provide hens more opportunities for natural behaviour but minimally compromise with food safety and public health. These alternative systems should be based on both technical performances of the systems, as well as on stakeholder values. Interactive multi-stakeholder design methods, such as used to develop Roundel, show that such design methods can be successful (Groot Koerkamp et al., 2008; Spoelstra et al., 2013). In that way, husbandry systems could be adapted or developed, which meet better with societal concerns and the interests of hens, consumers, farmers and environment.

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REFERENCES

- Benard, M., & de Cock Buning, T. (2013). Exploring the Potential of Dutch Pig Farmers and Urban-Citizens to Learn Through Frame Reflection. *Journal of Agricultural and Environmental Ethics*, 26(5), 1015-1036. doi:10.1007/s10806-013-9438-y
- Bergstra, T. J., Gremmen, B., & Stassen, E. N. (2015). Moral Values and Attitudes Toward Dutch Sow Husbandry. *Journal of Agricultural and Environmental Ethics*, 28(2), 375-401. doi:10.1007/s10806-015-9539-x
- Bergstra, T. J., Hogeveen, H., & Stassen, E. N. (2017). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values*, 34(2), 393-405. doi:10.1007/s10460-016-9721-4
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2006). Elements of societal perception of farm animal welfare: A quantitative study in The Netherlands. *Livestock Science*, 104(1-2), 13-22. doi:10.1016/j.livsci.2006.02.010
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, 5(9), 1458-1466. doi:10.1017/S1751731111000371
- Botreau, R., Veissier, I., Butterworth, A., Bracke, M. B. M., & Keeling, L. J. (2007). Definition of criteria for overall assessment of animal welfare. *Animal Welfare*, 16(2), 225-228.
- Brambell, R. (1965). *Report of the technical committee to enquire into the welfare of animals kept under intensive livestock husbandry systems*. Retrieved from London:
- Carifio, J., & Perla, R. (2008). Resolving the 50-year debate around using and misusing Likert scales. *Medical Education*, 42(12), 1150-1152. doi:10.1111/j.1365-2923.2008.03172.x
- Castellini, C., Boggia, A., Cortina, C., Dal Bosco, A., Paolotti, L., Novelli, E., & Mugnai, C. (2012). A multicriteria approach for measuring the sustainability of different poultry production systems. *Journal of Cleaner Production*, 37, 192-201. doi:10.1016/j.jclepro.2012.07.006
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, 25(3), 353-367. doi:10.2752/175303712x13403555186334
- De Boer, I. J. M., & Cornelissen, A. M. G. (2002). A method using sustainability indicators to compare conventional and animal-friendly egg production systems. *Poultry Science*, 81(2), 173-181.
- De Vries, M., Kwakkel, R. P., & Kijlstra, A. (2006). Dioxins in organic eggs: A review. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 207-221.
- Dekker, S. E. M., de Boer, I. J. M., Vermeij, I., Aarnink, A. J. A., & Koerkamp, P. W. G. G. (2011). Ecological and economic evaluation of Dutch egg production systems. *Livestock Science*, 139(1-2), 109-121. doi:10.1016/j.livsci.2011.03.011
- Eurobarometer. (2005). *Attitudes of consumers towards the welfare of farmed animals* (229). Retrieved from Brussels, Belgium: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_229_en.pdf
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (M. Carmichael Ed. 4th ed.): SAGE.
- Fraser, D. (1995). Science, Values and Animal Welfare: Exploring the 'Inextricable Connection'. *Animal Welfare*, 4(2), 103-117.
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6(3), 187-205.
- Freire, R., & Cowling, A. (2013). The welfare of laying hens in conventional cages and alternative systems: First steps towards a quantitative comparison. *Animal Welfare*, 22(1), 57-65. doi:10.7120/09627286.22.1.057

- Frewer, L. J., Shepherd, R., & Sparks, P. (1994). Biotechnology and food production: knowledge and perceived risk. *British Food Journal*, 96(9), 26-32.
- Gocsik, É., Van Der Lans, I. A., Oude Lansink, A. G. J. M., & Saatkamp, H. W. (2015). Willingness of Dutch broiler and pig farmers to convert to production systems with improved welfare. *Animal Welfare*, 24(2), 211-222. doi:10.7120/09627286.24.2.211
- Golden, J. B., & Arbona, D. V. (2012). Intensive versus extensive management systems in commercial egg production. *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 7, 1-12. doi:10.1079/PAVSNR20127050
- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, 7(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Groot Koerkamp, P. W. G., & Bos, A. P. (2008). Designing complex and sustainable agricultural production systems: an integrated and reflexive approach for the case of table egg production in the Netherlands. *NJAS - Wageningen Journal of Life Sciences*, 55(2), 113-138. doi:10.1016/S1573-5214(08)80032-2
- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, 41(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Hansson, H., & Lagerkvist, C. J. (2014). Defining and measuring farmers' attitudes to farm animal welfare. *Animal Welfare*, 23(1), 47-56. doi:10.7120/09627286.23.1.047
- Harper, G. C., & Henson, S. (2001). *Consumer concerns about animal welfare and the impact on food choice* (Final report). Retrieved from http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf
- Harvey, D., & Hubbard, C. (2013). Reconsidering the political economy of farm animal welfare: An anatomy of market failure. *Food Policy*, 38(1), 105-114. doi:10.1016/j.foodpol.2012.11.006
- Hegelund, L., Sørensen, J. T., & Hermansen, J. E. (2006). Welfare and productivity of laying hens in commercial organic egg production systems in Denmark. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 147-155.
- Heng, Y., Peterson, H. H., & Li, X. (2013). Consumer attitudes toward farm-animal welfare: The case of laying hens. *Journal of Agricultural and Resource Economics*, 38(3), 418-434.
- Hovi, M., Sundrum, A., & Thamsborg, S. M. (2003). Animal health and welfare in organic livestock production in Europe: current state and future challenges. *Livestock Production Science*, 80(1-2), 41-53. doi:10.1016/S0301-6226(02)00320-2
- Jensen, K. K., Lassen, J., Robinson, P., & Sandøe, P. (2005). Lay and expert perceptions of zoonotic risks: understanding conflicting perspectives in the light of moral theory. *International Journal of Food Microbiology*, 99(3), 245-255. doi:10.1016/j.ijfoodmicro.2004.09.004
- Kanis, E., Groen, A. B. F., & De Greef, K. H. (2003). Societal concerns about pork and pork production and their relationships to the production system. *Journal of Agricultural and Environmental Ethics*, 16(2), 137-162. doi:10.1023/A:1022985913847
- Kendall, H. A., Lobao, L. M., & Sharp, J. S. (2006). Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology*, 71(3), 399-428. doi:10.1526/003601106778070617
- Kijlstra, A., & Eijck, I. A. J. M. (2006). Animal health in organic livestock production systems: a review. *NJAS - Wageningen Journal of Life Sciences*, 54(1), 77-94. doi:10.1016/S1573-5214(06)80005-9
- Kijlstra, A., Meerburg, B. G., & Bos, A. P. (2009). Food Safety in Free-Range and Organic Livestock Systems: Risk Management and Responsibility. *Journal of Food Protection*, 72(12), 2629-2637.
- Knierim, U. (2006). Animal welfare aspects of outdoor runs for laying hens: A review. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 133-145.

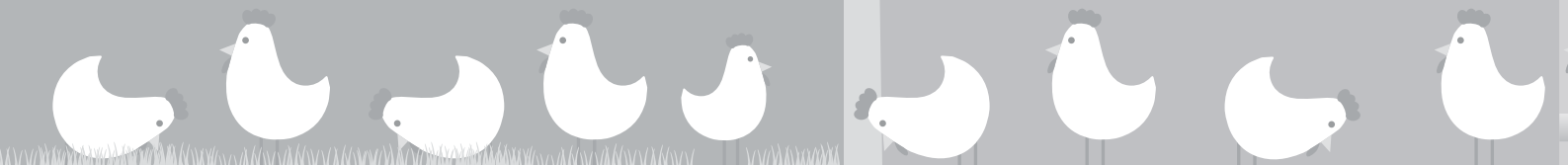
- Knight, S., Vrij, A., Cherryman, J., & Nunkoosing, K. (2004). Attitudes towards animal use and belief in animal mind. *Anthrozoös*, 17(1), 43-62.
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 179-194. doi:10.1016/s1573-5214(06)80021-7
- Lay Jr, D. C., Fulton, R. M., Hester, P. Y., Karcher, D. M., Kjaer, J. B., Mench, J. A., . . . Porter, R. E. (2011). Hen welfare in different housing systems. *Poultry Science*, 90(1), 278-294. doi:10.3382/ps.2010-00962
- Lebacqz, T., Baret, P. V., & Stilmant, D. (2013). Sustainability indicators for livestock farming. A review. *Agronomy for Sustainable Development*, 33(2), 311-327. doi:10.1007/s13593-012-0121-x
- Leinonen, I., Williams, A. G., & Kyriazakis, I. (2014). The effects of welfare-enhancing system changes on the environmental impacts of broiler and egg production. *Poultry Science*, 93(2), 256-266. doi:10.3382/ps.2013-03252
- Liu, X., Vedlitz, A., & Shi, L. (2014). Examining the determinants of public environmental concern: Evidence from national public surveys. *Environmental Science and Policy*, 39, 77-94. doi:10.1016/j.envsci.2014.02.006
- McGlone, J. J. (2001). Farm animal welfare in the context of other society issues: Toward sustainable systems. *Livestock Production Science*, 72(1-2), 75-81. doi:10.1016/S0301-6226(01)00268-8
- Meuwissen, M., & Van Der Lans, I. (2005). Trade-offs between consumer concerns: An application for pork supply chains. *Acta Agriculturae Scandinavica, Section C - Economy*, 2(1), 27-34. doi:10.1080/16507540510033442
- Mollenhorst, H., Berentsen, P. B., & De Boer, I. J. (2006). On-farm quantification of sustainability indicators: an application to egg production systems. *British Poultry Science*, 47(4), 405-417. doi:10.1080/00071660600829282
- Mollenhorst, H., & De Boer, I. J. M. (2004). Identifying sustainability issues using participatory SWOT analysis: A case study of egg production in the Netherlands. *Outlook on Agriculture*, 33(4), 267-276. doi:10.5367/0000000042664747
- Rodenburg, T. B., Tuytens, F. A. M., de Reu, K., Herman, L., Zoons, J., & Sonck, B. (2008). Welfare assessment of laying hens in furnished cages and non-cage systems: Assimilating expert opinion. *Animal Welfare*, 17(4), 355-361.
- Rollin, B. E. (2004). Annual Meeting Keynote Address: Animal agriculture and emerging social ethics for animals. *Journal of Animal Science*, 82(3), 955-964.
- Rollin, B. E. (2007). Cultural variation, animal welfare and telos. *Animal Welfare*, 16(SUPPL.), 129-133.
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Shimmura, T., Bracke, M. B. M., De Mol, R. M., Hirahara, S., Uetake, K., & Tanaka, T. (2011). Overall welfare assessment of laying hens: Comparing science-based, environment-based and animal-based assessments. *Animal Science Journal*, 82(1), 150-160. doi:10.1111/j.1740-0929.2010.00834.x
- Shimmura, T., Hirahara, S., Azuma, T., Suzuki, T., Eguchi, Y., Uetake, K., & Tanaka, T. (2010). Multi-factorial investigation of various housing systems for laying hens. *British Poultry Science*, 51(1), 31-42. doi:10.1080/0007166090342116
- Slovic, P. (1999). Trust, emotion, sex, politics, and science: Surveying the risk- assessment battlefield. *Risk Analysis*, 19(4), 689-701. doi:10.1023/A:1007041821623
- Spoelstra, S. F., Groot Koerkamp, P. W. G., Bos, A. P., Elzen, B., & Leenstra, F. R. (2013). Innovation for sustainable egg production: Realigning production with societal demands in The Netherlands. *World's Poultry Science Journal*, 69(2), 279-298. doi:10.1017/S0043933913000305
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2016). Survey of egg farmers regarding the ban on

- conventional cages in the EU and their opinion of alternative layer housing systems in Flanders, Belgium. *Poultry Science*, 95(3), 715-725. doi:10.3382/ps/pev334
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2015). Opinion of Belgian egg farmers on hen welfare and its relationship with housing type. *Animals*, 6(1), 1-11. doi:10.3390/ani6010001
- Sturgis, P., Brunton-Smith, I., & Fife-Schaw, C. (2010). Public attitudes to genomic science: An experiment in information provision. *Public Understanding of Science*, 19(2), 166-180. doi:10.1177/0963662508093371
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Thompson, P. B., Appleby, M., Busch, L., Kalof, L., Miele, M., Norwood, B. F., & Pajor, E. (2011). Values and public acceptability dimensions of sustainable egg production. *Poultry Science*, 90(9), 2097-2109. doi:10.3382/ps.2010-0138
- Tuytens, F. A. M., Vanhonacker, F., Van Poucke, E., & Verbeke, W. (2010). Quantitative verification of the correspondence between the Welfare Quality® operational definition of farm animal welfare and the opinion of Flemish farmers, citizens and vegetarians. *Livestock Science*, 131(1), 108-114. doi:10.1016/j.livsci.2010.03.008
- Vanhonacker, F., Van Poucke, E., Tuytens, F. A. M., & Verbeke, W. (2010). Citizens' Views on Farm Animal Welfare and Related Information Provision: Exploratory Insights from Flanders, Belgium. *Journal of Agricultural and Environmental Ethics*, 23(6), 551-569. doi:10.1007/s10806-010-9235-9
- Vanhonacker, F., Verbeke, W., Van Poucke, E., Buijs, S., & Tuytens, F. A. M. (2009). Societal concern related to stocking density, pen size and group size in farm animal production. *Livestock Science*, 123(1), 16-22. doi:10.1016/j.livsci.2008.09.023
- Vanhonacker, F., Verbeke, W., Van Poucke, E., Pieniak, Z., Nijs, G., & Tuytens, F. A. M. (2012). The Concept of Farm Animal Welfare: Citizen Perceptions and Stakeholder Opinion in Flanders, Belgium. *Journal of Agricultural and Environmental Ethics*, 25(1), 79-101. doi:10.1007/s10806-010-9299-6
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2007). Segmentation based on consumers' perceived importance and attitude toward farm animal welfare. *International Journal of Sociology of Food and Agriculture*, 15(3), 91-107.
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Verbeke, W. A. J., & Viaene, J. (2000). Ethical Challenges for Livestock Production: Meeting Consumer Concerns about Meat Safety and Animal Welfare. *Journal of Agricultural and Environmental Ethics*, 12(2), 141-151. doi:10.1023/a:1009538613588
- Weary, D. M., Ventura, B. A., & Von Keyserlingk, M. A. G. (2016). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal*, 10(2), 309-317. doi:10.1017/S1751731115001160
- Xiao, C., & McCright, A. M. (2015). Gender Differences in Environmental Concern: Revisiting the Institutional Trust Hypothesis in the USA. *Environment and Behavior*, 47(1), 17-37. doi:10.1177/0013916513491571
- Xin, H., Gates, R. S., Green, A. R., Mitloehner, F. M., Moore, P. A., & Wathes, C. M. (2011). Environmental impacts and sustainability of egg production systems. *Poultry Science*, 90(1), 263-277. doi:10.3382/ps.2010-00877



Perceptions of citizens, poultry farmers and poultry veterinarians of laying hen welfare

3



To be submitted



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ABSTRACT

In society, questions have been raised about laying hen welfare and about how hens should be kept. Insight into perceptions of hen welfare from different stakeholder groups could provide input on how to deal with the public concerns. Therefore, a quantitative survey by means of an online questionnaire was done to study perceptions of laying hen welfare from Dutch citizen, poultry farmers and poultry veterinarians. Questions regarded the perceptions of the welfare of hens in four different husbandry systems, the influence of various hen welfare aspects on the welfare of hens, and knowledge regarding hen husbandry. Citizens perceived the welfare of hens kept in an organic husbandry system as highest, while farmers and veterinarians perceived the welfare of hens in an indoor non-cage system as highest. These differences in welfare scores could be explained by different perceptions of aspects of hen welfare and knowledge regarding hen behaviour. Socio-demographic characteristics of the citizens were also of influence on the results. Compared to the professionals, citizens perceived the influence of aspects related to natural behaviour higher, and of the aspects pain, and anxiety or stress lower. This may explain the higher welfare scores of citizens and the lower welfare scores of the professionals for the outdoor systems. Several alternatives are suggested to deal with the different perceptions of stakeholder groups in order improve societal support for hen husbandry.

Key words: Animal welfare, husbandry systems, laying hens, perceptions, stakeholders, survey

INTRODUCTION

Last decades, livestock husbandry in western countries has transformed into a sector with predominately intensive husbandry systems, characterized by industrialized, mostly indoor systems with focus on efficient production. Due to this intensification, the number of animals per farm has increased and the number of people involved in livestock production decreased (Golden et al., 2012; Spoelstra et al., 2013). Meanwhile, other animal practices like keeping pets and livestock for hobby has become more important. It has resulted in a broader variety of human-animal relations and thus different views on animals and the way they should be treated (Cohen et al., 2010; Rollin, 2007). The change in views on how to treat animals has given rise to increased public concerns about animal welfare (McGlone, 2001; Rollin, 2007), especially about intensive kept livestock such as laying hens (Eurobarometer, 2005).

Headed by NGO's campaigns the general public asked for more welfare-friendly husbandry systems which led to for instance a ban on the conventional battery cages in the European Union since January 2012 (Council of the European Union, 1999). In the Netherlands, nowadays most laying hens are kept indoors in colony cages or indoor non-cage systems. A minor part of the Dutch hens is kept in free-range systems with outdoor access or in organic systems with outdoor access. The number of hens that has outdoor access is growing and represents about 20% of the total number of layers in the Netherlands (PPE, 2012).

Keeping hens in outdoor systems has raised questions about public health and food safety risks (Harper et al., 2001; Hovi et al., 2003; Verbeke et al., 2000). The use of outdoor runs may result in an increased risk of transmission of pathogens, such as the zoonotic pathogen Avian Influenza, from domestic or wild animals to laying hens (Gonzales et al., 2012; Koch et al., 2006) or an uptake by hens of dioxin, causing higher dioxin levels in outdoor produced eggs (Kijlstra et al., 2009; Schoeters et al., 2006). Consequently, keeping hens in outdoor systems gives rise to a dilemma between on the one hand a potential better animal welfare, and on the other hand public health and food safety risks occurs. The question is to what extent aspects of hen welfare, and especially outdoor access, are perceived as beneficial for hen welfare by citizens and professionals working in poultry husbandry.

To assess hen welfare in different hen husbandry systems several methods have been developed by scientists. The results of these welfare assessments methods differ, because different welfare parameters are taken into account (Mason et al., 1993; Zaludik et al., 2007). The choice and interpretation of welfare parameters depend on the perception of animal welfare, which is influenced by value-based views on what is necessary for animals to have a good life (Fraser, 1995; Mason et al., 1993). One view focuses on the biological functioning of the animal and welfare is measured by parameters like growth or production rate, morbidity and mortality (Fraser, 2003). A second view considers that a good animal life depends on the 'affective states' of animals (Fraser, 2003). According to this view, animal welfare is measured by means of animal-based parameters for aspects such as pain, anxiety or stress. Another view of animal welfare is that animals should lead natural lives. Welfare is perceived in terms of naturalness and animal welfare is assessed by measurement of environmental based parameters for aspects such as space, outdoor access, and opportunities to perform scratching and dust bathing behaviour (Fraser et al., 1997). These different views on good animal welfare may result in different perceptions of hen welfare.

Furthermore, perceptions of animal welfare are influenced by interests, knowledge and experiences with livestock (Te Velde et al., 2002; Vanhonacker et al., 2008). Compared to 60 years ago, less people are involved in animal production and as a consequence citizens became estranged from livestock production (Boogaard et al., 2011). Consequently, citizens and professionals working in laying hen husbandry differ in knowledge regarding for example, the productivity of hen or the behavioural needs of laying hens. It is also likely that professionals are more positively biased towards systems they gained experience in (Stadig et al., 2015), which is most often an indoor husbandry system. Consequently, the perceptions of hen welfare may differ between citizens and professionals, such as poultry farmers and poultry veterinarians. Also among citizens the perceptions may differ, because citizens may have different value-based views towards animals, as mentioned above (Cohen et al., 2012).

After the ban on the conventional battery cages and the introduction of alternative husbandry systems, the discussion on how hens should be kept is ongoing. It is stated that new systems, such as the furnished cage systems, which are developed to improve hen welfare in cage systems, do not address adequately public concerns regarding hen welfare (Weary et al., 2016). Insight into perceptions of citizens, poultry farmers and

poultry veterinarians regarding hen welfare would be valuable input for the development of hen husbandry systems that are more supported by society. Perceptions of farm animal welfare in general (e.g. Bracke et al., 2005; Te Velde et al., 2002; Vanhonacker et al., 2008) or in a specific farm animal species, such as broilers (Tuytens et al., 2014; Vanhonacker et al., 2016), have been studied. However, to our knowledge, no studies have been done on perceptions of hen welfare in citizens, poultry farmers and veterinarians. Therefore, in this study perceptions of the welfare of hens in different husbandry systems from citizens, poultry farmers and poultry veterinarians are analysed. To this end, for the three stakeholder groups the influence of various hen welfare aspects on the welfare of hens, and the influence of knowledge regarding laying hen husbandry on the perceptions of hen welfare are studied. Lastly, within the citizens' group is explored whether different segments of citizens with different perceptions of hen welfare can be identified.

METHODOLOGY

Survey

To collect data concerning perceptions on laying hen welfare from citizen, poultry farmers and poultry veterinarians, a quantitative survey by means of an online questionnaire was done. Respondents answered questions regarding the welfare of laying hens, knowledge of hen husbandry and hen behaviour, and regarding socio-demographic characteristics of the respondents. The questionnaire was developed using literature review and input from a consulting group. The consulting group consisted of experts on the field of hen health, hen welfare, public health, and representatives from different stakeholder groups, e.g. citizens, poultry farmers and poultry veterinarians. During the designing phase of the survey the consulting group provided input on the questionnaire on several occasions. Before the survey was done, the questionnaire was pilot tested for comprehensibility and clarity of the questions. Based on these results the questionnaire was then further optimized and subsequently executed.

Questionnaire

To gain insight into views of laying hen welfare from the stakeholder groups, two questions regarding laying hen welfare were asked. Firstly, the respondents were

asked to rate the welfare of laying hens in four different laying husbandry systems on a 5-point Likert scale ranging from poor to good. The question was: “*What do you think of the welfare of laying hens kept in following husbandry systems?*”. The four most applied systems in the Netherlands, colony cages, indoor non-cage, free-range with outdoor access and organic, were included in this question. For each husbandry system a short description, limited to the most important husbandry characteristics of the system, was given (Table 3.1). This research studies the current perceptions of people. Therefore, only limited information was provided, as new and detailed information may influence the current perceptions of the respondents (Boogaard et al., 2011; Te Velde et al., 2002; Ventura et al., 2016).

Table 3.1 Descriptions of laying hen husbandry systems

Husbandry system	Description
Colony cages*	cages for groups of 80 hens, littered area, nests, perches
Indoor non-cage	free-range on litter and/ or multi-tiered with nests, perches, a little more space
Free-range outdoor	free-range on litter and/ or multi-tiered with nests, perches, more space, outdoor access
Organic	free-range on litter and/ or multi-tiered with nests, perches, more space, outdoor access, beaks are not treated, organic feed.

*In the Netherlands additional legislation for furnished cages exists and these cages are referred to as colony cages

Secondly, the respondents were asked to score to what extent aspects of hen welfare influence hen welfare. The question was: “*To what extent do you think the welfare of laying hens is influenced by the following aspects?*”. Respondents could rate the influence on welfare of each aspect on a five-point Likert scale ranging from absolutely no influence on hen welfare to absolutely does influence hen welfare. Aspects relevant for hen welfare, based on different views on animal welfare – i.e. biological functioning, affective states, and leading natural lives – were selected: hens lay many eggs and mortality; for affective states: pain, anxiety or stress, and injuries, and for naturalness: space to move around freely, environment meets natural needs of the chicken, outdoor access, *ad lib.* feed and water, scratching and dust bathing opportunities, enrichment (straw, grain), a treated beak of the hens.

To assess the knowledge level regarding hen behaviour and production the respondents were asked to indicate for three statements whether they were true or false (Table 3.2). They could also choose for the option “I do not know”. The first statement concerned the egg production rate per hen in order to get some insight into

whether or not people have an idea of the current production level of hens. The second and the third statement concerned issues related to the behavioural needs of hens.

Table 3.2 Statements with correct answers

Statement	Correct answer
1. A laying hen kept for the production of eggs lays an egg every second day.	False
2. A chicken, which never had the opportunity to perform dust bathing behaviour, has no need for dust bathing.	False
3. Scratching behaviour is a natural need for chickens.	True

The last part of the questionnaire concerned questions regarding the socio-demographic characteristics of the respondents. Socio-demographic variables that may influence perceptions of animal welfare, were selected from literature: gender, age, educational level, personal income, urbanisation level of current residence, childhood residence, household with children (yes or no), pet ownership (yes or no), frequency of meat consumption and whether they donate to a nature or animal welfare organisation (Bergstra et al., 2017a; Boogaard et al., 2006; Cohen et al., 2012; Harper et al., 2001; Kendall et al., 2006; Knight et al., 2004; Tuyttens et al., 2010; Vanhonacker et al., 2010; Vanhonacker et al., 2009; Vanhonacker et al., 2007).

Respondents

The survey was carried out among Dutch citizens, poultry farmers and poultry veterinarians through March and April 2014. Because citizens, without being necessarily consumers, participate in the public debate about the laying hen husbandry (Harvey et al., 2013), people were surveyed in their role of citizen. Citizens were approached by CentERdata (www.centerdata.nl), a research institute specialized in online surveys. This institute holds a panel of Dutch citizens, which is representative for the Dutch population. CentERdata approached 3344 panel respondents of whom 2373 (71.0%) started to fill in the questionnaire and 2261 respondents (67.6%) completed the questionnaire. Two respondents were left out the results, because they reported not to have filled in the questionnaire seriously, leaving 2259 valid questionnaires for analysis. Veterinarians registered with the Section Poultry Health (VGP) of the Royal Veterinary Association of the Netherlands (n=144) were invited in an e-mail to fill in the online questionnaire. Of this registered group 51 (35.4%) completed the questionnaire. Of the 51 respondents 41 met our definition of poultry veterinarian – someone working more than 30% of their time as a veterinarian in the

poultry sector – and were included for analysis. We invited Dutch poultry farmers to participate in the survey by a digital newsletter of the Dutch organisation of poultry farmers (NOP), which was sent to approximately 3,000 people interested in poultry husbandry. Also several articles were posted on websites dealing with poultry production, such as the website of Dutch poultry magazine (Pluimveehouderij¹), and on a website regarding agriculture in general. The newsletter and websites were freely available. One hundred poultry farmers, who kept poultry professionally completed the questionnaire.

Statistical analyses

Data were analysed using SPSS 22.0. Analysis of variance was used to assess the effect of the group on (1) the mean hen welfare scores for the four husbandry systems and (2) the mean scores for the influence on hen welfare of 12 aspects. One-way analysis of variance (ANOVA) was done if variances were homogeneous according Levene's test. Not homogeneous variances were analysed using the Welch test. If the effect of the groups was significant, the post-hoc Games-Howell test for multiple comparisons was done to analyse differences between the means of the individual groups.

In the citizens' group, a cluster analysis was done to identify relatively homogeneous segments of citizens regarding the perception of hen welfare aspects. A two-step clustering procedure was performed. The first step was a hierarchical clustering method, Ward's method with Squared Euclidean distances, and aims to define the number of clusters. The number of clusters was determined based on a jump in the agglomeration coefficient. The second step, the K-means clustering, is a non-hierarchical procedure, which further reduces the heterogeneity within the clusters in order to get more accurate cluster memberships. Chi-square analysis was used to analyse the association between firstly, cluster membership and socio-demographic characteristics, and secondly between cluster membership and being farmer or veterinarian and knowledge.

¹ Poultry production: a professional journal for the poultry production sector.

RESULTS

Respondents

The main socio-demographic features of the respondents are presented in Table 3.3. Compared to the CBS data from the Netherlands the citizens' sample was slightly overrepresented with older people and higher educated people. Poultry farmers and poultry veterinarians are predominantly male.

Table 3.3 Socio-demographic characteristics of the respondents

	Citizens (n=2259)	Poultry farmers (n=100)	Poultry veterinarians (n=41)	CBS ¹
Gender (%)				
Male	52.2	88.0	80.5	49.2
Female	47.8	12.0	19.5	50.8
Age (%)				
15 - 34 years	16.6	11.0	12.2	29.3
35 - 54 years	36.8	73.0	51.2	34.2
> 55 years	46.6	16.0	36.6	36.5
Education (%)				
Low	26.7	28.0	0.0	30.9
Intermediate	29.3	43.0	0.0	41.0
High (BSc. /MSc.)	44.0	29.0	100.0	28.1

¹ Data from CBS Statistics Netherlands dated 01-03-2014

Perceptions hen welfare in four systems

The mean welfare scores of laying hens in four different husbandry systems according to the three stakeholder groups are presented in Table 3.4. Citizens scored the welfare of the hens in the four husbandry systems differently from poultry farmers and poultry veterinarians. Citizens perceived the welfare of hens kept in organic husbandry systems as highest, while farmers and veterinarians perceived the welfare of these hens as lowest. Farmers and veterinarians scored the welfare of laying hens in indoor non-cage systems and in colony cages higher than citizens.

Table 3.4 Mean welfare scores (\pm SE) for hens in four different husbandry systems according to citizens, poultry farmers and poultry veterinarians scored on a five-point Likert scale ranging from 1 = 'poor welfare' to 5 = 'good welfare'

	Citizens n = 2259	Poultry farmers n = 100	Poultry veterinarians n = 41	Test statistics	p-value
Colony cages	2.09 ^a \pm 0.022	3.68 ^b \pm 0.129	3.71 ^b \pm 0.149	F2,79.50 = 127.17	< 0.001
Indoor non-cage	2.97 ^a \pm 0.020	4.23 ^b \pm 0.097	4.10 ^b \pm 0.109	F2,2397 = 110.50	< 0.001
Free-range outdoor	3.84 ^a \pm 0.018	3.00 ^b \pm 0.151	3.61 ^a \pm 0.178	F2,77.61 = 127.17	< 0.001
Organic	4.34 ^a \pm 0.018	2.83 ^b \pm 0.158	3.15 ^b \pm 0.199	F2,77.40 = 62.25	< 0.001

^{a,b} Means within a row with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test)

Aspects of hen welfare

To find out how the respondents perceive aspects of hen welfare, the three stakeholder groups were asked to score the influence on hen welfare for 12 different aspects on a five-point Likert scale ranging from 1 = absolutely not influences welfare, to 5 = absolutely influences welfare. For each stakeholder group mean scores for the welfare aspects are presented in Figure 3.1. The range of the mean scores from poultry farmers (2.40 - 4.31) and poultry veterinarians (2.27 - 4.51) was larger than the range of the mean scores from citizens (3.42 - 4.32). The influence on laying hen welfare of the aspects 'injuries' and 'mortality' were not scored differently ($p > 0.05$) by the three stakeholder groups while the other aspects were scored differently among the groups ($p < 0.05$).

Citizens gave the highest scores for the aspects related to naturalness: 'space to move around freely', 'environment meets natural needs', 'outdoor access', 'ad lib. feed and water', 'scratching and dust bathing opportunities' and 'enrichment'. Farmers and veterinarians scored the influence of the aspects 'pain', 'anxiety or stress', and 'injuries' as highest and scored the influence of 'outdoor access' as lowest. Veterinarians scored the influence on hen welfare of 'scratching and dust bathing opportunities' higher than farmers did and not differently from citizens. The biggest difference in scores between citizens and the two professional groups regarded the aspects 'outdoor access' and 'hens lay many eggs'.

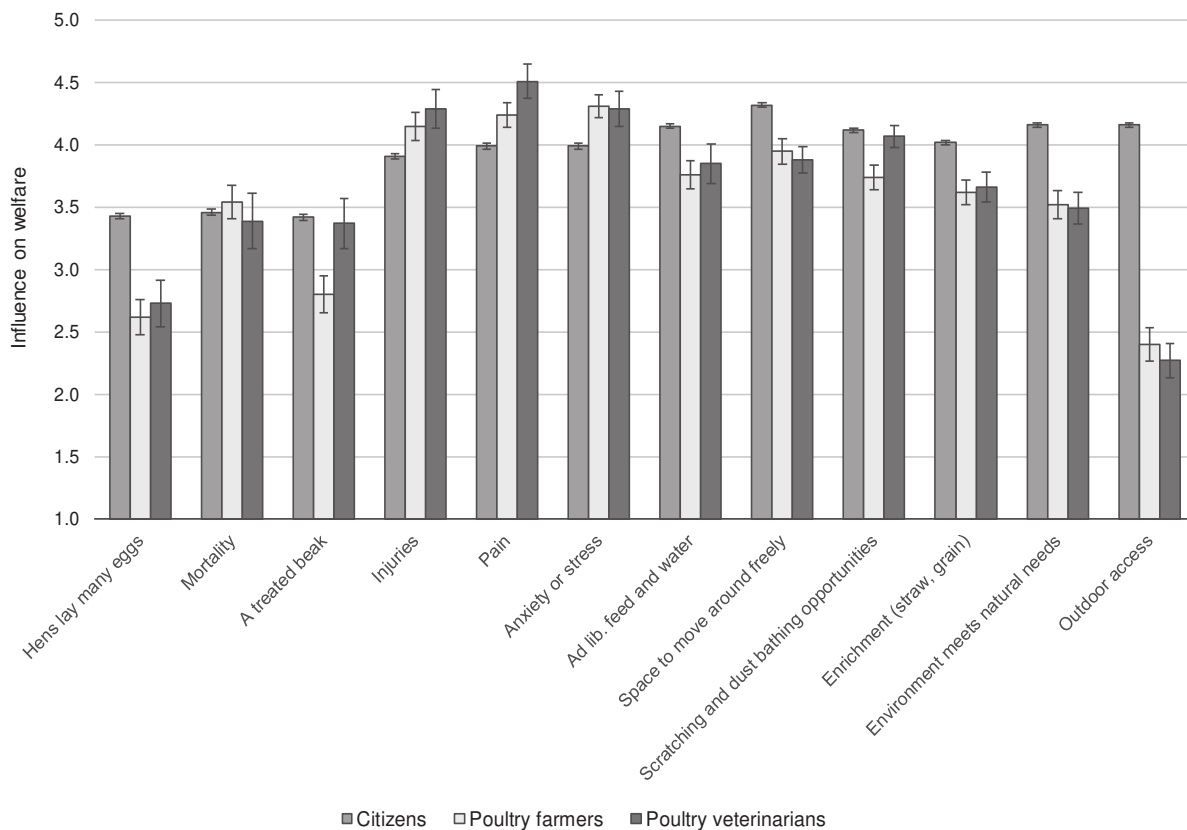


Figure 3.1 Mean scores (\pm SE) for 12 aspects of hen welfare for each stakeholder group scored on a five-point Likert scale ranging from 1 = ‘absolutely no influence’ to 5 = ‘absolutely does influence welfare’

Citizens analysis

Clusters of citizens

Results of the cluster analysis showed that, based on the scores respondents gave for the welfare aspects, four clusters of citizens can be distinguished (Figure 3.2). The first cluster consists of 18.1% of the citizens ($n = 410$). This cluster scored on average the influence of the aspects on hen welfare lower than the other clusters and is therefore called the Low cluster (LC). The second cluster is the largest cluster and includes 42.8% of the citizens ($n = 967$). This cluster ascertains moderate influence on all welfare aspects and will be referred to as the Moderate cluster (MC). The third cluster consists of 28.7% of the citizens ($n = 648$), who scored on average the influence of aspects on hen welfare higher than the other clusters and is therefore called the High cluster (HC). The last cluster holds the lowest number of citizens ($n=234$, 10.4%). This cluster of respondents scored the influence of the aspects ‘space to move around freely’, ‘environment meets natural needs’, ‘outdoor access’, ‘ad lib. feed and water’, ‘scratching and dust bathing opportunities’ and ‘enrichment’ high,

while they scored the other aspects low. Therefore, this cluster is called the Diverse cluster (DC). The mean scores for most aspects differed among the four clusters ($p < 0.001$). However, the scores of the Moderate and Diverse cluster for ‘space to move around freely’ and ‘enrichment’, and the scores of the Low and Diverse cluster for ‘hens lay many eggs’ did not differ ($p > 0.05$).

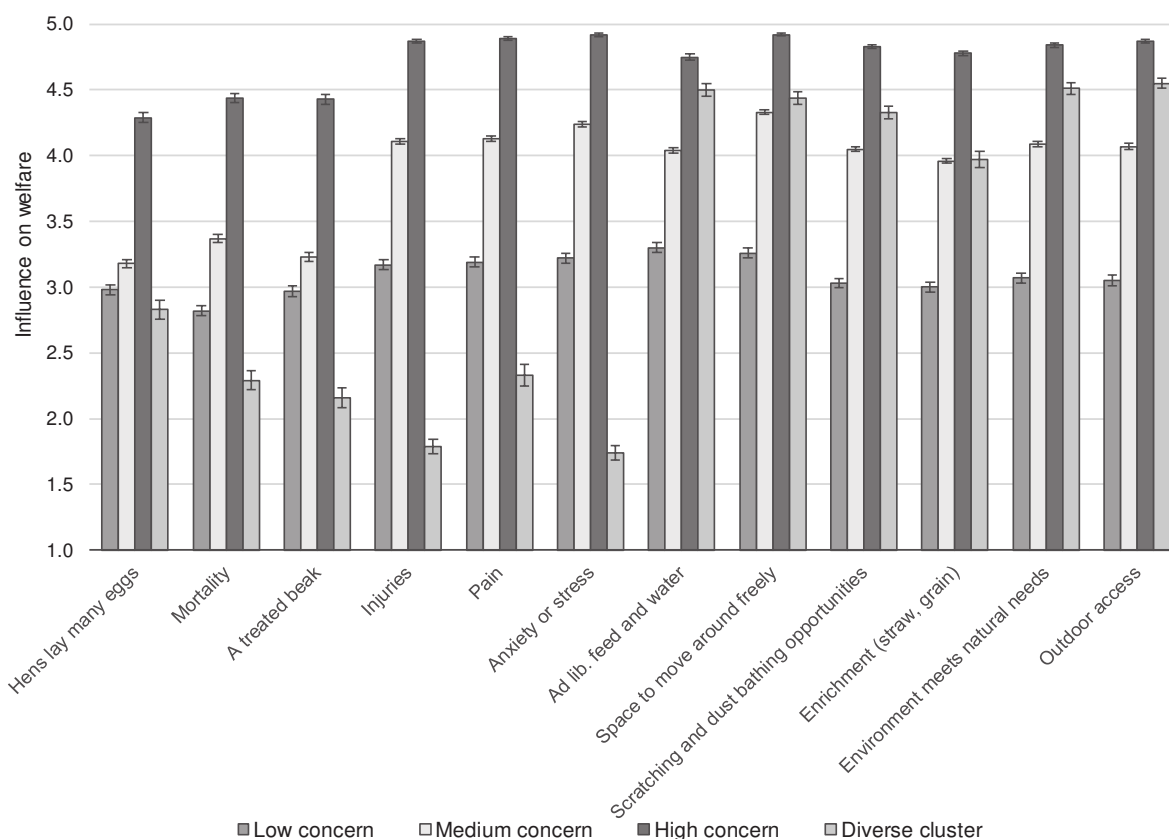


Figure 3.2 Mean scores (\pm SE) for 12 aspects of hen welfare for each cluster of citizens, the Low cluster ($n = 410$), Moderate cluster ($n = 967$), High cluster ($n = 648$) and Diverse cluster ($n = 234$), on a five-point Likert scale ranging from 1 = ‘absolutely no influence on hen welfare’ to 5 = ‘absolutely does influence hen welfare’

To analyse the clusters of citizens further, the mean welfare scores of hens in four different husbandry systems are presented per cluster in Table 3.5. Overall all clusters of citizens ranked the hen welfare in the different systems in the same order, with colony cages as the lowest welfare and organic system as the highest welfare. Compared to the Moderate and the Low cluster, the High cluster discriminated more in welfare scores as shown by a large range in mean scores (1.63 to 4.65). The mean welfare scores did not differ between the Diverse cluster and the Moderate cluster, but the scores of the High and the Low cluster differed from the Diverse and the Low cluster.

Table 3.5 Mean welfare scores (\pm SE) for hens in four different husbandry systems per cluster of citizens scored on a five-point Likert scale ranging from 1 = 'poor welfare' to 5 = 'good welfare'

	LC	MC	HC	DC	Test statistics	<i>p</i> -value
Colony cages	2.83 ^a \pm 0.047	2.07 ^b \pm 0.031	1.63 ^c \pm 0.036	2.09 ^b \pm 0.072	F(3, 787.55) = 137.25	<0.001
Indoor non-cage	3.30 ^a \pm 0.040	3.03 ^b \pm 0.028	2.61 ^c \pm 0.039	3.09 ^b \pm 0.069	F(3, 790.61) = 52.93	<0.001
Free-range	3.60 ^a \pm 0.041	3.91 ^{bc} \pm 0.024	3.83 ^c \pm 0.036	4.04 ^b \pm 0.058	F(3, 778.37) = 18.52	<0.001
Organic	3.68 ^a \pm 0.046	4.43 ^b \pm 0.024	4.65 ^c \pm 0.026	4.33 ^b \pm 0.060	F(3, 765.68) = 113.29	<0.001

LC = Low cluster (n = 410), MC = Moderate cluster (n = 967), HC = High cluster (n = 648), DC = Diverse cluster (n = 234)

^{a,b,c} Means within a row with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test)

Socio-demographic characteristics

The four clusters differed in socio-demographic characteristics (Table 3.6). Childhood residence ($p = 0.191$) and income ($p = 0.055$) did not differ among the clusters and are not presented in Table 3.6. All other socio-demographic characteristics differed significantly between the four clusters ($p < 0.05$). Compared to the sample mean, the citizens of the Low cluster are male more often, between 45 and 64 years of age, have pets less often, consume meat more frequently and donate to an animal welfare or nature organisation less often. The Moderate cluster seems most comparable with the sample mean, but includes citizens who are more likely to be male with a higher level of education and consume meat more often than the sample mean. The High cluster consists of citizens who are compared to the sample mean, females more often and between 25 and 44 years old, higher educated, have pets more often, consume meat less frequent, and donate to an animal welfare or nature organisation more often. Compared to the sample mean, the Diverse cluster consists of more citizens above 65 years, who are lower educated, have a household with children less often and consume meat less frequently.

Table 3.6 Socio-demographic representation per cluster of citizens and test statistics

	TC	LC	MC	HC	DC	Test statistics	p-value
Gender (%)						$\chi^2(3) = 45.79$	< 0.001
Male	52.2	61.0	55.5	41.7	52.6		
Female	47.8	39.0	44.5	58.3	47.4		
Age (%)						$\chi^2(15) = 129.99$	< 0.001
15 - 24 years	2.7	4.4	2.7	1.7	2.1		
25 - 34 years	13.9	15.6	14.2	16.2	3.4		
35 - 44 years	23.4	21.5	23.8	27.2	14.5		
45 - 54 years	13.5	16.6	14.5	12.5	6.4		
55 - 64 years	19.3	21.2	19.5	18.1	18.8		
>65 years	27.3	20.7	25.3	24.4	54.7		
Education (%)						$\chi^2(15) = 80.26$	< 0.001
Primary school	4.2	4.4	3.8	3.2	8.1		
Lower secondary	22.5	29.0	19.5	18.2	35.0		
Higher secondary	11.2	11.5	11.4	12.0	7.7		
Vocational	18.1	19.5	16.3	19.1	20.1		
Bachelor	28.8	24.6	30.8	30.7	22.6		
Master	15.2	11.0	18.1	16.7	6.4		
Urbanisation ¹ (%)						$\chi^2(12) = 24.39$	0.018
Very high urbanisation	15.0	14.3	14.3	16.9	15.2		
High urbanisation	25.7	24.7	25.1	29.1	23.4		
Moderate urbanisation	19.8	18.0	19.3	21.1	23.8		
Little urbanisation	20.8	24.9	23.7	15.6	18.6		
No urbanisation	17.6	18.0	17.6	17.3	19.0		
Household with children (%)						$\chi^2(3) = 23.48$	< 0.001
Yes	37.8	38.9	38.9	37.8	24.4		
No	62.2	61.1	61.1	62.2	75.6		
Pet ownership (%)						$\chi^2(3) = 31.83$	< 0.001
Yes	47.0	39.3	45.1	55.7	44.0		
No	53.0	60.7	54.9	44.3	56.0		
Frequency of meat consumption (%)						$\chi^2(6) = 58.08$	< 0.001
6-7 times a week	41.7	52.0	44.5	35.3	30.3		
2-5 times a week	48.5	41.5	47.8	50.3	59.0		
0-1 time a week	9.7	6.6	7.8	14.4	10.7		
Donates to a nature or animal welfare organisation (%)						$\chi^2(3) = 66.83$	< 0.001
Yes	37.8	21.0	39.8	45.4	38.5		
No	62.2	79.0	60.2	54.6	61.5		

CI = citizens (n = 2259), PF = poultry farmers (n=100) PV = poultry veterinarians (n = 41)

TC = total citizens, LC = Low cluster (n = 410), MC = Moderate cluster (n = 967), HC = High cluster (n = 648), DC = Diverse cluster (n = 234)

¹ Number of inhabitants per square kilometre (Very high urbanisation: > 2500, High urbanisation: 1500 – 2500, Moderate urbanisation: 1000 – 1500, Little urbanisation: 500 – 1000, No urbanisation: less than 500)

Knowledge of laying hen husbandry

Three statements regarding knowledge about the hen behaviour and production were asked to study the effect of knowledge on the perceptions of hen welfare. The results of the four clusters of citizens, poultry farmers and veterinarians are presented in Table 3.7. Compared to poultry farmers and veterinarians, citizens answered the least number of statements correctly. Of the citizens, 48.7% answered the statement regarding egg production rate correctly, 17.5% answered the statement incorrectly, and 33.8% indicated not to know the answer. The statement regarding dust bathing behaviour is answered correctly by 44.0% of the citizens and incorrectly by 5.4% of the citizens, while 50.6% of the citizens responded not know the answer. Of the three statements, citizens answered the statement regarding scratching behaviour most often correctly (87.5%), least often incorrectly (2.2%) and least often answered 'I do not know' (10.4%). Poultry veterinarians scored all three statements correctly (81%) more often than poultry farmers (65%) and citizens (27%). Citizens answered 'I do not know' more often than the two professional groups did. For the statements regarding hen behaviour, citizens chose the incorrect answer less often than farmers did.

Table 3.7 Percentage of correct, incorrect and "I do not know" answers on questions regarding laying hen production and behaviour in four clusters of citizens, and poultry farmers and poultry veterinarians

		CI				PF	PV
		LC	MC	HC	DC		
A laying hen kept for the production of eggs lays an egg every second day	Correct (%)	39.8	52.3	50.5	44.4	95.0	90.2
	Incorrect (%)	15.1	17.4	14.5	30.8	5.0	9.8
	I do not know (%)	45.1	30.3	35.0	24.8	0.0	0.0
A chicken which never had the opportunity to perform dust bathing behaviour, has no need for dust bathing	Correct (%)	27.1	43.6	54.0	47.0	69.0	90.2
	Incorrect (%)	9.8	5.7	1.9	6.8	11.0	2.4
	I do not know (%)	63.2	50.7	44.1	46.2	20.0	7.3
Scratching behaviour is a natural need for chickens	Correct (%)	66.8	91.2	92.9	93.2	89.0	97.6
	Incorrect (%)	4.6	1.7	1.5	1.7	6.0	2.4
	I do not know (%)	28.5	7.1	5.6	5.1	5.0	0.0

CI = citizens (n = 2259); PF = poultry farmers (n=100); PV = poultry veterinarians (n = 41).

LC = Low cluster (n = 410); MC = Moderate cluster (n = 967); HC = High cluster (n = 648); DC = Diverse cluster (n = 234).

Cluster membership, being poultry farmer or poultry veterinarian were significant associated with knowledge regarding egg production rate ($\chi^2(10) = 175.96$; $p < 0.001$), dust bathing behaviour ($\chi^2(10) = 159.71$; $p < 0.001$), and scratching behaviour ($\chi^2(10) = 218.56$; $p < 0.001$). Of the four clusters of citizens, the High cluster scored in total the most statements correctly. The Low cluster scored the least statements correctly and scored the highest percentage 'I do not know'. The Moderate cluster scored statement regarding the production of laying hens more often correctly than the others, but scored the statements regarding hen behaviour less often correctly than the High and Diverse cluster.

Knowledge in relation to welfare aspects

For the citizens' group, it was tested whether the knowledge level regarding hen production and hen behaviour was associated with the welfare scores for the systems or was associated with the scores for the 12 welfare aspects (Table 3.8). Regardless of the answers for the three knowledge questions, the mean hen welfare in the colony cages was scored as lowest and in the organic systems as highest. However, the range in welfare scores for the two statements regarding behaviour is larger in the group that answered a statement correctly than the group that answered incorrectly or indicated not to know the answer. Citizens who answered the statement regarding scratching behaviour and dust bathing behaviour correctly scored all aspects, except for 'hens lay many eggs', higher than citizens who answered these statements incorrectly ($p < 0.05$).

Table 3.8 Citizens' knowledge regarding laying hen welfare production and behaviour, and scores for hen welfare in four systems and for aspects of hen welfare

	A laying hen kept for the production of eggs lays an egg every second day		A chicken, which never had the opportunity to perform dust bathing behaviour, has <i>no</i> need for dust bathing		Scratching behaviour is a natural need for chickens				
	C n = 1100	I n = 396	Dnk n = 763	C n = 993	I n = 123	Dnk n = 1143	C n = 1976	I n = 49	Dnk n = 234
Welfare scores hen husbandry systems									
Colony cages	2.08	2.01	2.13	1.91 ^a	2.70 ^b	2.18 ^c	2.01 ^a	2.61 ^b	2.64 ^b
Indoor non-cage	2.98	3.02	2.92	2.85 ^a	3.43 ^b	3.02 ^c	2.95 ^a	3.33 ^b	3.07 ^{ab}
Free-range outdoor	3.89 ^a	3.93 ^a	3.73 ^b	3.86	3.94	3.82	3.89 ^a	3.88 ^a	3.45 ^b
Organic	4.41 ^a	4.35	4.25 ^b	4.44 ^a	4.11 ^b	4.28 ^b	4.42 ^a	4.14 ^{ab}	3.74 ^b
Scores for aspects of hen welfare									
Pain	4.09 ^a	3.79 ^b	3.96 ^c	4.10 ^a	3.65 ^b	3.91 ^c	4.04 ^a	3.84	3.58 ^b
Anxiety or stress	4.08 ^a	3.78 ^b	3.97 ^a	4.11 ^a	3.70 ^b	3.91 ^b	4.05 ^a	3.78	3.56 ^b
Injuries	3.99 ^a	3.72 ^b	3.91 ^b	4.01 ^a	3.65 ^b	3.86 ^b	3.96 ^a	3.61	3.56 ^b
Space to move around freely	4.36 ^a	4.34	4.23 ^b	4.46 ^a	3.98 ^b	4.22 ^c	4.39 ^a	4.04 ^b	3.71 ^b
Environment meets the natural needs	4.18	4.19	4.12	4.31 ^a	3.66 ^b	4.09 ^c	4.24 ^a	3.80 ^b	3.58 ^b
Outdoor access	4.17	4.21	4.12	4.31 ^a	3.65 ^b	4.09 ^c	4.24 ^a	3.78 ^b	3.59 ^b
<i>Ad lib.</i> feed and water	4.20 ^a	4.22 ^a	4.06 ^b	4.28 ^a	3.98 ^b	4.06 ^b	4.22 ^a	3.80 ^b	3.64 ^b
Scratching and dust bathing opportunities	4.17 ^a	4.12	4.04 ^b	4.32 ^a	3.69 ^b	3.99 ^c	4.20 ^a	3.90 ^a	3.51 ^b
Enrichment (straw, grain)	4.07 ^a	4.02	3.96 ^b	4.20 ^a	3.61 ^b	3.92 ^c	4.08 ^a	3.86	3.54 ^b
Mortality	3.50	3.37	3.47	3.55 ^a	3.11 ^b	3.43 ^c	3.49 ^a	3.31	3.31 ^b
Hens lay many eggs	3.44	3.35	3.45	3.48	3.34	3.39	3.44 ^a	3.47	3.27 ^b
A treated beak in hens	3.47 ^a	3.17 ^b	3.48 ^a	3.47 ^a	3.16 ^b	3.41 ^b	3.44 ^a	3.37	3.27 ^b

^{a,b,c} Means within a row within a statement with different superscripts differ significantly at $p < 0.05$ (Post-hoc Games Howell multiple comparisons test
C = Correct, I = Incorrect, Dnk = I do not know



DISCUSSION

Despite several adaptations in laying hen husbandry to improve laying hen welfare, such as the ban on conventional cages, society still expresses concerns about laying hen welfare. Due to the intensification of livestock production, less citizens are involved in hen husbandry. However, their views on animal husbandry became more important, because their influence on decision making concerning animal husbandry, especially through NGO's, has enhanced (Boogaard et al., 2011). Insight into current perceptions and the knowledge of citizens, poultry farmers and poultry veterinarians regarding hen welfare may provide input how to deal with these developments. Therefore, by means of an online questionnaire, the perceptions of citizens, poultry farmers and poultry veterinarians regarding laying hen welfare were studied.

Perceptions of hen welfare

The majority of the Dutch citizens perceived a husbandry system with outdoor access as the best system for laying hen husbandry, while the majority of poultry farmers and poultry veterinarians perceived an indoor system as the best system (Chapter 2). This study shows that the perceptions of the welfare of hens in four different husbandry systems also differ between citizens and the two professional groups. Farmers and veterinarians scored the welfare of hens in the indoor non-cage system as highest, while citizens scored the welfare of hens in the organic system as highest. On the contrary, hen welfare in organic system was scored as lowest by farmers and veterinarians. Certifications programs, such as the Better Life hallmark of the Dutch Society for the Protection of Animals, claim that systems with outdoor access provide higher levels of hen welfare (Van Wijk-Jansen et al., 2009). Dutch citizens evaluate hen welfare in the systems in accordance with such certifications programs, while farmers and veterinarians do not evaluate hen welfare in accordance with these certifications programs. Most of the poultry farmers in our sample scored hen welfare highest in the system they practice themselves, which confirms that experience with a system may result in higher welfare scores for that system (Stadig et al., 2015).

Aspects of hen welfare

The differences in welfare judgments between stakeholder groups may be explained by how they perceive different aspects of hen welfare. Poultry farmers and poultry

veterinarians scored hen welfare aspects related to natural behaviour, like ‘space to move around freely’, ‘environment meets natural needs’, ‘outdoor access’, ‘scratching and dust bathing opportunities’, and ‘enrichment’, lower than citizens did. These results match with earlier studies regarding perceptions of general farm animal welfare (Te Velde et al., 2002; Tuyttens et al., 2010; Vanhonacker et al., 2008). Notable is that farmers and veterinarians scored the aspects ‘environment meets natural needs’ and especially ‘outdoor access’ considerably lower than citizens did. Most studies on scientific welfare assessment of hens kept in various systems show that indoor systems perform better on freedom from pain, injuries and diseases than outdoor systems (Lay Jr et al., 2011; Shimmura et al., 2011; Shimmura et al., 2010). Farmers and veterinarians perceived the influence on hen welfare of the aspects ‘pain’, ‘injuries’, and ‘anxiety or stress’ higher than influence of the natural behaviour aspects, which may explain their high welfare scores for the indoor systems. In contrast citizens scored the influence on hen welfare of the aspects ‘space to move around freely’, ‘environment meets natural needs’, ‘outdoor access’, ‘*ad lib.* feed and water’, ‘scratching and dust bathing opportunities’, and ‘enrichment’ higher than ‘pain’, ‘injuries’, and ‘anxiety or stress’. Outdoor systems score better on opportunities to perform natural behaviour than indoor systems (Freire et al., 2013; Lay Jr et al., 2011; Shimmura et al., 2010). This may clarify citizens’ higher welfare scores for outdoor systems than for indoor systems.

The specific perceptions of hen welfare in the different stakeholder groups may be explained by several factors. First, the high scores for the aspects ‘pain’, ‘injuries’, and ‘anxiety or stress’ from farmers and veterinarians are compatible with a Rational/Industrial world-view, which focusses on productivity and progress. People with this world-view perceive a good animal life as a healthy life and consequently they focus on disease prevention and prefer animals in confinement (Fraser, 2008). Animal welfare is for professionals a way to achieve economic results (Hubbard et al., 2011; Kendall et al., 2006) and thus they focus predominantly on health and productivity of the hens. Second, most farmers and veterinarians are predominantly male. It has been shown that males are less concerned about animal welfare and attribute to animals less mental capacities, such as feelings and emotions, than do females (Kendall et al., 2006; Knight et al., 2004). Moreover, changing to a system that offers more opportunities to perform natural behaviour involves high investments and may not be economically profitable (Te Velde et al., 2002). Citizens scored the

animal health aspects lower than the natural behaviour aspects, which is in line with other studies on perceptions of animal welfare that report that citizens perceive animal welfare in terms of freedom to express natural behaviour and leading natural lives (Bracke et al., 2005; Fraser, 2003; Fraser et al., 1997; Te Velde et al., 2002; Vanhonacker et al., 2008). This perception of hen welfare, which focusses on leading natural lives, is in accordance with a Romantic/Agrarian world-view, which perceives good animal life as a natural life. People with this view emphasise on the importance of emotions of animals and the freedom to perform natural behaviour. People with the Romantic/Agrarian world-view therefore prefer free-range systems with outdoor access (Fraser, 2008).

Citizens perceived the influence on welfare of ‘a treated beak’ and ‘hens lay many eggs’ higher than farmers and veterinarians. However, respondents may have interpreted these aspects in two ways. Especially citizens might have perceived ‘a treated beak’ as a surgical intervention and a ‘high production rate’ as an indicator of the intensity or industrialisation of hen husbandry. Therefore, citizens may have perceived these two aspects negatively for hen welfare. On the contrary, farmers might have thought that trimming of the beaks will affect hen welfare positively, because it reduces feather pecking and cannibalism in the flock (Jendral et al., 2004). Farmers and veterinarians view biological functioning as an important aspect of hen welfare (Fraser et al., 1997; Te Velde et al., 2002) and may therefore view ‘hens lay many eggs’ as an indicator for good welfare.

Clusters of citizens

Cluster analysis of citizens revealed that within the Dutch citizens four groups of citizens can be recognised based on how they scored aspects of hen welfare. None of these clusters scored the welfare aspects in accordance with the professionals. The Low, Moderate and High cluster show a similar pattern in scores, but the average scores are respectively low, moderate and high. The Diverse cluster however, shows a different pattern in their evaluation of hen welfare aspects. The Diverse cluster scored the aspects ‘pain’, ‘anxiety or stress’ and ‘injuries’ to have little influence on hen welfare. It may be that this cluster interpreted the question differently and scored these aspects to have a negative influence on hen welfare. Furthermore, the clusters do not differ in the ranking of hen welfare scores for the four husbandry systems. All four clusters scored the hen welfare in the colony cages as lowest and the welfare in

the organic systems as highest. The range in scores for the husbandry systems however, differs among the clusters, with the High cluster scoring the largest range and the Low cluster the smallest range of the four clusters.

Socio-demographic characteristics

The High cluster, representing 29% of the citizens, is compared to the other clusters composed of more females, younger, higher educated citizens, who are pet owner more often, consume less meat and donate to an animal welfare or nature organisation more often. According to literature, females, vegetarians, higher educated people and pet owners are more concerned about animal welfare in general (Cohen et al., 2012; Kendall et al., 2006; Knight et al., 2004; Paul et al., 1993; Vanhonacker et al., 2007). Compared to the other clusters, the low cluster scored all aspects of hen welfare lower and they discriminated less in welfare scores for the four husbandry systems.

Compared to the other clusters, the Low cluster, representing 18% of the respondents, consists of more males, lower educated citizens, who have less often pets, consume more often meat and donate less often to an animal welfare or nature organisation. Therefore, it may be concluded that citizens from the Low cluster perceive hen welfare as a less important issue, whereas the citizens from the high cluster perceive hen welfare as an important issue. Cluster analysis was not performed on farmers and veterinarians because there were not enough respondents in these groups. Studies regarding pig farmers have shown that within pig farmers the perception regarding animal welfare can differ (Bergstra et al., 2017b; Hubbard et al., 2011). Therefore, also within poultry farmers and poultry veterinarians, different clusters may consist based on how they view hen welfare.

Knowledge

The information about the four husbandry systems provided to the respondents in the questionnaire was limited to the most important husbandry characteristics of the systems. The objective was to get insight into current perceptions of participants and therefore neither technical nor performance parameters were provided. Consequently, respondents may have judged hen welfare while having limited knowledge about the systems and their performance on hen welfare. Assessment of knowledge regarding laying hen behaviour and egg production by three questions confirmed that farmers and veterinarians were more knowledge about laying hen behaviour than citizens.

Veterinarians and farmers differed in knowledge about hen behaviour. It has been shown that farmers do not seek for information on animal welfare (Te Velde et al., 2002), which might explain the difference in knowledge between farmers and veterinarians.

Conclusion and implications

This study shows that perceptions of hen welfare in four systems differed among clusters of citizens and between citizens and poultry farmers and poultry veterinarians. The differences could be explained by different perceptions of aspects of hen welfare and underlying world-views, socio-demographic characteristics and knowledge. To deal with these different perceptions in order to improve societal support for laying hen husbandry, different options have been suggested. The sector believes that providing information to citizens will change citizens' perceptions of livestock husbandry in perception that are more in line with the perception of the sector (Benard et al., 2013). However, the 'knowledge deficit' model as an explanation for differences between citizens and professionals, which presumes that concerns can be repaired through education, has been questioned (Hansen et al., 2003; Ventura et al., 2016). Also, our results do not support the knowledge deficit model, because the citizens with more knowledge about hen behaviour value hen welfare more differently from farmers and veterinarians than citizens with less knowledge.

Citizens and professionals differ in knowledge and they differ in moral values regarding animals (Cohen et al., 2012; Fraser, 2008). Moral values are deeply rooted and consequently perceptions will not easily change by one-way education. Another option would be to adapt current systems more in line with the citizens' perceptions. The perceptions of animal welfare from citizens suggest that systems should offer to the hens more opportunities to express natural behaviour and should offer outdoor access. However, farmers and veterinarians perceive indoor systems, which may perform better than outdoor systems on both animal health and public health, as the best systems. Although the current research shows that citizens, poultry farmers and poultry farmers perceive hen welfare differently, they all perceive animal health related aspects to have a high influence on hen welfare. Moreover, it has been shown that citizens and farmers share a number of values, such as animals have value, duty to care and protect animals (Cohen, 2010), and love for animals (Benard et al., 2013). These shared moral values could be a starting point for reaching consensus about how

systems could benefit hen welfare. Interactive multi-stakeholder design methods, such as used to develop Roundel, an innovative system that to allow hens to perform their natural behaviour and brought the outdoor access indoors, show that such design method can be successful (Groot Koerkamp et al., 2008; Spoelstra et al., 2013). Our study shows a wide variation of perceptions of hen welfare within and between stakeholder groups. Consequently, it may be interesting to focus on specific groups of citizens and professionals instead of considering them as one uniform group. In that way, husbandry systems might be adapted or developed that are beneficial for hen welfare and may count on support of multiple stakeholder groups

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REFERENCES

- Benard, M., & de Cock Buning, T. (2013). Exploring the Potential of Dutch Pig Farmers and Urban-Citizens to Learn Through Frame Reflection. *Journal of Agricultural and Environmental Ethics*, 26(5), 1015-1036. doi:10.1007/s10806-013-9438-y
- Bergstra, T. J., Hogeveen, H., Erno Kuiper, W., Oude Lansink, A. G. J. M., & Stassen, E. N. (2017a). Attitudes of Dutch Citizens toward Sow Husbandry with Regard to Animals, Humans, and the Environment. *Anthrozoös*, 30(2), 195-211. doi:10.1080/08927936.2017.1310985
- Bergstra, T. J., Hogeveen, H., & Stassen, E. N. (2017b). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values*, 34(2), 393-405. doi:10.1007/s10460-016-9721-4
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2006). Elements of societal perception of farm animal welfare: A quantitative study in The Netherlands. *Livestock Science*, 104(1-2), 13-22. doi:10.1016/j.livsci.2006.02.010
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, 5(9), 1458-1466. doi:10.1017/S1751731111000371
- Bracke, M. B. M., de Greef, K. H., & Hopster, H. (2005). Qualitative stakeholder analysis for the development of sustainable monitoring systems for farm animal welfare. *Journal of Agricultural and Environmental Ethics*, 18(1), 27-56. doi:10.1007/s10806-004-3085-2
- Cohen, N. E. (2010). General discussion *Thesis: Considering animals. Moral convictions concerning animals and judgement on the culling of healthy animals in animal disease epidemics*. Wageningen, the Netherlands: Wageningen University.
- Cohen, N. E., Brom, F., & Stassen, E. (2010). Keeping backyard animals in the Netherlands. A study into to the nature of the practice, its specific human-animal bond and views on the culling of healthy animals during an animal disease epidemic. In: *Considering animals. Moral convictions concerning animals and judgement on the culling of healthy animals in animal disease epidemics* (PhD thesis, pp. 35-51). Wageningen, the Netherlands: Wageningen University.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, 25(3), 353-367. doi:10.2752/175303712x13403555186334
- Council of the European Union (1999). Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens. *Official Journal of the European Communities*, L 203, 53-57.
- Eurobarometer. (2005). *Attitudes of consumers towards the welfare of farmed animals* (229). Retrieved from Brussels, Belgium: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_229_en.pdf
- Fraser, D. (1995). Science, Values and Animal Welfare: Exploring the 'Inextricable Connection'. *Animal Welfare*, 4(2), 103-117.
- Fraser, D. (2003). Assessing animal welfare at the farm and group level: the interplay of science and values. *Animal Welfare*, 12(4), 433-443.
- Fraser, D. (2008). Understanding animal welfare. *Acta Veterinaria Scandinavica*, 50(Suppl 1):S1. doi:10.1186/1751-0147-50-s1-s1
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6(3), 187-205.
- Freire, R., & Cowling, A. (2013). The welfare of laying hens in conventional cages and alternative systems: First steps towards a quantitative comparison. *Animal Welfare*, 22(1), 57-65. doi:10.7120/09627286.22.1.057
- Golden, J. B., & Arbona, D. V. (2012). Intensive versus extensive management systems in commercial egg production. *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 7, 1-12. doi:10.1079/PAVSNR20127050

- Gonzales, J. L., Elbers, A. R. W., Bouma, A., Koch, G., de Wit, J. J., & Stegeman, J. A. (2012). Transmission characteristics of low pathogenic avian influenza virus of H7N7 and H5N7 subtypes in layer chickens. *Veterinary Microbiology*, *155*(2-4), 207-213. doi:10.1016/j.vetmic.2011.09.016
- Groot Koerkamp, P. W. G., & Bos, A. P. (2008). Designing complex and sustainable agricultural production systems: an integrated and reflexive approach for the case of table egg production in the Netherlands. *NJAS - Wageningen Journal of Life Sciences*, *55*(2), 113-138. doi:10.1016/S1573-5214(08)80032-2
- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, *41*(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Harper, G. C., & Henson, S. (2001). *Consumer concerns about animal welfare and the impact on food choice* (Final report). Retrieved from http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf
- Harvey, D., & Hubbard, C. (2013). Reconsidering the political economy of farm animal welfare: An anatomy of market failure. *Food Policy*, *38*(1), 105-114. doi:10.1016/j.foodpol.2012.11.006
- Hovi, M., Sundrum, A., & Thamsborg, S. M. (2003). Animal health and welfare in organic livestock production in Europe: current state and future challenges. *Livestock Production Science*, *80*(1-2), 41-53. doi:10.1016/S0301-6226(02)00320-2
- Hubbard, C., & Scott, K. (2011). Do farmers and scientists differ in their understanding and assessment of farm animal welfare? *Animal Welfare*, *20*(1), 79-87.
- Jendral, M. J., & Robinson, F. E. (2004). Beak trimming in chickens: historical, economical, physiological and welfare implications, and alternatives for preventing feather pecking and cannibalistic activity. *Avian and Poultry Biology Reviews*, *15*(1), 9-23. doi:10.3184/147020604783637444
- Kendall, H. A., Lobao, L. M., & Sharp, J. S. (2006). Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology*, *71*(3), 399-428. doi:10.1526/003601106778070617
- Kijlstra, A., Meerburg, B. G., & Bos, A. P. (2009). Food Safety in Free-Range and Organic Livestock Systems: Risk Management and Responsibility. *Journal of Food Protection*, *72*(12), 2629-2637.
- Knight, S., Vrij, A., Cherryman, J., & Nunkoosing, K. (2004). Attitudes towards animal use and belief in animal mind. *Anthrozoös*, *17*(1), 43-62.
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, *54*(2), 179-194. doi:10.1016/S1573-5214(06)80021-7
- Lay Jr, D. C., Fulton, R. M., Hester, P. Y., Karcher, D. M., Kjaer, J. B., Mench, J. A., . . . Porter, R. E. (2011). Hen welfare in different housing systems. *Poultry Science*, *90*(1), 278-294. doi:10.3382/ps.2010-00962
- Mason, G., & Mendl, M. (1993). Why is there no simple way of Measuring Animal Welfare? *Animal Welfare*, *2*(4), 301-319.
- McGlone, J. J. (2001). Farm animal welfare in the context of other society issues: Toward sustainable systems. *Livestock Production Science*, *72*(1-2), 75-81. doi:10.1016/S0301-6226(01)00268-8
- Paul, E. S., & Serpell, J. A. (1993). Childhood Pet keeping and Humane Attitudes in Young Adulthood. *Animal Welfare*, *2*(4), 321-337.
- PPE. (2012). *Voorlopige jaarcijfers 2011 pluimveesector*. Retrieved from <http://www.pve.nl/pve?waxtrapp=rduHsHsuOnbPTEcBPR&context=nfMsHsuOnbPTEC>
- Rollin, B. E. (2007). Cultural variation, animal welfare and telos. *Animal Welfare*, *16*(SUPPL.), 129-133.

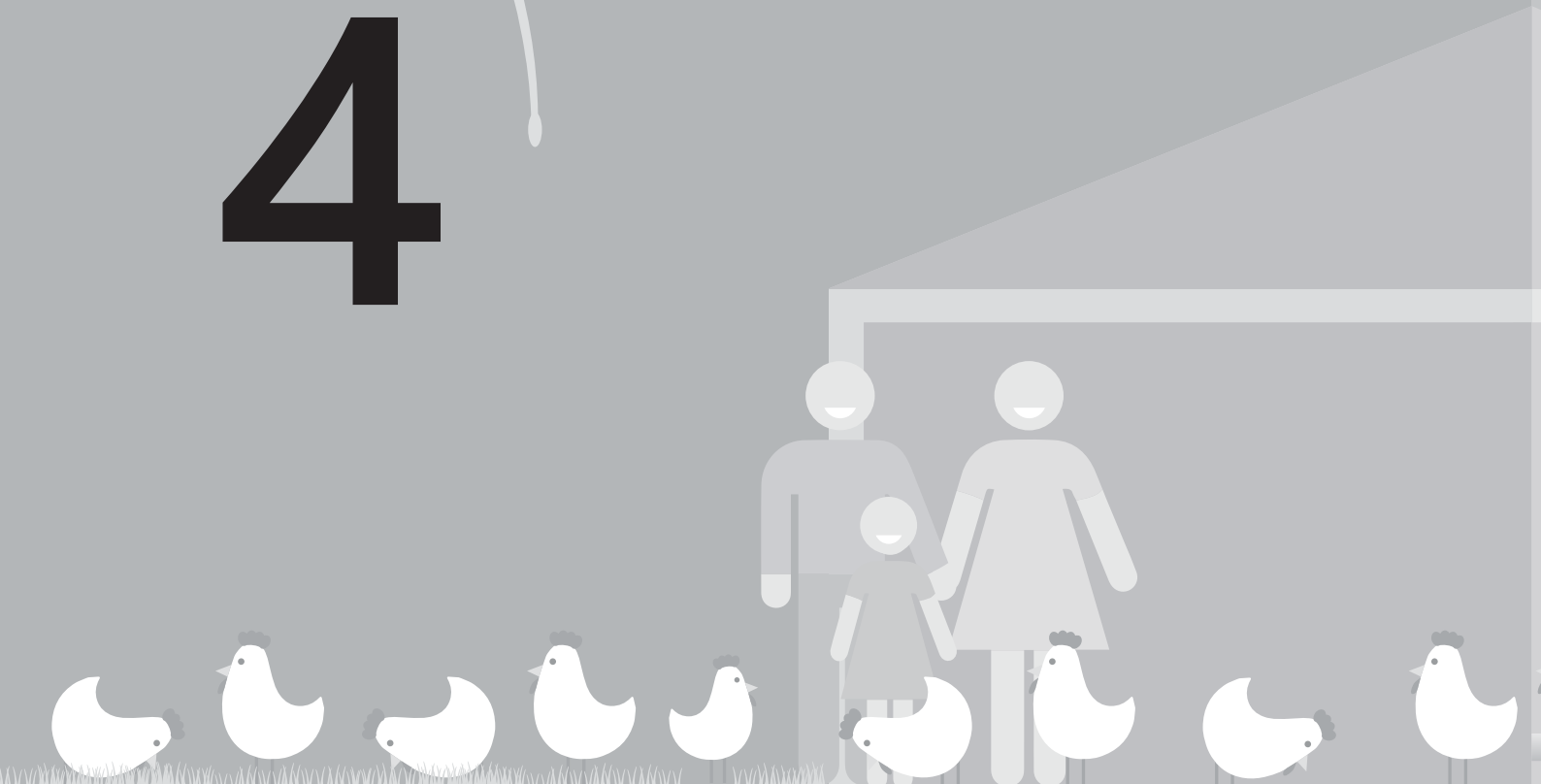
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Shimmura, T., Bracke, M. B. M., De Mol, R. M., Hirahara, S., Uetake, K., & Tanaka, T. (2011). Overall welfare assessment of laying hens: Comparing science-based, environment-based and animal-based assessments. *Animal Science Journal*, 82(1), 150-160. doi:10.1111/j.1740-0929.2010.00834.x
- Shimmura, T., Hirahara, S., Azuma, T., Suzuki, T., Eguchi, Y., Uetake, K., & Tanaka, T. (2010). Multi-factorial investigation of various housing systems for laying hens. *British Poultry Science*, 51(1), 31-42. doi:10.1080/0007166090342116
- Spoelstra, S. F., Groot Koerkamp, P. W. G., Bos, A. P., Elzen, B., & Leenstra, F. R. (2013). Innovation for sustainable egg production: Realigning production with societal demands in The Netherlands. *World's Poultry Science Journal*, 69(2), 279-298. doi:10.1017/S0043933913000305
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2015). Opinion of Belgian egg farmers on hen welfare and its relationship with housing type. *Animals*, 6(1), 1-11. doi:10.3390/ani6010001
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Tuytens, F., Vanhonacker, F., & Verbeke, W. (2014). Broiler production in Flanders, Belgium: Current situation and producers' opinions about animal welfare. *World's Poultry Science Journal*, 70(2), 343-354.
- Tuytens, F. A. M., Vanhonacker, F., Van Poucke, E., & Verbeke, W. (2010). Quantitative verification of the correspondence between the Welfare Quality® operational definition of farm animal welfare and the opinion of Flemish farmers, citizens and vegetarians. *Livestock Science*, 131(1), 108-114. doi:10.1016/j.livsci.2010.03.008
- Van Wijk-Jansen, E. E. C., Hoogendam, K., & Bakker, T. (2009). *The Beter Leven mark: the perception of organic consumers*. Retrieved from Wageningen:
- Vanhonacker, F., Tuytens, F. A. M., & Verbeke, W. (2016). Belgian citizens' and broiler producers' perceptions of broiler chicken welfare in Belgium versus Brazil. *Poultry Science*, 95(7), 1555-1563. doi:10.3382/ps/pew059
- Vanhonacker, F., Van Poucke, E., Tuytens, F. A. M., & Verbeke, W. (2010). Citizens' Views on Farm Animal Welfare and Related Information Provision: Exploratory Insights from Flanders, Belgium. *Journal of Agricultural and Environmental Ethics*, 23(6), 551-569. doi:10.1007/s10806-010-9235-9
- Vanhonacker, F., Verbeke, W., Van Poucke, E., Buijs, S., & Tuytens, F. A. M. (2009). Societal concern related to stocking density, pen size and group size in farm animal production. *Livestock Science*, 123(1), 16-22. doi:10.1016/j.livsci.2008.09.023
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2007). Segmentation based on consumers' perceived importance and attitude toward farm animal welfare. *International Journal of Sociology of Food and Agriculture*, 15(3), 91-107.
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Ventura, B. A., von Keyserlingk, M. A. G., Wittman, H., & Weary, D. M. (2016). What Difference Does a Visit Make? Changes in Animal Welfare Perceptions after Interested Citizens Tour a Dairy Farm. *PLoS ONE*, 11(5), e0154733. doi:10.1371/journal.pone.0154733
- Verbeke, W. A. J., & Viaene, J. (2000). Ethical Challenges for Livestock Production: Meeting Consumer Concerns about Meat Safety and Animal Welfare. *Journal of Agricultural and Environmental Ethics*, 12(2), 141-151. doi:10.1023/a:1009538613588
- Weary, D. M., Ventura, B. A., & Von Keyserlingk, M. A. G. (2016). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal*, 10(2), 309-317. doi:10.1017/S1751731115001160

Zaludik, K., Lugmair, A., Baumung, R., Troxler, J., & Niebuhr, K. (2007). Results of the Animal Needs Index (ANI-35L) compared to animal-based parameters in free-range and organic laying hen flocks in Austria. *Animal Welfare*, 16(2), 217-219.



Risk perceptions of public health and food safety hazards in poultry husbandry by citizens, poultry farmers, and poultry veterinarians

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ABSTRACT

Differences in risk perceptions of public health and food safety hazards in various poultry husbandry systems by various stakeholder groups, may affect the acceptability of those husbandry systems. Therefore, the objective was to gain insight into risk perceptions of citizens, poultry farmers, and poultry veterinarians of food safety and public health hazards in poultry husbandry systems, and into factors explaining these risk perceptions. We surveyed risk perceptions of *Campylobacter* contamination of broiler meat, avian influenza introduction in laying hens, and altered dioxin levels in eggs for the most commonly used broiler and laying hen husbandry systems in Dutch citizens (n = 2,259), poultry farmers (n = 100), and poultry veterinarians (n = 41). Citizens perceived the risks of the three hazards in the indoor systems higher and in the outdoor systems lower than did the professionals. Citizens reported higher concerns regarding aspects reflecting underlying psychological factors of risk perception compared to professionals. Professionals indicated a relatively high level of personal control, which might imply risk denial. Of the socio-demographic characteristics, gender and childhood residence were associated with risk perceptions. The influence of other factors of risks perception are discussed. It is suggested that risk perceptions of all stakeholder groups are influenced by affect, stigma and underlying values. To adapt current or new husbandry systems that can count on societal support, views of key stakeholders and multiple aspects such as animal welfare, public health, food safety, and underlying values should be considered integrally. When trade-offs, such as between animal welfare and public health have to be made, insight into underlying values might help to find consensus among stakeholders.

Key words: poultry husbandry, risk perception, stakeholder perception, public health, food safety

INTRODUCTION

In the Netherlands poultry husbandry is characterized by intensive husbandry systems with high numbers of animals kept at high stocking densities, mostly without access to an outdoor run. From 2000 to 2015, the total number of chickens increased from 104 million to 107 million, while the number of farms that keep chickens – laying hens or broilers – decreased from 3,860 to 2,049 (CBS StatLine, 2016). Over the last decade, the media has covered multiple crises related to poultry husbandry, such as compromised welfare of fast growing broilers and laying hens in cage systems, disease outbreaks such as avian influenza (bird flu), and food safety scandals, such as the dioxin affair. Also, non-governmental organisation (NGOs) and citizens have expressed their concerns about how animals are kept, about the public health risks of livestock production and about the safety of food (Bergstra et al., 2017; Hansen et al., 2003).

As a result, new legislation has come into force in the European Union, such as a ban on the conventional battery cages for laying hens since January 2012 (Council of the European Union, 1999). Today, the most applied husbandry systems are indoor colony cages or indoor non-cage systems (for laying hens), and conventional indoor systems (for broilers). Only a minor part of the husbandry systems offers outdoor access to poultry, but the number of outdoor systems and the consumption of outdoor eggs and meat is growing (Bejaei et al., 2011). Which husbandry system people prefer depends on how they perceive variegated issues such as animal welfare, price of eggs or meat, or public health and food safety risks, and which issues they weigh in most heavily. For example, professionals, such as farmers and veterinarians perceive good care to animals and an economically viable system important (Bergstra et al., 2017; Vanhonacker et al., 2008), and they prefer indoor systems (Gocsik et al., 2016; Van Asselt et al., 2015; Chapter 2). Quite in contrast, citizens perceive naturalness, outdoor access, public health and food safety important (Bergstra et al., 2017; Vanhonacker et al., 2008), and they prefer free-range systems that provide to chickens outdoor access (Van Asselt et al., 2015; Chapter 2).

Existing literature on public health hazards in poultry husbandry indicated that, compared to chickens in indoor systems, keeping chickens in free-range systems with outdoor access is associated with higher public health and food safety risks for certain hazards, such as *Campylobacter* contamination, avian influenza and dioxin (Kijlstra et

al., 2009). Although sample methods and results differ, meat from broilers kept in outdoor systems, such as free-range and organic systems, is more likely to be contaminated with *Campylobacter* than meat from indoor kept broilers (Heuer et al., 2001; Rosenquist et al., 2013; van der Zee et al., 2005). In a study of Rosenquist et al. (2013) meat from organic broilers was about two times more likely to be contaminated than meat from conventional kept broilers (54% vs 20%). With regard to laying hens, two hazards are associated with keeping hens in outdoor systems: elevated dioxin levels in eggs and avian influenza. Studies indicated that dioxin levels are higher in eggs from hens that have outdoor access, and in particular in eggs from organic hens from private owners, than in eggs from hens that are kept indoors (EFSA, 2012; Kijlstra et al., 2007; Pussemier et al., 2004; Schoeters et al., 2006; Van Overmeire et al., 2006; Van Overmeire et al., 2009a; Van Overmeire et al., 2009b). Outdoor access to laying hens was a risk factor for avian influenza (Gonzales et al., 2013; Koch et al., 2006). A Dutch study reported that the introduction rate of the low pathogen avian influenza virus on farms that offer outdoor access to hens, was 11 times higher compared to farms that do not offer outdoor access (Gonzales et al., 2013). Considering these studies, one may argue that from a public health point of view indoor husbandry systems are preferable above outdoor systems.

The general public seems not aware that these risks may be higher when chickens are kept in systems with outdoor access than when chickens are kept in indoor systems. NGO's such as the Dutch Society for the Protection of Animals (Dierenbescherming) and the Alert Animal Foundation (Wakker dier), who both favour organic production, do not communicate about these risks (Kijlstra et al., 2009). Professionals involved in poultry husbandry, such as farmers and veterinarians, may be more knowledgeable and experienced regarding public health and food safety hazards related to poultry husbandry than are citizens. Literature on risk perceptions indicate that in case people lack knowledge or when the risk assessment is complex, they will make a more intuitive risk assessment, in which other aspects, such as feelings and trust levels may play a role (Finucane et al., 2000a; Slovic et al., 2007). Consequently, the general public may view food safety and public health hazards in various poultry husbandry systems differently from professionals such as poultry farmers and poultry veterinarians. Studies on risk perceptions of the general public compared to experts in the context of, for example, new technologies and food production, have shown that knowledge and experience, psychological factors and socio-demographic

characteristics, could explain differences between risks perceptions of lay people and experts (Fife-Schaw et al., 1996; Fischhoff, 1978; Hansen et al., 2003; Sjöberg, 2000; Slovic, 1987).

Differences in risk perceptions among the general public and professionals, such as farmers and veterinarians of public health and food safety hazards may have consequences for the acceptability of poultry husbandry systems and especially for the acceptability of outdoor systems. To co-design socially acceptable husbandry systems, the perceptions of different stakeholders should be understood and considered (Groot Koerkamp et al., 2008; Spoelstra et al., 2013). A better understanding of risks perceptions of food safety and public health hazards by stakeholder groups, may contribute to the co-design of poultry husbandry systems that address societal concerns.

The objective of this study is twofold: 1) to gain insight into risk perceptions of food safety and public health hazards in different poultry husbandry systems from the general public as compared to professionals involved in poultry husbandry, and 2) exploring the reasons why these risk perceptions differ. This study will survey the perceptions of three potential public health hazards that may appear more often in outdoor poultry husbandry systems than in indoor husbandry systems: *Campylobacter* contamination of broiler meat (Heuer et al., 2001; Rosenquist et al., 2013; Van Overbeke et al., 2006), avian influenza introduction in laying hens (Gonzales et al., 2013; Koch et al., 2006) and increased dioxin levels in eggs (EFSA, 2012; Schoeters et al., 2006; Van Overmeire et al., 2006). The risks perceptions of these three hazards will be surveyed for the most common used broiler husbandry systems – conventional, conventional plus, free-range, and organic – and in laying husbandry systems – colony cages, indoor non-cage, free-range, and organic. We will now give a concise overview of relevant risk perception research that will guide the analysis of the current study.

Theoretical background

Risk perceptions

Risk perceptions are complex and are affected by several factors. First of all, the “real” or “objectified” risk, a result of technical estimate of risks, influences the perception of risk (Sjöberg, 2000). In some contexts, when people have experience with and hazard-related knowledge – such as experts on the field of topic – the perceived risk may converge more or less with objective risk estimates (Sjöberg, 2000). In most contexts, however, as is in the context of poultry husbandry, risk perceptions of people who are non-experts is open to the influence of other subjective factors (Slovic et al., 2007). Instead of an objective risks assessment of the hazards related to poultry husbandry, people assess the risks more intuitively, whereby risks and benefits are not perceived independently from each other (Finucane et al., 2000a; Ueland et al., 2012). A variety of theories have identified factors that explain risk perceptions, such as knowledge and experience, underlying psychological factors, and self-protection (for example see Fife-Schaw et al., 1996; Fischhoff, 1978; Hansen et al., 2003; Krewski et al., 2012; Sjöberg, 2000; Slovic, 1987).

Knowledge and experience

In order to accurately assess the riskiness of public health hazards in poultry husbandry some knowledge of the probability and consequences of the hazards, and also about poultry husbandry in general, is necessary. Experts tend to assess risks more in accordance with objectified standards than lay people (Slovic, 1987). Therefore, differences in risk perception between experts and the general public were attributed to the knowledge deficit of lay people (Hansen et al., 2003). Regarding public health hazards related to poultry husbandry, most citizens are lay people, while professionals - such as poultry veterinarians - have received extensive training and experience, are thus more knowledgeable on these hazards and can be considered as experts. However, it has been questioned whether experts are “right” and lay people “wrong” and it has been strongly argued that risk perception is affected by other factors rather than just knowledge (Hansen et al., 2003; Rowe et al., 2001).

Underlying psychological factors

In many studies devoted to risk perceptions in general or regarding food hazards more specifically, the psychometric approach is used to explain differences in risk perceptions (Fife-Schaw et al., 1996; Slovic, 1987; Sparks et al., 1994). Psychometric studies demonstrated that risk perceptions are influenced by specific perceptual factors, such as perceptions with respect to the degree of control, severity of the consequences, fatality of consequences, voluntariness, trust in experts and unknownness by the people exposed (Fife-Schaw et al., 1996; Fischhoff, 1978; Slovic, 1987, 1993; Sparks et al., 1994). Later studies suggested additional factors that should be included in the psychometric model. For example, the naturalness of hazards influences risk perceptions (Fife-Schaw et al., 1996; Siegrist et al., 2006) and chemical hazards are perceived as more risky than are microbial hazards (Kher et al., 2013; Siegrist et al., 2006). Therefore, the type of hazard should be considered as well. Furthermore, it was shown that the degree of perceived personal control over the hazard is an important factor of risk perception. Risks that are perceived to be under control, are judged less severe than when they are not (Hansen et al., 2003; Leikas et al., 2009; Sjöberg, 2000; Sparks et al., 1994; Weinstein, 1982).

Self-protection

To explain fear appeals and to change self-protective behaviour in risk contexts, the Protection Motivation Theory is used (Maddux et al., 1983; Rogers, 1975). According to this theory, perceived risk and perceived self-efficacy are relevant aspects in risk attitudes (Maddux et al., 1983; Rogers, 1975). Self-efficacy is the level of confidence in one's ability to undertake protective behaviour. In the context of risk perception in poultry husbandry it refers to a person's ability to protect himself against a hazard related to poultry husbandry systems and will be referred to as self-protection.

Based on the literature above, we hypothesize the following in the context of public health hazards in poultry husbandry. Given their diverging background in knowledge and expertise, 1) risk perceptions of citizens will differ from professionals such as poultry farmers and poultry veterinarians; 2) these differences in risk perceptions may be attributed to differences in underlying psychological factors held by citizens vis-à-vis professionals; 3) the perceived ability to protect themselves against hazards related to poultry husbandry will differ between citizens and professionals.

MATERIALS AND METHODS

Survey

To gain insight into risk perceptions of public health hazards related to poultry husbandry by different stakeholder groups and factors that may explain these risks perceptions, a quantitative survey was done by means of an online questionnaire among three key stakeholder groups in March and April 2014. The general public, poultry farmers and poultry veterinarians were considered relevant stakeholder groups. The opinions of the general public concerning adaptation of current or development of new husbandry systems, most notably through NGO's, has become important (Boogaard et al., 2011). The general public was investigated in their role as citizens, because citizens, without being necessarily consumers, participate in the public debate about poultry husbandry (Harvey et al., 2013). Poultry farmers' opinions were considered relevant because they are most directly involved in choosing husbandry systems. Poultry veterinarians are the farmers' key advisors on disease prevention which makes their risk perceptions of interest.

Participants

The questionnaire was filled out by representatives of Dutch citizens, poultry farmers, and poultry veterinarians. CentERdata (www.centerdata.nl), a research institute specialized in online survey research by means of the CentERpanel, approached the citizens. The CentERpanel is a representative sample of the Dutch population. CentERdata approached 3,344 CentERpanel participants, of whom 2,373 (71.0%) began the questionnaire and 2,259 respondents (67.6%) completed the questionnaire. We invited poultry farmers to participate in the questionnaire by a digital newsletter of the Dutch organisation of poultry farmers (NOP), which was sent to about 3,000 people interested in poultry husbandry. Moreover, we posted several articles on websites regarding poultry husbandry, such as the Dutch poultry magazine (Pluimveehouderij¹), and on a website regarding agriculture in general. The newsletter and websites were all free available. Out of the 2,046 professional poultry farmers in the Netherlands, 100 farmers (4.9%) completed the questionnaire. Veterinarians registered with the Section Poultry Health (VGP) of the Royal Veterinary Association of

¹ Poultry production: a professional journal for the poultry production sector.

the Netherlands (n = 144) were invited in an e-mail from CentERdata to participate in the survey. Of this registered group 51 (35.4%) completed the questionnaire and of them, 40 met our definition of poultry veterinarian – someone working more than 30% of their time as a veterinarian in the poultry sector – and were included for analysis.

Questionnaire

The questionnaire was developed using literature review and input from a consulting group consisting of experts and representatives of several stakeholder groups, citizens, poultry farmers and poultry veterinarians. Prior to data collection, the survey was pilot tested for clarity and comprehensibility of the questions by representatives of the three stakeholder groups. Based on these comments the questionnaire was then further revised and subsequently executed. Because the survey was part of a larger research that was designed to explore perceptions of poultry husbandry, only questions relevant for the study of risk perception are reported here. The questionnaire consisted of different parts: 1) statements to assess knowledge, 2) degree of self-protection, 3) underlying psychological factors of risk perception, 4) risk perceptions of three public health hazards in four different husbandry systems, and 5) questions regarding socio-demographic characteristics.

Measures

Knowledge

As a first check to verify whether the knowledge of the three stakeholder groups differs regarding the three public health hazards, the question was asked before any additional information about the hazards or husbandry systems was provided. To assess the knowledge a statement was included regarding the disease caused by each of the respective hazards (Table 4.1). The respondents were asked to indicate for each statement whether it was true or false. They could also choose for the option “I do not know”.

Table 4.1 Statements regarding three hazards with correct answers

Statement	Correct answer
1. <i>Campylobacter</i> , an intestinal bacterium present in chicken, is the most important cause of intestinal infections in humans.	True
2. All bird flu viruses are a threat to public health.	False
3. Prolonged intake of dioxin may cause cancer.	True

Self-protection

To measure the ability of self-protection we asked respondents to rate to what extent they are able to protect themselves against the three public health hazards. Because the respondents might not know the specific hazards, the questionnaire did not present the names of the hazards, but wordings that reflect the hazards, namely: “chicken pathogens spread through the air”, “pathogens on broiler meat” and “chemical substances in eggs”. Respondents could rate the degree of self-protection against these hazards on a five-point Likert scale ranging from “absolutely not” to “absolutely yes”.

Underlying psychological factors

Based on the literature we selected underlying psychological factors of risk perception that were relevant for this research. To research these underlying psychological factors of risk perception, 11 statements were formulated, which reflect the following factors: unknown by the people exposed, trust in experts, severity of the consequences, voluntariness, the type of the hazard (bacteria vs chemicals) and personal control (Table 4.2).

Table 4.2 Psychological factors of risk perception and statements based on these factors of risk perception

Psychological factors of risk perception	Statement reflecting psychological factors of risk perception
Unknown	There is no information about the health consequences
Trust in experts	Experts state that health consequences are little
Severity (mild)	People may get an eye infection from it
Severity (medium)	People may get diarrhea from it
Severity (severe)	A few people will get cancer from it
Severity (fatal)	Someone may die from it
Voluntariness	People may get ill when being around a poultry farm
Voluntariness	People may get ill when eating chicken that is not cooked well enough
Type of hazard	Bacteria are present on chicken meat
Type of hazard	Chemicals are present in eggs
Personal control	People themselves may take measures to prevent the risk

Respondents were asked to what extent they perceived the situation as being risky: “To what extent are you concerned to get ill from chickens, broiler meat or eggs in the following situations?” They could rate their concern on a five-point Likert scale ranging from “absolutely not” to “absolutely yes”. Because people tend to perceive personal risks lower than risks for other people (Weinstein, 1982), we asked explicitly to rate the risks for themselves.

Risk perceptions

To gain insight into risk perceptions, participants were asked to score the public health risks of 1) *Campylobacter* on broiler meat for broilers kept in a respectively conventional, a conventional plus, a free-range system with outdoor access and in an organic system, 2) the public health risk of bird flu, and 3) of dioxin in eggs for laying hens kept in respectively colony cages, an indoor non-cage system, a free-range system with outdoor access and in an organic system. A short description of the husbandry systems was provided as is shown in Table 4.3.

Table 4.3 Descriptions of the four broiler and laying hen husbandry systems

Husbandry system	Description
Broilers	
Conventional	free-range on litter, age at slaughter 42 days
Conventional plus	free-range on litter, a little more space, enrichment, age at slaughter 56 days
Free-range outdoor	free-range on litter, more space, enrichment, outdoor access, age at slaughter 56 days
Organic	free-range on litter, more space, enrichment, outdoor access, organic feed, age at slaughter 70 days
Laying hens	
Colony cages	cages for groups of 80 hens, littered area, nests, perches
Indoor non-cage	free-range on litter and/ or multi-tiered, with nests, perches, a little more space
Free-range outdoor	free-range on litter and/ or multi-tiered, with nests, perches, more space, outdoor access
Organic	free-range on litter and/ or multi-tiered with nests, perches, more space, outdoor access, beaks are not treated, organic feed

Also for each hazard the following additional info was given:

- *Campylobacter* is an intestinal bacterium from chicken. A *Campylobacter* contamination may cause an intestinal infection in humans.
- Bird flu viruses are transmissible between different bird species and are usually not contagious to humans. Bird flu viruses are changing constantly and in future, bird flu might cause infection and disease in humans.

- Dioxin is a chemical substance, which is present in various products from animal origin. In humans, prolonged intake of dioxin may cause cancer.

The respondents could score the public health risk of three hazards in the four different husbandry systems on a five-point Likert scale ranging from “very low” to “very high”. They could also opt for the answer option “I do not know”.

Socio-demographic characteristics

Socio-demographic characteristics have been shown to be associated with perceptions of risk (Finucane et al., 2000b; Slovic, 1999) and perceptions of animals and animal welfare (Cohen et al., 2012; Kendall et al., 2006; Knight et al., 2004; Vanhonacker et al., 2007). Therefore, the last part of the questionnaire contained questions regarding socio-demographic characteristics of the respondents: gender, age, educational level, urbanisation level of current residence childhood residence, having children (yes or no), household income, pet ownership (yes or no), frequency of meat consumption, and whether they donate to a nature or animal welfare organisation. The main socio-demographic features of the respondents are presented in Table 4.4. Compared to the data from the Central Bureau of Statistics (CBS) in the Netherlands the citizens' sample was slightly overrepresented with older people, and higher educated people. Poultry farmers and poultry veterinarians were predominantly male, which was representative for these professional groups.

Table 4.4 Socio-demographic characteristics of the respondents

	Citizens (n = 2259)	Poultry farmers (n = 100)	Poultry veterinarians (n = 41)	CBS ¹
Gender (%)				
Male	52.2	88.0	80.5	49.2
Female	47.8	12.0	19.5	50.8
Age (%)				
15 - 34 years	16.6	11.0	12.2	29.3
35 - 54 years	36.8	73.0	51.2	34.2
> 55 years	46.6	16.0	36.6	36.5
Education (%)				
Low	26.7	28.0	0.0	30.9
Intermediate	29.3	43.0	0.0	41.0
High (Bachelor / Master)	44.0	29.0	100.0	28.1

¹ Data from CBS Statistics Netherlands dated 01-03-2014

Data analyses

To process and analyse data SPSS 22.0 was used. To compute mean scores \pm standard errors for the risk perceptions of the three hazards in the four different husbandry systems, the answer “I do not know” was recoded into missing. For each risk, the percentage of “I do not know” scores was calculated. The association between 1) mean scores for risk perceptions of the individual hazards within a husbandry system, and 2) the stakeholder groups was explored by analysis of variances. ANOVA was done if variances were homogeneous according to Levene’s test. If variances were not homogeneous, the Welch test was used instead. If the effect of the stakeholder groups on the mean risk perception scores was significant ($p < 0.05$) using ANOVA F-test, the post-hoc Games-Howell test for multiple comparisons was done to analyse differences between individual stakeholder groups. The effect of socio-demographic characteristics of citizens on the risk perceptions of the three hazards in four different husbandry systems was analysed by calculating Person’s chi-square.

RESULTS

Knowledge regarding hazards

The assessment of knowledge regarding the disease caused by *Campylobacter*, avian influenza and dioxin confirmed that the context-specific knowledge of the stakeholder groups differed between citizens and the professional groups (Table 4.5). From the

Table 4.5 Knowledge regarding public health hazards in citizens (n = 2259), poultry farmers (n = 100), and poultry veterinarians (n = 41)

Statement		Citizens	Poultry farmers	Poultry veterinarians
<i>Campylobacter</i>	Correct (%)	20.8	40.0	63.4
	Incorrect (%)	10.0	45.0	29.3
	I do not know (%)	69.1	15.0	7.3
Avian influenza	Correct (%)	33.2	78.0	80.5
	Incorrect (%)	36.7	17.0	17.1
	I do not know (%)	30.1	5.0	2.4
Dioxin	Correct (%)	59.4	90.0	90.2
	Incorrect (%)	2.3	2.0	0
	I do not know (%)	38.3	8.0	9.8

three stakeholder groups, poultry veterinarians answered the most statements correctly, and citizens were the least accurate. As could also be expected, citizens responded more often than the farmers and veterinarians “I do not know”, which indicates a higher level of experienced uncertainty concerning these topics. Compared to the other statements, the statement regarding *Campylobacter* was most often answered with “I do not know”. The statement regarding dioxin in eggs was answered most often correctly as compared to the other statements.

Risk perceptions

To gain insight into the risk perceptions of public health hazards related to poultry husbandry, perceived risks were surveyed in the three stakeholder groups. The perceived risk of (1) *Campylobacter* contamination of broiler meat, of (2) avian influenza, and of (3) dioxin in eggs, from broiler or hens, kept in four different husbandry systems are presented in Table 4.6. The mean risk scores of the citizens showed a different pattern from the mean risk scores of the two professional groups.

Citizens expressed higher risk perceptions of the three hazards when poultry is kept in the indoor systems (conventional, conventional plus, colony cages, or indoor non-cage systems) relative to farmers and veterinarians ($p < 0.05$). Farmers, however, perceived the risks of the three hazards in the outdoor systems (free-range and organic systems) higher ($p < 0.05$) than did citizens. Also veterinarians scored the risks of *Campylobacter* and avian influenza in organic systems, and of dioxin in eggs from hens kept in both free-range outdoor and organic systems higher ($p < 0.05$) compared to citizens. The largest differences we observed between the scores from the citizens and the farmers. Farmers perceived the risks in indoor systems lower than did veterinarians, but this difference was significant ($p < 0.05$) only for the perceived risk of *Campylobacter* in the indoor systems. Citizens perceived risk of dioxin in eggs from chicken kept in an organic system lowest from the three public health hazards. It is interesting to notice that the range in mean scores from citizens is lower than the range in mean scores from the professionals.

Table 4.6 Mean perceived public health risks (\pm SE) in citizens (n = 2259), poultry farmers (n = 100), and poultry veterinarians (n = 41) (1 = very low; 5 = very high risk)

	Citizens		Poultry farmers		Poultry veterinarians		Test statistics	p-value
	Mean	% dnk	Mean	% dnk	Mean	% dnk		
Public health risk of <i>Campylobacter</i> in broilers kept in:								
Conventional system	3.49 ^a \pm 1.145	41.4	2.02 ^b \pm 1.079	8.0	2.88 ^c \pm 1.122	0.0	F(2, 1454) = 75.82	< 0.001
Conventional plus	3.23 ^a \pm 0.957	40.4	2.35 ^b \pm 1.042	8.0	3.02 ^a \pm 1.129	0.0	F(2, 1477) = 36.29	< 0.001
Free-range outdoor	2.96 ^a \pm 0.973	39.8	3.80 ^b \pm 1.328	8.0	3.33 \pm 1.207	2.4	F(2, 76.27) = 19.06	< 0.001
Organic system	2.74 ^a \pm 1.191	38.8	4.02 ^b \pm 1.305	11.0	3.55 ^b \pm 1.176	2.4	F(2, 1487) = 55.19	< 0.001
Public health risk of avian influenza in laying hens kept in:								
Colony cages	3.46 ^a \pm 0.033	31.7	1.38 ^b \pm 0.082	1.0	1.50 ^b \pm 0.129	2.4	F(2, 86.93) = 351.19	< 0.001
Indoor non-cage	3.17 ^a \pm 0.027	31.9	1.47 ^b \pm 0.076	1.0	1.60 ^b \pm 0.133	2.4	F(2, 83.09) = 270.69	< 0.001
Free-range outdoor	3.25 ^a \pm 0.026	31.2	4.13 ^b \pm 0.115	2.0	3.72 \pm 0.220	4.9	F(2, 76.24) = 29.49	< 0.001
Organic system	3.04 ^a \pm 0.032	32.2	4.22 ^b \pm 0.117	3.0	3.87 ^b \pm 0.198	4.9	F(2, 1665) = 49.07	< 0.001
Public health risk of dioxin in eggs from laying hens kept in:								
Colony cages	3.33 ^a \pm 1.250	39.2	1.28 ^b \pm 0.706	4.0	1.38 ^b \pm 0.667	2.4	F(2, 91.31) = 434.29	< 0.001
Indoor non-cage	3.07 ^a \pm 1.063	39.2	1.33 ^b \pm 0.691	5.0	1.43 ^b \pm 0.675	2.4	F(2, 86.67) = 339.08	< 0.001
Free-range outdoor	2.92 ^a \pm 1.038	39.1	3.67 ^b \pm 1.370	7.0	3.49 ^b \pm 1.227	0.0	F(2, 78.21) = 17.25	< 0.001
Organic system	2.61 ^a \pm 1.191	38.9	3.95 ^b \pm 1.363	5.0	3.76 ^b \pm 1.090	0.0	F(2, 1513) = 70.39	< 0.001

* % dnk: % respondents of the stakeholder group who answered "I do not know"

^{a,b,c} Means within a row with different superscripts differ significantly ($P < 0.05$, Post-hoc Games Howell multiple comparisons test)

Self-protection

To understand why the risk perceptions of public health hazards in poultry husbandry differ between the three stakeholder groups, the degree of self-protection against three hazards was surveyed. The mean scores for the extent to which participants think to be able to protect themselves against three hazards are presented in Table 4.7. All three stakeholder groups scored their ability to protect themselves against the hazard “pathogens on chicken meat’ as highest of the three hazards. However, for “pathogens on chicken meat’ the mean score from citizens was lower ($p < 0.001$) than the mean scores from farmers and veterinarians. The mean scores for the hazard “chicken pathogens that spread through air” did not differ among the three groups. Veterinarians scored the ability to protect themselves against “chemicals in eggs” lower ($p < 0.05$) than did citizens and farmers. Compared to farmers and citizens, veterinarians showed the largest range in mean scores for self-protection against all three hazards.

Table 4.7 Mean self-protection ability (\pm SE) against public health hazards in citizens, poultry farmers, and poultry veterinarians (1 = absolutely not; 5 = absolutely yes)

	Citizens	Poultry farmers	Poultry veterinarians	Test statistics	<i>p</i> -value
Pathogens on chicken meat	3.65 ^a \pm 0.024	4.35 ^b \pm 0.121	4.56 ^b \pm 0.202	F(2, 83.04) = 53.67	< 0.001
Chicken pathogens spread through air	2.71 \pm 0.024	2.87 \pm 0.091	2.85 \pm 0.116	F(2, 2379) = 1.12	0.327
Chemicals in eggs	2.66 ^a \pm 0.027	2.60 ^a \pm 0.141	1.78 ^b \pm 0.146	F(2, 81.44) = 17.34	< 0.001

^{a,b} Means within a row with different superscripts differ significantly ($p < 0.05$, Post-hoc Games Howell multiple comparisons test).

Underlying psychological factors

The means scores for statements reflecting underlying psychological factors of risk perception - concern to get ill from chicken, chicken meat or eggs - given by citizens, poultry farmers, and poultry veterinarians, are presented in Table 4.8. The range of the mean scores from farmers and veterinarians was larger than the range of mean scores from citizens. Citizens were more concerned ($p < 0.05$) for 9 out of 11 statements than were farmers and for 7 out of 11 statements than were veterinarians. Farmers only scored the statement reflecting the factor personal control, “people themselves can take measures to prevent the risk”, higher ($p < 0.05$) than citizens did. The concern for “people may get ill when being around a poultry farm”, a statement

Table 4.8 Mean concern (\pm SE) for situations reflecting psychological factors of risk perception in citizens, poultry farmers and poultry veterinarians (1 = absolutely not concerned; 5 = absolutely concerned)

Psychological factor	Statement	Poultry			Test statistics	p-value
		Citizens	farmers	veterinarians		
Unknown	There is no information about the health consequences	3.28 ^a \pm 0.002	2.45 ^b \pm 0.127	2.54 ^b \pm 0.224	F(2, 78.27) = 25.62	< 0.001
Trust in experts	Experts state that health hazards are little	2.90 ^a \pm 0.020	2.42 ^b \pm 0.124	2.59 \pm 0.212	F(2, 77.96) = 8.22	0.001
Severity (mild)	People may get an eye infection from it	3.05 ^a \pm 0.020	2.28 ^b \pm 0.115	2.41 ^b \pm 0.204	F(2, 78.34) = 26.10	< 0.001
Severity (medium)	People may get diarrhoea from it	3.43 ^a \pm 0.021	2.64 ^b \pm 0.128	3.02 \pm 0.196	F(2, 78.32) = 20.44	< 0.001
Severity (severe)	A few people will get cancer from it someday	3.08 ^a \pm 0.022	2.26 ^b \pm 0.116	1.90 ^b \pm 0.187	F(2, 2397) = 53.57	< 0.001
Severity (fatal)	Someone may die from it	3.25 ^a \pm 0.024	2.23 ^b \pm 0.116	2.66 ^b \pm 0.241	F(2, 78.82) = 39.38	< 0.001
Voluntariness	People may get ill when being around a poultry farm	2.98 ^a \pm 0.023	1.52 ^b \pm 0.086	2.10 ^c \pm 0.170	F(2, 2397) = 102.15	< 0.001
Voluntariness	People may get ill when eating chicken that is not cooked well enough	3.81 \pm 0.024	3.56 \pm 0.127	3.39 \pm 0.223	F(2, 78.80) = 3.40	0.039
Type of hazard	Bacteria are present on chicken meat	3.64 ^a \pm 0.023	2.92 ^b \pm 0.130	2.88 ^b \pm 0.252	F(2, 78.27) = 18.88	< 0.001
Type of hazard	Chemicals are present in eggs	3.43 ^a \pm 0.020	2.33 ^b \pm 0.135	2.80 ^b \pm 0.186	F(2, 78.22) = 37.11	< 0.001
Personal control	People themselves can take measures to prevent the risk	3.39 ^a \pm 0.023	3.76 ^b \pm 0.149	3.59 \pm 0.207	F(2, 78.33) = 3.35	0.040

^{a,b,c} Means within a row with different superscripts differ significantly (P < 0.05, Post-hoc Games Howell multiple comparisons test)

which reflects voluntariness, shows a considerable difference ($F(2, 2,397) = 102.15; p < 0.001$) among the three stakeholder groups. Farmers scored this latter statement, “people may get ill when being around a poultry farm” lower ($p < 0.05$) than veterinarians, while farmers scored all other statements not did differently from the veterinarians. The three groups scored the other statement reflecting voluntariness, “people could become ill when eating chicken that is not cooked well enough” not differently. The structure of the ratings did not differ much among the stakeholder group. However, citizens scored the concern for “people may get ill when eating chicken that is not cooked well enough” as highest, followed by “bacteria are present on chicken meat”, while farmers and veterinarians scored the concern for personal control, “people themselves can take measures to prevent the risk”, as highest.

Socio-demographic characteristics

The potential effect of socio-demographic characteristics on risks perception scores from citizens was analysed. Gender and childhood residence were related to the risk perception scores for the three risks in the four different husbandry systems (Chi-square test; $p < 0.05$ and $p < 0.001$). Compared to male respondents, female respondents perceived the risks of the three hazards in indoor systems higher ($p < 0.05$) and in outdoor systems lower ($p < 0.01$), and females answered more often “I do not know”. Respondents who grew up on a farm more often scored the risks in indoor systems lower ($p < 0.01$), and in outdoor systems higher ($p < 0.01$) than respondents who did not grow up on a farm. Respondents who eat meat one time a week or less perceived the risks in the indoor systems higher ($p < 0.001$) than respondents who eat meat more often. Age, educational level, household income, children (yes or no), pet owner (yes or no) and donate to a nature or animal welfare organization had a significant effect ($p < 0.05$) on one or more risk perceptions, but these effects did not point into one clear direction and were difficult to interpret. Risk perceptions were not significantly associated with social class, and urbanization level of current residence.

DISCUSSION

Last decades society has increasingly expressed concerns regarding livestock husbandry and especially regarding intensive animal husbandry (Bergstra et al., 2017; Hansen et al., 2003). Citizens prefer husbandry systems that offer outdoor access to chickens, but these outdoor systems may have negative consequences for public health and food safety risks. Insight into stakeholder views regarding risk perceptions provides crucial input for adaptation of current or development of new husbandry systems, which can count on societal support. Therefore, the objective of this research was firstly to gain insight into risk perceptions of three public health hazards related to keeping poultry in various husbandry systems, and secondly to explore how these risk perceptions of the stakeholder groups may be explained. The present investigation is the first study that reports risk perceptions of public health hazards in different poultry husbandry systems by three key stakeholder groups: Dutch citizens, poultry farmers, and poultry veterinarians. Regarding the Dutch citizens, a representative panel was used in our study. However, only 4.9% of the total number of Dutch poultry farmers was included in this research, and these participated because they were invited by announcement in magazines and newsletters targeted at poultry farmers. Although the educational level of the farmers ranged from lower education to higher education and shows a variegated distribution, it should be noted that the selection method of poultry farmers could be biased, for example towards more knowledgeable farmers.

Risk perceptions poultry husbandry systems

Our results indicate that the stakeholder groups assess the public health risks related to poultry husbandry differently. Citizens perceived the public health risks of *Campylobacter* contamination of broiler meat, altered dioxin levels in eggs and of avian influenza in chickens kept in indoor systems higher than they perceived these risks in chickens kept in outdoor systems. Farmers and veterinarians, however, perceived these risks higher when chickens are kept in a system with outdoor access than when they are kept in an indoor system. According to literature the “real” risks of these hazards, avian influenza, *Campylobacter*, and dioxin in eggs, are higher in outdoor than in indoor poultry husbandry systems (Bouwknegt et al., 2004; Gonzales et al., 2013; Kijlstra et al., 2009; Koch et al., 2006; Schoeters et al., 2006; Sommer et

al., 2013). However, it is not clear what the “real” risks for consumers’ health are, and to what extent these hazards imply a higher public health risk when chickens are kept in outdoor instead of indoor systems.

Literature describes the risks for introduction of avian influenza, for contamination of eggs with dioxin, or for contamination of meat with *Campylobacter*, and not the “real” risks for citizens or for consumers of eggs or broiler meat. To what extent a hazard is a risk to public health depends also on several aspects, such as prevention measures and consumer behaviour. For example, meat from broilers kept in outdoor systems is more often contaminated with *Campylobacter*, but meat from all broiler husbandry systems may be contaminated with *Campylobacter* and meat may get contaminated during slaughter (EFSA, 2011; Wagenaar et al., 2013). Thus, independent from the origin of the broiler meat, human infections can occur and depend on hygienic handling and preparation of chicken meat (Bell et al., 2009; EFSA, 2011). With regard to dioxin in eggs, it appears that eggs have only a small impact on the total dietary dioxin intake (De Vries et al., 2006; EFSA, 2012; Kiviranta et al., 2004) and dioxin levels in eggs from outdoor chickens can be monitored not to exceed a certain level. Outdoor access is a risk factor for avian influenza, but indoor poultry was also infected with avian influenza. In high risk periods, avian influenza transmission from wild bird to chickens may be prevented by keeping outdoor poultry temporarily indoors. Avian influenza transmission from birds to humans is rare (Wildoner, 2016) and if a flock is infected, the flock is culled as soon as possible, so the infection risk for the general public is small. Although the “real” risks of *Campylobacter*, dioxins and avian influenza for the public health are not clear, it seems that professionals perceive these risks in different husbandry systems better in accordance with literature than do citizens. The professionals and especially the farmers, however, may have an optimistic bias of the public health risks related to the indoor systems and they may overestimate the risks related to the outdoor systems.

Role of knowledge

The observed differences between risk perceptions of the stakeholder groups are in line with earlier studies, which describe that lay people perceive risks differently from experts (Hansen et al., 2003; Jensen et al., 2005; Slovic, 1987; Zingg et al., 2012). The general public expresses more concerns regarding modern methods of food production

than experts do (Hansen et al., 2003; Ueland et al., 2012). As explanatory factor of these differences put forward in the literature is the knowledge deficit of lay people, which implies that their lack of knowledge and understanding of the modern production methods causes these concerns. The present study confirms that citizens were less knowledgeable than were farmers and veterinarians regarding disease caused by the hazards *Campylobacter*, avian influenza, and dioxin. Citizens may be considered as lay people and poultry veterinarians may be considered as experts on public health hazards related to poultry husbandry. However, it is less certain whether poultry farmers can be considered per se as experts regarding public health hazards. Thus, the difference between citizens and professionals might not be caused by just knowledge differences. Also, in literature, the knowledge discrepancy as sole cause of the lay - expert differences in risk perception has been questioned (Hansen et al., 2003; Rowe et al., 2001; Sjoberg, 1999). That is, differences in risk perceptions may also be caused by differences in views on the degree of self-protection, underlying psychological factors and socio-demographic characteristics.

Self-protection

Based on the knowledge and experience of the professionals it was expected that they would rate their capacity of self-protection higher than citizens. Indeed, farmers and veterinarians considered their ability to protect themselves against “pathogens on chicken meat” higher than did citizens. Based on the professionals’ higher ability of self-protection, one might think that the professionals might perceive the public health risk due to *Campylobacter* on broiler meat and dioxin in eggs lower than do citizens. The professionals scored the risks for *Campylobacter* and dioxin in eggs in the indoor systems lower than citizens, but they scored these risks in outdoor systems higher than did citizens. These higher risk perceptions related to outdoor systems in professionals seem not to correspond with the professionals’ higher self-protection. So, the ability to protect themselves could not explain the differences in risk perceptions between citizens and the professionals.

Underlying psychological factors

Previous studies on underlying psychological factors of risk perception revealed that risk perception is influenced by severity of the consequences, unknown by the people

exposed, voluntariness, trust in experts, type of hazard and personal control. In our study, we asked participant to indicate their degree of concern for statements reflecting these factors in the context of poultry husbandry and the three public health hazards. Citizens were more concerned for 9 out of 11 factors than were farmers and for 7 out of 11 factors than were veterinarians. The scores for the statement “people may get ill when being around a poultry farm”, which reflects personal control, differed most between the farmers and citizens. The farmers did not perceive being around a farm as a risk, while literature indicates that being around a poultry farm is a risk to get ill from *Campylobacter* or avian influenza (Havelaar et al., 2009; Koopmans et al., 2004). As this statement reflects personal control, farmers may feel that they have control in this situation. Control is an important factor of risk denial (Sjöberg, 2000), which may cause an optimistic bias regarding the public health risks related to poultry farms by these professionals. However, it does not explain why the professionals perceive the risks of the indoor systems lower and of the outdoor systems higher than do citizens. Other risk factors based on the psychometric model could not explain clearly the differences in risks perceptions between the stakeholder groups.

Socio-demographic characteristics

The socio-demographic characteristics of citizens, gender and childhood residence, were associated with risk perceptions. Female citizens perceived the risks in indoor systems higher and in outdoor systems lower than did males. This is in line with earlier studies on risk perceptions, which report that women assess risks as more problematic than do men (Finucane et al., 2000b; Slovic, 1999; Zingg et al., 2012). The professional groups in this study were predominantly male and this might have influenced the risk perception of these professional groups. Also, the childhood residence of citizens was of influence and as most farmers are spent their childhood on a farm, this period of childhood may be of influence on risk perception. This implies that the perceptions of females and people who did not spend their childhood on a farm should be considered when designing new husbandry systems in order to gauge the social acceptability of the system.

Affect

In the specific context of poultry husbandry, factors that we did not survey may have influenced risk perceptions. Two concepts that may be helpful in this regard, affect and stigmatisation, will be discussed here. The risk assessment of public health hazards in poultry husbandry is complex and requires some knowledge regarding both poultry husbandry systems and the hazards. When risk judgement is complex or when people lack knowledge, they make a more intuitive and holistic judgement and refer to more general knowledge, instead of making a deliberate judgement (Slovic et al., 2007; Van den Heuvel et al., 2008). In this intuitive judgement, affect plays an important role (Finucane et al., 2000a; Slovic et al., 2007). “Affect” refers to an emotional state, and is defined a positive (like) or negative (dislike) evaluative feeling towards a stimulus. It means that positive or negative feelings towards a husbandry system (i.e. the stimulus), may influence risk perceptions related to that system. This would mean that people will use their positive or negative feelings regarding, for example poultry husbandry systems, hen welfare, or healthiness of the poultry products, to assess the public health risks.

Citizens

Citizens perceived outdoor systems as the most desirable husbandry systems for broilers (Van Asselt et al., 2015) and laying hens (Chapter 2). They also view naturalness and outdoor access important for animal welfare (Bergstra et al., 2015; Vanhonacker et al., 2008), and consider organic food healthier and safer than conventional food (Aertsens et al., 2009; Harper et al., 2002). Citizens’ positive attitudes towards outdoor and especially towards organic husbandry systems, could therefore influence the assessment public health risk related to the poultry husbandry systems.

Professionals

Affect may have also influenced the risk perceptions of professional stakeholders – farmers and veterinarians. It has been shown that conventional farmers often have negative attitudes towards outdoor husbandry systems (Gocsik et al., 2016; Stadig et al., 2016a; Van Asselt et al., 2015; Chapter 2). Several reasons may underlie this negative attitude. First of all, farmers may worry about the risk of disease spread of

among others, avian influenza (Gocsik et al., 2015), most notably because in case of an outbreak of avian influenza in a flock, all chickens have to be culled. Also, *Campylobacter* contamination of meat or altered dioxin levels in eggs may have negative consequences, e.g., financial impact, for the farmers. Secondly, the negative attitude of farmers may be caused by their current farm characteristics that might not be suitable to convert to an outdoor system (Gocsik et al., 2015). The professionals and especially the poultry farmers may have extended their negative attitudes towards the outdoor systems to the perceptions of public health risks in the outdoor systems. This may explain why the farmers assessed the risk for the three hazards in the outdoor systems ranging from high till very high.

Stigma

Another mechanism that may be of influence on the observed risk perceptions is stigmatisation. A stigma is a lasting and negative affective response that may dominate the perception of a certain issue (Lofstedt, 2010; Walker, 2013), and often originates from media images. Citizens' knowledge concerning risks in poultry husbandry derives mainly from media, which regards mainly portrayals of problems of intensive livestock husbandry, such as food scandals, animal disease outbreaks and the dioxin affair (Te Velde et al., 2002). These media portrayals may have led to stigmatisation of intensive production systems, and poultry husbandry in particular. Citizens' negative attitudes towards intensive husbandry may have negatively influenced their perception of public health risks of the more intensive indoor systems.

Underlying values

The results might suggest that differences between stakeholder groups can be explained by differences in knowledge and experience, which resulted in a more holistic and intuitive risk assessment. Hence, one might conclude that providing information may bring the perceptions of the stakeholder groups more in accordance with each other. However, there are several reasons why information provision may fail. First of all, also in the professional groups affect seems to play a role. Secondly, in the current post-trust society top down communication from experts to lay public does not work (Lofstedt, 2010). And even if people have the same knowledge level, still the acceptable level of risk may differ among people (Hansen et al., 2003). The acceptable level of risk may depend on involved values (Hansen et al., 2003) and perceived

benefits (Ueland et al., 2012). For example, in case people perceive a more ethical production method important, they may accept greater public health risks (Jensen et al., 2005). Also, other aspects, such as a better taste of meat from free-range broilers (Stadig et al., 2016b) may be weighed against the public health risks. So, in the context of poultry husbandry systems, trade-offs, such as between risks for human health and benefits for poultry welfare, may be based on underlying values (Hayenhjelm et al., 2012).

Implications

Differences in risk perceptions among and within stakeholder groups will have consequences for the acceptability of the various husbandry systems. Citizens perceive outdoor systems as better for public health and food safety, while most professionals tend to have negative attitudes towards outdoor systems. The public health and food safety risks may be higher in outdoor systems than in indoor systems, but these risks related to outdoor systems may be controlled. Thus, outdoor systems could be social acceptable poultry husbandry systems.

To adapt current or new husbandry systems that can count on societal support, views of relevant stakeholder groups and multiple aspects such as animal welfare, public health risks and underlying values should be considered integrally. Co-design (e.g. Groot Koerkamp et al., 2008; Spoelstra et al., 2013) has proven to be a successful design process that involves successfully multiple stakeholders and their opinions. When trade-offs, such as between animal welfare and public health risks have to be made, insight into underlying values might help to find consensus among stakeholders.

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REFERENCES

- Aertsens, J., Verbeke, W., Mondelaers, K., & van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: A review. *British Food Journal*, *111*(10), 1140-1167. doi:10.1108/00070700910992961
- Bejaei, M., Wiseman, K., & Cheng, K. M. (2011). Influences of demographic characteristics, attitudes, and preferences of consumers on table egg consumption in British Columbia, Canada. *Poultry Science*, *90*(5), 1088-1095.
- Bell, C., & Kyriakides, A. (2009). *Campylobacter: a practical approach to the organism and its control in foods*: Wiley-Blackwell.
- Bergstra, T. J., Gremmen, B., & Stassen, E. N. (2015). Moral Values and Attitudes Toward Dutch Sow Husbandry. *Journal of Agricultural and Environmental Ethics*, *28*(2), 375-401. doi:10.1007/s10806-015-9539-x
- Bergstra, T. J., Hogeveen, H., & Stassen, E. N. (2017). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values*, *34*(2), 393-405. doi:10.1007/s10460-016-9721-4
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, *5*(9), 1458-1466. doi:10.1017/S1751731111000371
- Bouwknegt, M., Van De Giessen, A. W., Dam-Deisz, W. D. C., Havelaar, A. H., Nagelkerke, N. J. D., & Henken, A. M. (2004). Risk factors for the presence of *Campylobacter* spp. in Dutch broiler flocks. *Preventive Veterinary Medicine*, *62*(1), 35-49. doi:10.1016/j.prevetmed.2003.09.003
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, *25*(3), 353-367. doi:10.2752/175303712x13403555186334
- Council of the European Union. (1999). Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens. *Official Journal of the European Communities*, *L 203*, 53-57.
- De Vries, M., Kwakkel, R. P., & Kijlstra, A. (2006). Dioxins in organic eggs: A review. *NJAS - Wageningen Journal of Life Sciences*, *54*(2), 207-221.
- EFSA. (2011). Scientific Opinion on *Campylobacter* in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain. *EFSA Journal*, *9*(4), 2105. doi:10.2903/j.efsa.2011.2105
- EFSA. (2012). Update of the monitoring of levels of dioxins and PCBs in food and feed. *EFSA Journal*, *10*(7), 82. doi:10.2903/j.efsa.2012.2832
- Fife-Schaw, C., & Rowe, G. (1996). Public Perceptions of Everyday Food Hazards: A Psychometric Study. *Risk Analysis*, *16*(4), 487-500. doi:10.1111/j.1539-6924.1996.tb01095.x
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000a). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, *13*(1), 1-17.
- Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000b). Gender, race, and perceived risk: The 'white male' effect. *Health, Risk and Society*, *2*(2), 170-172.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes toward technological risk and benefists. *Policy Sciences*(9), 127-152.
- Gocsik, É., van der Lans, I. A., Lansink, A. G. J. M. O., & Saatkamp, H. W. (2016). Elicitation of preferences of Dutch broiler and pig farmers to support decision making on animal welfare. *NJAS - Wageningen Journal of Life Sciences*, *76*, 75-86. doi:10.1016/j.njas.2015.11.006
- Gocsik, É., Van Der Lans, I. A., Oude Lansink, A. G. J. M., & Saatkamp, H. W. (2015). Willingness of Dutch broiler and pig farmers to convert to production systems with improved welfare. *Animal Welfare*, *24*(2), 211-222. doi:10.7120/09627286.24.2.211

- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, 7(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Groot Koerkamp, P. W. G., & Bos, A. P. (2008). Designing complex and sustainable agricultural production systems: an integrated and reflexive approach for the case of table egg production in the Netherlands. *NJAS - Wageningen Journal of Life Sciences*, 55(2), 113-138. doi:10.1016/S1573-5214(08)80032-2
- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, 41(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Harper, G. C., & Makatouni, A. (2002). Consumer perception of organic food production and farm animal welfare. *British Food Journal*, 104(3-5), 287-299. doi:10.1108/00070700210425723
- Harvey, D., & Hubbard, C. (2013). Reconsidering the political economy of farm animal welfare: An anatomy of market failure. *Food Policy*, 38(1), 105-114. doi:10.1016/j.foodpol.2012.11.006
- Havelaar, A. H., van Pelt, W., Ang, C. W., Wagenaar, J. A., van Putten, J. P., Gross, U., & Newell, D. G. (2009). Immunity to *Campylobacter*: its role in risk assessment and epidemiology. *Critical Reviews in Microbiology*, 35(1), 1-22. doi:10.1080/10408410802636017
- Hayenhjelm, M., & Wolff, J. (2012). The moral problem of risk impositions: A survey of the literature. *European Journal of Philosophy*, 20(SUPPL. 1), e26-e51. doi:10.1111/j.1468-0378.2011.00482.x
- Heuer, O. E., Pedersen, K., Andersen, J., & Madsen, M. (2001). Prevalence and antimicrobial susceptibility of thermophilic *Campylobacter* in organic and conventional broiler flocks. *Letters in Applied Microbiology*, 33(4), 269-274. doi:10.1046/j.1472-765X.2001.00994.x
- Jensen, K. K., Lassen, J., Robinson, P., & Sandøe, P. (2005). Lay and expert perceptions of zoonotic risks: understanding conflicting perspectives in the light of moral theory. *International Journal of Food Microbiology*, 99(3), 245-255. doi:10.1016/j.ijfoodmicro.2004.09.004
- Kendall, H. A., Lobao, L. M., & Sharp, J. S. (2006). Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology*, 71(3), 399-428. doi:10.1526/003601106778070617
- Kher, S. V., De Jonge, J., Wentholt, M. T., Deliza, R., de Andrade, J. C., Cnossen, H. J., . . . Frewer, L. J. (2013). Consumer perceptions of risks of chemical and microbiological contaminants associated with food chains: A cross-national study. *International Journal of Consumer Studies*, 37(1), 73-83. doi:10.1111/j.1470-6431.2011.01054.x
- Kijlstra, A., Meerburg, B. G., & Bos, A. P. (2009). Food Safety in Free-Range and Organic Livestock Systems: Risk Management and Responsibility. *Journal of Food Protection*, 72(12), 2629-2637.
- Kijlstra, A., Traag, W. A., & Hoogenboom, L. A. P. (2007). Effect of Flock Size on Dioxin Levels in Eggs from Chickens Kept Outside. *Poultry Science*, 86(9), 2042-2048.
- Kiviranta, H., Ovaskainen, M. L., & Vartiainen, T. (2004). Market basket study on dietary intake of PCDD/Fs, PCBs, and PBDEs in Finland. *Environment International*, 30(7), 923-932. doi:doi.org/10.1016/j.envint.2004.03.002
- Knight, S., Vrij, A., Cherryman, J., & Nunkoosing, K. (2004). Attitudes towards animal use and belief in animal mind. *Anthrozoös*, 17(1), 43-62.
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 179-194. doi:10.1016/s1573-5214(06)80021-7
- Koopmans, M., Wilbrink, B., Conyn, M., Natrop, G., Van Der Nat, H., Vennema, H., . . . Bosman, A. (2004). Transmission of H7N7 avian influenza A virus to human beings during a large outbreak in commercial poultry farms in the Netherlands. *Lancet*, 363(9409), 587-593. doi:10.1016/S0140-6736(04)15589-X
- Krewski, D., Turner, M. C., Lemyre, L., & Lee, J. E. C. (2012). Expert vs. public perception of population health risks in Canada. *Journal of Risk Research*, 15(6), 601-625. doi:10.1080/13669877.2011.649297

- Leikas, S., Lindeman, M., Roininen, K., & Lähteenmäki, L. (2009). Who is responsible for food risks? The influence of risk type and risk characteristics. *Appetite*, 53(1), 123-126. doi:10.1016/j.appet.2009.05.003
- Lofstedt, R. E. (2010). Viewpoint: Risk communication guidelines for Europe: A modest proposition. *Journal of Risk Research*, 13(1), 87-109. doi:10.1080/13669870903126176
- Maddux, J. E., & Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, 19(5), 469-479. doi:10.1016/0022-1031(83)90023-9
- Pussemier, L., Mohimont, L., Huyghebaert, A., & Goeyens, L. (2004). Enhanced levels of dioxins in eggs from free range hens; a fast evaluation approach. *Talanta*, 63(5), 1273-1276. doi:10.1016/j.talanta.2004.05.031
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *The Journal of psychology*, 91(1), 93-114.
- Rosenquist, H., Boysen, L., Krogh, A. L., Jensen, A. N., & Nauta, M. (2013). Campylobacter contamination and the relative risk of illness from organic broiler meat in comparison with conventional broiler meat. *International Journal of Food Microbiology*, 162(3), 226-230. doi:10.1016/j.ijfoodmicro.2013.01.022
- Rowe, G., & Wright, G. (2001). Differences in expert and lay judgments of risk: Myth or reality? *Risk Analysis*, 21(2), 341-356.
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Siegrist, M., Keller, C., & Kiers, H. A. L. (2006). Lay people's perception of food hazards: Comparing aggregated data and individual data. *Appetite*, 47(3), 324-332. doi:10.1016/j.appet.2006.05.012
- Sjoberg, L. (1999). Risk perception by the public and by experts: A dilemma in risk management. *Human Ecology Review*, 6(2), 1-9.
- Sjöberg, L. (2000). Factors in risk perception. *Risk Analysis*, 20(1), 1-11. doi:10.1111/0272-4332.00001
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280-285.
- Slovic, P. (1993). Perceived Risk, Trust, and Democracy. *Risk Analysis*, 13(6), 675-682. doi:10.1111/j.1539-6924.1993.tb01329.x
- Slovic, P. (1999). Trust, emotion, sex, politics, and science: Surveying the risk- assessment battlefield. *Risk Analysis*, 19(4), 689-701. doi:10.1023/A:1007041821623
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177(3), 1333-1352. doi:10.1016/j.ejor.2005.04.006
- Sommer, H. M., Heuer, O. E., Sørensen, A. I. V., & Madsen, M. (2013). Analysis of factors important for the occurrence of Campylobacter in Danish broiler flocks. *Preventive Veterinary Medicine*, 111(1-2), 100-111. doi:10.1016/j.prevetmed.2013.04.004
- Sparks, P., & Shepherd, R. (1994). Public perceptions of the potential hazards associated with food production and food consumption: An empirical study. *Risk Analysis*, 14(5), 799-806. doi:10.1111/j.1539-6924.1994.tb00291.x
- Spoelstra, S. F., Groot Koerkamp, P. W. G., Bos, A. P., Elzen, B., & Leenstra, F. R. (2013). Innovation for sustainable egg production: Realigning production with societal demands in The Netherlands. *World's Poultry Science Journal*, 69(2), 279-298. doi:10.1017/S0043933913000305
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2016a). Survey of egg farmers regarding the ban on conventional cages in the EU and their opinion of alternative layer housing systems in Flanders, Belgium. *Poultry Science*, 95(3), 715-725. doi:10.3382/ps/pev334
- Stadig, L. M., Rodenburg, T. B., Reubens, B., Aerts, J., Duquenne, B., & Tuytens, F. A. M. (2016b). Effects of free-range access on production parameters and meat quality, composition and taste in slow-growing broiler chickens. *Poultry Science*, 95(12), 2971-2978. doi:10.3382/ps/pew226

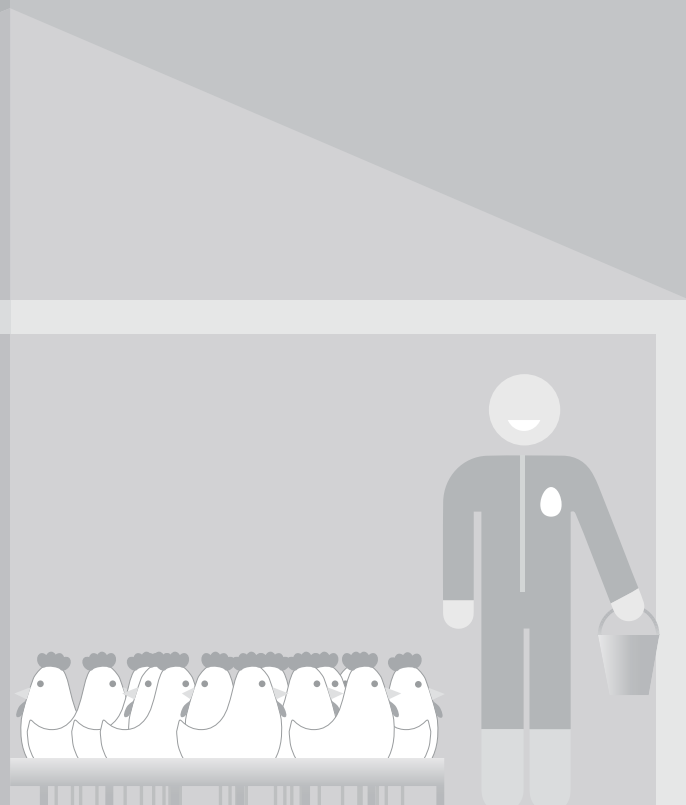
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Ueland, Ø., Gunnlaugsdottir, H., Holm, F., Kalogeras, N., Leino, O., Luteijn, J. M., . . . Verhagen, H. (2012). State of the art in benefit-risk analysis: Consumer perception. *Food and Chemical Toxicology*, 50(1), 67-76.
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians. In D. E. Dumitras, I. M. Jitea, & S. Aerts (Eds.), *Know your food. Food ethics and innovation*. (pp. 138-143). Wageningen: Wageningen Academic Publishers Books.
- Van den Heuvel, T., Renes, R. J., Gremmen, B., Van Woerkum, C., & Van Trijp, H. (2008). Consumers' images regarding genomics as a tomato breeding technology: "Maybe it can provide a more tasty tomato". *Euphytica*, 159(1-2), 207-216. doi:10.1007/s10681-007-9474-7
- van der Zee, H., Wit, B., & Vollema, A. R. (2005). *Survey pathogenen en bacteriele resistentie in kipproducten uit biologische teelt, jaar 2004*. (Project nr: OT04H005). Retrieved from Zutphen:
- Van Overbeke, I., Duchateau, L., De Zutter, L., Albers, G., & Ducatelle, R. (2006). A comparison survey of organic and conventional broiler chickens for infectious agents affecting health and food safety. *Avian Diseases*, 50(2), 196-200.
- Van Overmeire, I., Pussemier, L., Hanot, V., De Temmerman, L., Hoenig, M., & Goeyens, L. (2006). Chemical contamination of free-range eggs from Belgium. *Food Additives & Contaminants*, 23(11), 1109-1122. doi:10.1080/02652030600699320
- Van Overmeire, I., Pussemier, L., Waegeneers, N., Hanot, V., Windal, I., Boxus, L., . . . Goeyens, L. (2009a). Assessment of the chemical contamination in home-produced eggs in Belgium: General overview of the CONTEGG study. *Science of the Total Environment*, 407(15), 4403-4410. doi:10.1016/j.scitotenv.2008.10.066
- Van Overmeire, I., Waegeneers, N., Sioen, I., Bilau, M., De Henauw, S., Goeyens, L., . . . Eppe, G. (2009b). PCDD/Fs and dioxin-like PCBs in home-produced eggs from Belgium: Levels, contamination sources and health risks. *Science of the Total Environment*, 407(15), 4419-4429. doi:10.1016/j.scitotenv.2008.11.058
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2007). Segmentation based on consumers' perceived importance and attitude toward farm animal welfare. *International Journal of Sociology of Food and Agriculture*, 15(3), 91-107.
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Wagenaar, J. A., French, N. P., & Havelaar, A. H. (2013). Preventing *Campylobacter* at the Source: Why Is It So Difficult? *Clinical Infectious Diseases*, 57(11), 1600-1606. doi:10.1093/cid/cit555
- Walker, V. R. (2013). Defining and identifying stigma. In J. Flynn, P. Slovic, & H. Kunreuther (Eds.), *Risk, media and stigma: Understanding public challenges to modern science and technology* (pp. 353-360). London: Routledge.
- Weinstein, N. D. (1982). Unrealistic optimism about susceptibility to health problems. *Journal of Behavioral Medicine*, 5(4), 441-460. doi:10.1007/BF00845372
- Wildoner, D. A. (2016). What's New with Pandemic Flu. *Clinical Microbiology Newsletter*, 38(4), 27-31. doi:10.1016/j.clinmicnews.2016.02.001
- Zingg, A., & Siegrist, M. (2012). Lay people's and experts' risk perception and acceptance of vaccination and culling strategies to fight animal epidemics. *Journal of Risk Research*, 15(1), 53-66.



The trade-off between chicken welfare and public health risks in poultry husbandry: significance of moral convictions

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ABSTRACT

Welfare-friendly outdoor poultry husbandry systems are associated with potentially higher public health risks for certain hazards, which results in a dilemma: whether to choose a system that improves chicken welfare or a system that reduces these public health risks. We studied the views of citizens and poultry farmers on judging the dilemma, relevant moral convictions and moral arguments in a practical context. By means of an online questionnaire, citizens (n = 2259) and poultry farmers (n = 100) judged three practical cases, which illustrate the dilemma of improving chicken welfare or reducing public health risks for *Campylobacter*, avian influenza and dioxin. Furthermore, they scored the importance of moral arguments and to what extent they agreed with moral convictions related to humans and chickens. Citizens were more likely than farmers to choose a system that benefits chicken welfare at the expense of public health. These different judgments could be explained by differing moral convictions and valuations of moral arguments. Judgments of citizens and farmers were associated with moral arguments and convictions, predominantly with those regarding the *value of chickens* and *naturalness*. Citizens agreed stronger with moral convictions regarding the intrinsic value of chickens and regarding *naturalness* than farmers did, while farmers agreed stronger with conviction regarding *fairness*. We argue that opinions of citizens and farmers are context-dependent, which may explain the differences between these groups. It implies that opinions of different stakeholder groups should be considered in order to achieve successful innovations in poultry husbandry, which are supported by society.

Key words: animal welfare, moral convictions, poultry husbandry, public health, stakeholder views

INTRODUCTION

In intensive poultry husbandry systems, which were introduced after World War II, large numbers of chickens are kept at high stocking densities in order to produce ample and affordable poultry products efficiently (Rollin, 2004). The drawbacks of these intensive indoor systems with the focus on high production are animal welfare issues, such as production-related diseases and behavioural problems. These welfare issues in the intensive systems led to societal concerns regarding poultry husbandry, which focused on chickens' opportunities to express natural behaviour and lead natural lives (Eurobarometer, 2005; Fraser et al., 1997; McGlone, 2001; Rollin, 2007). Consequently, the general public, led by NGO campaigns, called for alternative husbandry systems for chickens that are more animal welfare-friendly, offering animals more space and freedom to express natural behaviour, e.g. by means of outdoor husbandry systems (Chapter 2, 3).

The more welfare-friendly poultry husbandry systems, however, are associated with higher public health risks for certain hazards, such as *Campylobacter*, avian influenza, and dioxin. For example, for broiler chickens, outdoor access and an older age at slaughter are risk factors for an increased *Campylobacter* prevalence in broilers and on broiler meat (Bouwknegt et al., 2004; EFSA, 2011; Sommer et al., 2013). Outdoor access for laying hens increases the risk of introducing avian influenza into a flock (Gonzales et al., 2013; Koch et al., 2006) and of elevated dioxin levels in eggs (EFSA, 2012; Schoeters et al., 2006) relative to indoor systems. These examples show that adaptations in husbandry systems in order to improve chicken welfare, such as outdoor access, may be a risk to public health. They imply that the choice for husbandry systems, in particular for indoor or outdoor systems, causes dilemmas necessitating choices between chicken welfare and certain public health and food safety risks. The question is how people – both the general public and poultry farmers – balance the interests of chickens against those of humans when faced with the dilemma of choosing a system that improves chicken welfare or reduces public health and food safety risks. An understanding of how to achieve this balance and approach the dilemma is useful for developing or adapting husbandry systems in such way that they can count on support from society.

At the farm level, the dilemma of improving chicken welfare or reducing public health risks in poultry husbandry is influenced by many factors, such as scientific facts, fundamental moral values and convictions considering humans and animals. Fundamental moral values are deeply rooted beliefs that are founded on knowledge, and multiple social, cultural, and religious aspects, and are shared in society (Beauchamp et al., 2009; Cohen et al., 2009). In individuals or in a group of individuals, such as farmers, these fundamental moral values are influenced by knowledge, personal experiences with animals, and belief in mental capacity of animals (Knight et al., 2008; Knight et al., 2009), and become personal moral convictions regarding animals and animal husbandry. In a society or in a specific group, people may share moral convictions concerning humans and animals. For example, in the Netherlands most people consider animals to have intrinsic value, and 67% of people consider humans to be superior to animals (Cohen et al., 2012). In a practical case, however, moral convictions are shaped to the specific context and the entities involved, and are balanced against each other and relevant facts (Childress et al., 2002; Cohen et al., 2009; Cohen et al., 2016). It may result in people making different judgments regarding the dilemma of improving chicken welfare or reducing public health risks.

Previous studies have shown that citizens and farmers have different views on 1) the preferred husbandry systems for laying hens and broiler chickens (Chapter 2; Stadig et al., 2016; Stadig et al., 2015; Van Asselt et al., 2015b); and 2) the importance of various issues such as animal welfare and public health risks (Chapter 2; Stadig et al., 2015; Van Asselt et al., 2015b; Vanhonacker et al., 2016; Vanhonacker et al., 2008). For poultry husbandry, it has been shown that compared to poultry farmers, citizens have more positive views regarding outdoor poultry husbandry systems (Chapter 2; Van Asselt et al., 2015a; Vanhonacker et al., 2016). Moreover, citizens evaluate chicken welfare in outdoor systems as better (Chapter 3; Van Asselt et al., 2017; Vanhonacker et al., 2016), and certain public health hazards in outdoor systems as less risky than do poultry farmers (Van Asselt et al., 2018). These different views of poultry farmers and citizens on poultry husbandry systems may be based on different moral convictions related to humans and chickens. It is expected that citizens and poultry farmers will make different judgments regarding a dilemma of improving chicken welfare or reducing public health risks, because they may have different views on the importance of various moral arguments related to their moral convictions. As yet, no studies have

compared citizens' and farmers' judgments regarding a dilemma of improving chicken welfare or reducing public health risks, and moral convictions and arguments involved. Therefore, the objective of this study is to fill this knowledge gap.

To study dilemmas in society and the moral convictions involved, multi-criteria frameworks have been developed which integrate values from the consequentialist and deontological perspectives. These frameworks give insight into various moral convictions and arguments regarding fundamental moral values such as *autonomy*, *justice*, and *wellbeing* for different interest groups, such as farmers, consumers, and animals (Beauchamp et al., 2009; Mepham, 2000). Other researchers have elaborated further on these frameworks and adapted them in order to study moral convictions and arguments regarding humans and animals in a specific context, such as livestock husbandry or food production (e.g. Bergstra et al., 2015; Bruijnjs et al., 2015; Cohen et al., 2009; Gremmen et al., 2018; Jensen et al., 2011; Mepham, 2000; Michalopoulos et al., 2008). These frameworks, however, are not specific to the dilemmas of improving chicken welfare or reducing public health risks and do not cover the debates on these dilemmas. To study the judgments of the dilemma, and relevant moral convictions and arguments of citizens and poultry farmers, existing frameworks should be adapted in order to develop a framework that considers moral convictions and arguments specifically for the dilemma presented.

To study the judgment of the dilemma, three practical cases were used. For the cases, three potential public health risks were chosen which may arise more often in alternative and outdoor poultry husbandry systems than in conventional indoor husbandry systems: 1) *Campylobacter* in broilers; 2) avian influenza introduction in laying hens; and 3) dioxin in eggs. The objective of this paper is to study in citizens and poultry farmers 1) moral convictions regarding humans and chickens; 2) the judgment of the dilemma of improving chicken welfare or reducing public health risks; and 3) the valuation of moral arguments relevant for the judgment of three practical cases representing the dilemma.

MATERIAL AND METHODS

To study the judgment of three cases illustrating the dilemma, moral arguments, and moral convictions relevant for citizens and poultry farmers, a survey was carried out by means of an online questionnaire. Three cases were selected which represent a dilemma of choosing a system that improves chicken welfare or reduces the public health or food safety risk for *Campylobacter*, avian influenza or dioxin. These cases were selected because the public health or food safety hazard may occur more often in alternative and outdoor husbandry systems than in conventional indoor systems. The questionnaire was based on a multi-criteria framework containing moral convictions, moral arguments, and the three cases describing a dilemma.

Framework

The multi-criteria framework (Figure 5.1) is based on an analysis of existing frameworks regarding dilemmas in animal and food production, and an analysis of the debate related to chicken welfare and public health risks (e.g. Bergstra et al., 2015; Bruijnijis et al., 2015; Cohen et al., 2009; Gremmen et al., 2018; Jensen et al., 2011; Mepham, 2000; Michalopoulos et al., 2008). Because our study focuses on the dilemma of choosing a system that improves chicken welfare or reduces public health risks related to poultry farming, only convictions directly relevant for this dilemma were considered. The main interest groups involved in the dilemma are chickens – depending on the case, these were laying hens or broilers – farmers, consumers of chicken products, and citizens who are at risk.

To explain the framework used, we will now give a concise overview of relevant literature and the public debate regarding the dilemma of improving chicken welfare or reducing public health risks. Literature review and analyses of the debate on the dilemma mentioned indicate that four clusters of moral values may be relevant to the study: *Value of chickens*, *Naturalness*, *Fairness* and *Wellbeing* (e.g. Beauchamp et al., 2009; Bergstra et al., 2015; Cohen et al., 2009; Jensen et al., 2011; Mepham, 2000; Michalopoulos et al., 2008). With regard to the dilemma presented, the interests of humans will be balanced against those of chickens. In the context of poultry husbandry, fundamental moral values related to humans and chickens will be expressed by people as personal moral convictions. Judging a dilemma will be influenced by moral convictions regarding the *value of chickens*. For example, chickens

may have functional value, but can also have other values, such as relational value or intrinsic value (Cohen et al., 2009; Warren, 1997). The functional value of chickens refers to their usefulness for humans, namely producing meat and eggs. A reason to attribute to chickens intrinsic value is acknowledging them as sentient beings who are able to experience pain, pleasure and boredom (Heeger et al., 2001; Warren, 1997). Balancing the interests and values related to humans against those related to chickens is influenced by the value of chickens and how their value is related to human value, i.e. the hierarchical position of a person with respect to animals (Cohen et al., 2009). For this study, the convictions ‘chickens experience pain’, ‘chickens experience pleasure and boredom’, ‘chickens have intrinsic value’, ‘chickens have functional value’ and ‘hierarchical position’ may be of relevance for the judgment and are included in the framework (Figure 5.1).

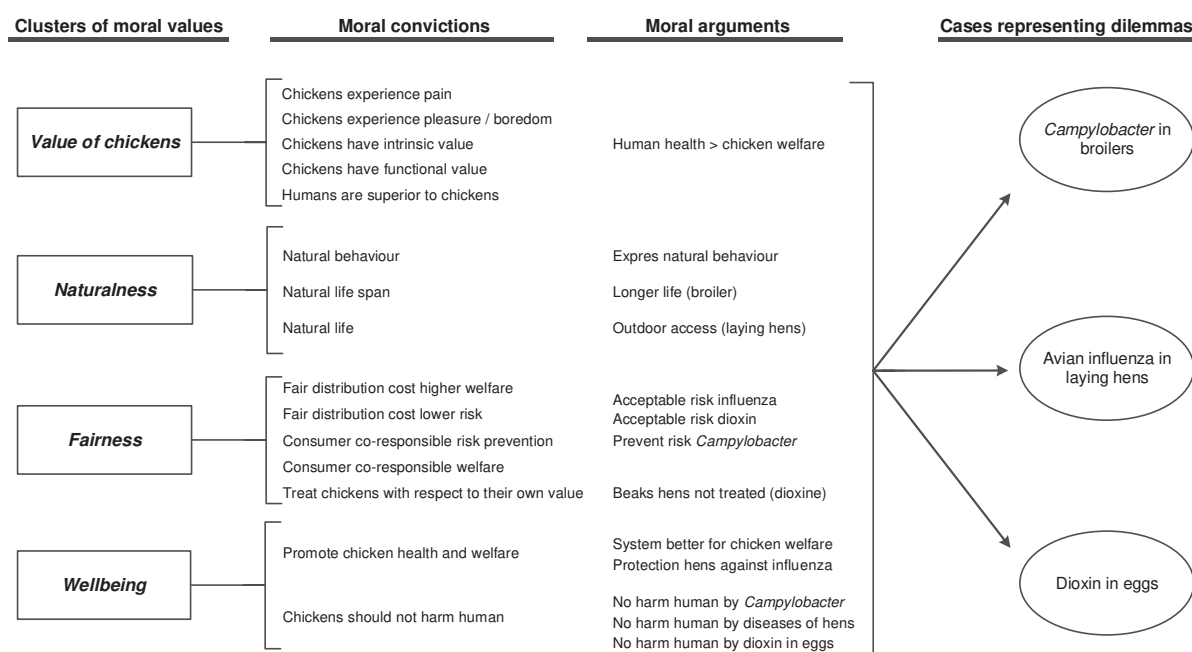


Figure 5.1 Framework for the analyses of moral convictions and moral arguments relevant for the judgment of three cases representing a dilemma of improving chicken welfare or reducing public health risks

In discussions about how animals should be kept, *naturalness* is often emphasized, especially by citizens (Bergstra et al., 2015; Boogaard et al., 2011a; Lassen et al., 2006; Vanhonacker et al., 2008; Verbeke, 2009; Verhoog et al., 2007). Both citizens and farmers perceive freedom of movement and possibility to perform natural behaviour as important (Bergstra et al., 2015; Boogaard et al., 2011a; Te Velde et al., 2002), but

citizens also see a natural life and a natural lifespan as being important in animal husbandry (Bergstra et al., 2015; Lassen et al., 2006). In the dilemma of improving chicken welfare or reducing public health risks, *naturalness* may play a role in the choice of husbandry system, because outdoor systems are in line with convictions regarding *naturalness*, such as freedom to express natural behaviour and leading natural lives. Therefore, ‘natural behaviour’ and ‘natural life’ are included in our framework. For broilers specifically, ‘natural lifespan’ is of relevance, because broilers used in non-conventional systems are of a slower growing genetic line and are thus slaughtered at an older age and will be studied.

The third cluster of values we found relevant is *fairness*, which is also referred to as justice. When applied to the dilemma of improving chicken welfare or reducing public health risks, *fairness* may represent a fair distribution of costs for improving animal welfare and for reducing public health risks, and a fair distribution of responsibility for chicken welfare and risk prevention among farmers and consumers. The corresponding convictions for this study are ‘fair distribution of costs of higher welfare’, ‘fair distribution of costs of lower public health risks’, ‘consumers are co-responsible for risk prevention’, and ‘consumers are co-responsible for chicken welfare’. With regard to animals, *fairness* has been defined as respect for the intrinsic values of animals (Mepham, 2000). It means that chickens have a value of their own, independently from their instrumental value to humans, and should be treated with respect to their own value. In the present study, *fairness* will refer to respect for the intrinsic value of chickens: ‘treat chickens with respect to their own value’.

The last cluster of moral values concerns *wellbeing*. *Wellbeing* means promote health and welfare, do not harm, and protect against harm (Beauchamp et al., 2009; Cohen et al., 2009; Mepham, 2000). The dilemma outlined above relates to a change of husbandry system, which may be beneficial for poultry welfare, but may also entail higher risks to public health or food safety hazards. The general public and poultry farmers view poultry health, public health and food safety as important issues for poultry husbandry (Chapter 2; Van Asselt et al., 2015b). Thus, as regards the dilemma, the convictions ‘promote chicken health and welfare’ and ‘should not harm human health’ are relevant to the framework and are included. Related to the moral convictions as described above and, in the framework (Figure 5.1), we formulated statements (see Table 5.3), which were included in the questionnaire.

In this study, three cases were presented to survey participants regarding the dilemma of improving chicken welfare or reducing public health risks. In each case, certain specific moral arguments are relevant. These moral arguments are related to the previously described moral convictions (Figure 5.1). Because we were interested to study the judgments in three specific cases, only relevant moral arguments for the specific cases are included. Consequently, not for every moral conviction a moral argument is included in the framework in Figure 5.1. Some of the moral arguments are relevant for all cases, for example ‘human health is more important than chicken welfare’, ‘express natural behaviour’, and ‘the system is better for chicken welfare’. Other arguments are specific to one case, such as ‘longer life for broilers’ for the *Campylobacter* case; ‘outdoor access’ for the avian influenza and dioxin case; and ‘beaks are not treated’ for the dioxin case. For each case six arguments were chosen. Based on these arguments for each case, six statements were formulated and included in the questionnaire (see Table 5.2).

Cases representing the dilemma

For methodological reasons, the three cases representing the dilemma were formulated in two ways. The two cases representing a dilemma regarding *Campylobacter* in broilers and dioxin in eggs describe a situation in which a broiler farmer and a laying hen farmer switch to a husbandry system that is considered more welfare-friendly than the old system but may imply higher food safety risks. The avian influenza case describes a switch from an outdoor system to a less welfare-friendly indoor system with fewer risks of avian influenza than the outdoor system. In the questionnaire, the three cases were presented to the participants. After each case the participants were asked to give their opinions (agree, neither agree nor disagree, or disagree) on the choice of a poultry farmer for a husbandry system.

Campylobacter case

A poultry farmer keeps his broiler chickens in a conventional indoor husbandry system: in a barn with litter on the floor, and the broilers are slaughtered at the age of 42 days. The farmer would like to change from the conventional system to a conventional plus (indoor) system. Compared to a conventional system, the broilers in a conventional plus system are offered more space, enrichment (straw) and will be slaughtered at the age of 56 days. Ten per cent of conventional broiler meat is infected

with the intestinal bacterium *Campylobacter*. In the new system, the *Campylobacter* contamination of broiler meat will increase to 30%, due to the longer growing period of the broilers. In humans, contamination with *Campylobacter* may cause intestinal infections. Contamination can be prevented through hygienic food handling and thorough cooking of broiler meat.

Avian influenza case

A poultry farmer keeps his laying hens in a free-range system with outdoor access. The hens have access to an outdoor run for eight hours a day. Hens kept in this system with outdoor access have an introduction rate of avian influenza that is 11 times higher than for hens kept in systems without outdoor access. Therefore, the poultry farmer decides to keep his hens permanently indoors. The avian influenza virus is transmitted to several bird species and is usually not contagious to humans. Influenza viruses change continuously. In future, avian influenza may infect humans and may cause human diseases varying from eye infections to flu.

Dioxin case

A laying hen farmer switches from an indoor non-cage husbandry system to an organic system. Compared to the indoor non-cage system, hens in this organic system have more space, access to an outdoor run for eight hours a day, have untreated beaks, and receive organic feed. When the farmer kept his hens in the indoor system, the dioxin levels in the eggs were well below the legal norm. In the system with outdoor access, hens can take up dioxin from the environment and the average dioxin level in eggs has increased, but is still within the legal norm. Dioxin is a chemical compound, which after a prolonged uptake may cause cancer in humans. The norm is set at a level such that the cancer risk is minimal.

Survey

A quantitative survey was done by means of an online questionnaire in March and April 2014. We formulated the survey questions based on the moral convictions, moral arguments and cases presented in the framework (Figure 5.1). Prior to data collection, the questionnaire was pilot tested for clarity and comprehensibility of the questions by representatives of the two stakeholder groups. Based on these comments, the questionnaire was then further revised and subsequently executed. The questions

addressed 1) moral convictions concerning chickens and humans; 2) the judgments of three cases; 3) arguments of relevance for the judgment of the dilemmas; and 4) socio-demographic characteristics of the participants. For the questions regarding the moral convictions (Figure 5.1), we asked the participants to score to what extent they agreed with 15 statements (Table 5.3) on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

The participants were then presented first with the *Campylobacter* case and were asked to give their opinions (agree, neither agree nor disagree, or disagree) on the choice made by a poultry farmer in a case that represents a dilemma of improving broiler welfare or increasing the risk of *Campylobacter*. Participants were then asked to rate the importance of six statements regarding the moral arguments for their judgment of the *Campylobacter* case on a scale of 1 to 5 (1 = very unimportant, 5 = very important). Subsequently, the other two cases, the avian influenza and dioxin case, were presented. Participants were again asked to make a judgment and to rate the importance of six statements regarding moral arguments (Table 5.2).

Participants

The general public and poultry farmers were considered relevant stakeholder groups for studying the dilemma of improving chicken welfare or reducing public health risks. The opinions of the general public concerning livestock husbandry, most notably channelled through NGOs, have become important (Boogaard et al., 2011b). The general public were studied in their role as citizens, because citizens, without being necessarily consumers, may be involved in public debates about poultry husbandry (Harvey et al., 2013). The views of poultry farmers were regarded as relevant because they are most directly involved in choosing and investing in poultry husbandry systems.

Representatives of Dutch citizens and poultry farmers filled in the questionnaire. CentERdata (www.centerdata.nl), a research institute specialized in online survey research, invited citizens from their CentERpanel to participate in the survey. The CentERpanel is considered to be a representative sample of the Dutch population. CentERdata approached 3,344 CentERpanel citizens, of whom 2,373 (71.0%) started to fill in the questionnaire, and 2,259 (67.6%) completed the questionnaire. Dutch

poultry farmers were invited to participate in the questionnaire by a digital newsletter of the Dutch organization of poultry farmers (NOP). We also posted several articles on websites dealing with poultry husbandry, and a website concerned with agriculture in general. The newsletter and websites were freely available. One hundred poultry farmers fully completed the questionnaire. The data of CBS Statistics Netherlands (2018, April 04) indicate that 2,046 farms kept poultry professionally in 2014. Information about the main socio-demographic features of the respondents, citizens and poultry farmers, are presented in Table 5.1.

Table 5.1 Socio-demographic characteristics of the respondents

	Citizens (n = 2259)	Poultry farmers (n = 100)	CBS Statline ¹
Gender (%)			
Male	52.2	88.0	49.2
Female	47.8	12.0	50.8
Age (%)			
15 - 34 years	16.6	11.0	29.3
35 - 54 years	36.8	73.0	34.2
> 55 years	46.6	16.0	36.5
Education (%)			
Low	26.7	28.0	30.9
Intermediate	29.3	43.0	41.0
High (Bachelor / Master)	44.0	29.0	28.1

¹ Data from Statline (CBS Statistics Netherlands) dated 01-03-2014

Statistical analyses

Only fully completed questionnaires were included in the analyses. Data were processed and analysed using SPSS 22.0. Two cases, the *Campylobacter* and dioxin cases, described a switch to a system that benefits chicken welfare at the expense of public health. For the avian influenza case, however, the case was formulated the other way round for methodological reasons, thus describing a switch from a system that benefits animal welfare to a system that benefits public health. To facilitate the analyses of the dilemmas, for the influenza case the categories disagree and agree were switched so that for all three cases an 'agree' signifies agreement with a farmer's choice of a husbandry system that may benefit chicken welfare, and a 'disagree' signifies disagreement with a farmer's choice of a husbandry system that may benefit chicken welfare. The Chi square test was done to analyse the association between the judgment of the cases and the stakeholder group. Analysis of variances was used to

explore the association between 1) the mean importance scores for the moral arguments and the judgment of the case; 2) the mean level of agreement with statements regarding moral convictions and stakeholder group; and 3) the mean level of agreement with statements regarding moral convictions and judgment of the case. One-way analysis of variance (ANOVA) was done if variances were homogeneous according to Leven's test. If variances were not homogeneous, the Welch test was used. If the effect of the judgment of a case on the arguments was significant, the post-hoc Games-Howell test for multiple comparisons was done to analyse differences between the groups that agreed, neither agreed nor disagreed, or disagreed with a farmer's choice of a system that may benefit chicken welfare.

RESULTS

To gain insight into the judgment of the dilemma and relevant moral arguments and convictions, we first present the judgments of citizens and poultry farmers on the three cases. Second, the importance of the moral arguments for the judgment of the three cases will be shown. Next, the moral convictions of the citizens and poultry farmers will be presented, and finally, these moral convictions will be presented in relation to the judgments of citizens and farmers regarding the three cases.

Opinions on the cases

Citizens and poultry farmers had different opinions on the three cases representing a dilemma of improving chicken welfare or reducing public health risks from 1) *Campylobacter* in broilers; 2) avian influenza in laying hens; and 3) dioxin in eggs (Figure 5.2). Citizens were more likely than farmers to agree with a system that benefits chicken welfare at the expense of public health, while farmers were more likely than citizens to disagree with a system that benefits chicken welfare for the *Campylobacter* case ($\chi^2(2) = 11.23, p = 0.004$), the avian influenza case ($\chi^2(2) = 75.97, p < 0.001$), and the dioxin case ($\chi^2(2) = 179.65, p < 0.001$). Of the three cases, citizens most often agreed with a system that benefits chicken welfare when considering the dioxin case (50%), while farmers most often agreed with a system that benefits chicken welfare when considering the *Campylobacter* case (30%).

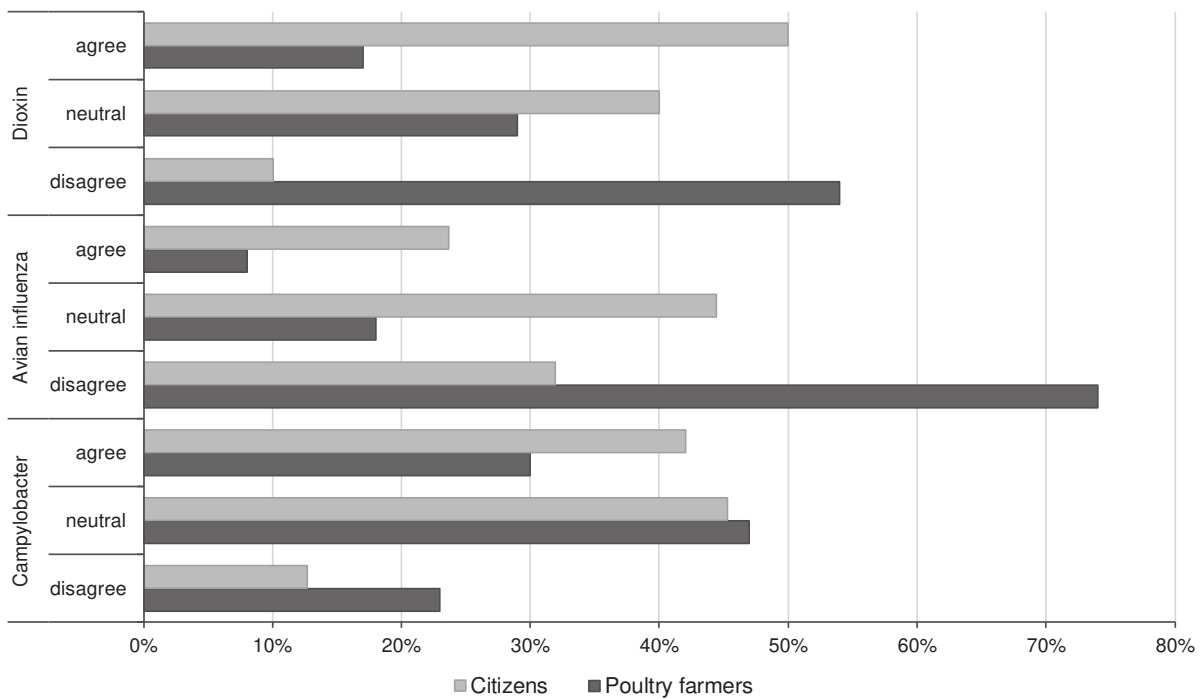


Figure 5.2 Percentage of citizen and poultry farmer respondents who agreed, were neutral (neither agreed, nor disagreed), and disagreed with the choice of a husbandry system that benefits chicken welfare at the expense of public health for *Campylobacter* in broilers, avian influenza in laying hens, and dioxin in eggs

For the *Campylobacter* case, the difference between citizens and farmers was smaller than for the influenza and dioxin cases. Of the three cases, citizens and farmers disagreed most often on the avian influenza case. Notable is the high percentage of farmers (74%) who disagreed with a system that benefits hen welfare and increases the risk of avian influenza introduction. Of the citizens, about 40-45% neither agreed nor disagreed with the three cases, while among poultry farmers, a comparable neutral score was only found for the *Campylobacter* case.

Moral arguments

After making a judgment of the cases, the respondents scored the importance of moral arguments for their judgment of the three cases (Table 5.2). For all three cases, citizens and farmers who agreed with a choice of a system that favours chicken welfare scored 1) all arguments concerning *naturalness*; 2) all arguments concerning *fairness*; and 3) the argument concerning *wellbeing* ‘free range systems are better for broiler welfare’, as more important ($p < 0.05$) than those who favoured a system with fewer public health risks. Respondents who disagreed with the choice of a system with better chicken welfare and higher public health risks scored the arguments regarding

Table 5.2 Mean scores for moral arguments according to citizens (n=2259) and poultry farmers (n=100) who disagree (D), are neutral (N) or agree (A) with the choice of a husbandry system that benefits chicken welfare at the expense of public health for Campylobacter in broilers, avian influenza in laying hens, and dioxin in eggs on a five-point Likert scale ranging from 1 = very unimportant to 5 = very important

Cluster of moral values	Moral arguments	Citizens			Poultry farmers		
		D	N	A	D	N	A
Broiler	Campylobacter case	n=286	n=1023	n=950	n=23	n=47	n=30
Value chickens	Human health is more important than broiler welfare	4.14 ^a	3.72 ^b	3.37 ^c	4.57 ^a	4.11 ^b	3.80 ^c
Naturalness	In free-range systems, broilers can express more natural behaviour	3.05 ^a	3.67 ^b	4.26 ^c	2.57 ^a	2.70 ^b	3.57 ^c
Naturalness	In free-range systems, broilers live longer	2.95 ^a	3.43 ^b	3.74 ^c	1.70 ^a	2.40 ^b	3.13 ^c
Fairness	The infection risk is small if, while preparing broiler meat, one works in a hygienic way and cooks the meat thoroughly	3.73 ^a	3.95 ^b	4.34 ^c	3.26 ^a	4.09 ^b	4.50 ^c
Wellbeing	Free-range systems are better for broiler welfare	3.14 ^a	3.68 ^b	4.30 ^c	2.35 ^a	2.81 ^b	3.67 ^c
Wellbeing	Consumers have the right to broiler meat with minimal bacterial contamination	4.35 ^a	3.91 ^b	3.47 ^c	4.65 ^a	3.94 ^b	3.47 ^c
Laying hen	Avian influenza case	n=721	n=1004	n=534	n=74	n=18	n=8
Value chickens	Human health is more important than hen welfare	4.09 ^a	3.68 ^b	3.34 ^c	4.46 ^a	4.06	2.75 ^b
Naturalness	In the free-range system, hens can express more natural behaviour	3.31 ^a	3.77 ^b	4.34 ^c	2.26 ^a	3.56 ^b	4.75 ^c
Naturalness	Laying hens should have the opportunity to go outside	3.14 ^a	3.73 ^b	4.39 ^c	1.54 ^a	2.78 ^b	4.63 ^c
Fairness	Because of proper monitoring of bird flu in laying hens, the risk of disease in humans is low	3.95 ^a	3.75 ^b	4.10 ^c	3.66 ^a	4.17	4.63 ^b
Wellbeing	Laying hens are better protected indoors against avian influenza infection	4.25 ^a	3.56 ^b	2.77 ^c	4.80 ^a	4.17 ^b	1.63 ^c
Wellbeing	People have the right to protection against diseases transmitted by laying hens	4.24 ^a	3.85 ^b	3.60 ^c	4.24 ^a	3.83 ^a	2.25 ^b
Laying hen	Dioxin case	n=227	n=903	n=1129	n=54	n=29	n=17
Value chickens	Human health is more important than hen welfare	4.41 ^a	3.78 ^b	3.61 ^c	4.54 ^a	4.17	3.47 ^b
Naturalness	In the organic system, hens can express more natural behaviour	2.98 ^a	3.60 ^b	4.34 ^c	2.09 ^a	2.83 ^b	3.94 ^c
Naturalness	Laying hens should have the opportunity to go outside	2.95 ^a	3.57 ^b	4.25 ^c	1.30 ^a	2.10 ^b	4.06 ^c
Fairness	The dioxin level in the eggs is still within the legal limits and thus the disease risk in humans is low	3.68 ^a	3.58 ^a	4.09 ^b	2.98 ^a	3.76 ^b	4.18
Fairness	The beaks of the hens are not treated	2.91 ^a	3.46 ^b	4.06 ^c	2.00 ^a	2.31	3.18 ^b
Wellbeing	People have the right to eggs with little or no dioxin	4.44 ^a	3.89 ^b	3.73 ^c	4.78 ^a	4.14 ^b	3.47 ^b

^{a, b, c} Means within a row with different superscripts indicate a significant difference ($p < 0.05$) in means within groups of citizens or groups of farmers (Post-hoc Games Howell multiple comparisons test)

value of chickens – ‘human health is more important than chicken welfare’ –, and the argument regarding *wellbeing*, namely ‘not harm human’, as more important ($p < 0.05$) than respondents who agreed with the choice of a system favouring chicken welfare. In citizens, a difference of more than 1.0 was found between the agree group and the disagree group for arguments regarding *naturalness* – ‘chickens can express more natural behaviour’, and ‘hens should have the opportunity to go outside’–, for the argument regarding *wellbeing* chicken in the *Campylobacter* case, and for the argument ‘beaks of the hens are not treated’ in the dioxin case. The scores of the farmers who agreed and disagreed differed for almost all arguments by more than 1.0. A difference of more than 1.8 was found between the agree and disagree groups for arguments regarding *naturalness* – ‘chickens can express more natural behaviour’, and ‘hens should have the opportunity to go outside’ – in the influenza and dioxin case, and regarding *wellbeing* in the influenza case. Notable are the low scores of farmers who disagreed with the choice of a system that benefits chicken welfare for all the arguments regarding *naturalness*.

Moral convictions

Table 5.3 shows the mean scores of citizens and poultry farmers for moral convictions relevant in the context of the dilemma of improving chicken welfare or reducing public health risks. Citizens scored the statement ‘chickens or chicken products should not harm human health’, which reflects the *wellbeing* of humans, as highest, and the statement ‘chickens have functional value’ lowest of all statements. Poultry farmers scored the statement ‘costs of improving chicken welfare may be charged in price of eggs or meat’, which reflects *fairness* of distribution of costs, highest and they scored ‘chickens should reach their natural lifespan’ lowest of all statements. The mean scores of citizens and farmers did not differ ($p > 0.05$) for the two statements regarding chicken sentience, namely ‘chickens experience pain’, and ‘chickens experience pleasure and boredom’, and did not differ for the statement ‘chickens or chicken products should not harm human health’ (*wellbeing*). All other statements were scored differently ($p < 0.05$) between citizens and poultry farmers. Citizens scored the statements regarding the intrinsic value of chickens, and the three statements regarding *naturalness* higher ($p < 0.05$) than farmers did. The statements ‘chickens have functional value’, ‘humans are superior to chickens’, the five statements regarding *fairness*, and ‘a farmer should treat a chicken when it is ill’ were scored

Table 5.3 Mean scores for statements regarding moral convictions according to citizens (n=2259) and poultry farmers (n=100) on a on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree

Cluster of moral values	Moral convictions	Citizens	Poultry farmers	Test statistics	p-value
Value of chickens	Chickens experience pain	4.22	4.22	F (1, 2357) = 0.002	< 0.001
	Chickens experience pleasure and boredom	3.84	3.64	F (1, 105.40) = 3.08	0.082
	Chickens have intrinsic value	3.53	3.26	F (1, 105.94) = 5.96	0.016
	Chickens have functional value	3.25	4.32	F (1, 114.20) = 150.23	< 0.001
	Humans are superior to chickens	3.86	4.66	F (1, 119.18) = 110.07	< 0.001
Naturalness	Chickens should express natural behaviour	3.97	3.48	F (1, 107.12) = 31.66	< 0.001
	Chickens should reach their natural lifespan	3.42	2.23	F (1, 2357) = 135.30	< 0.001
	Chickens have right to a natural life	3.86	2.90	F (1, 2357) = 108.24	< 0.001
Fairness	Costs of improving chicken welfare may be charged in the price of eggs or meat	3.97	4.75	F (1, 112.65) = 112.17	< 0.001
	Costs of reducing public health risks may be charged in the price of eggs or meat	3.91	4.59	F (1, 108.23) = 49.75	< 0.001
	Consumers are co-responsible for chicken welfare by their purchasing behaviour	3.95	4.60	F (1, 114.23) = 70.20	< 0.001
	Consumers themselves should reduce health risks of chicken products	3.97	4.50	F (1, 2357) = 32.59	< 0.001
	Farmers should treat chickens with respect to their own value	3.96	4.16	F (1, 2357) = 5.14	0.023
Wellbeing	A farmer should treat a chicken when it is ill	3.92	4.21	F (1, 2357) = 8.28	0.004
	Chickens or chicken products should not harm human health	4.44	4.41	F (1, 2357) = 0.11	0.740

higher by farmers than by citizens ($p < 0.05$). The biggest differences between scores given by citizens and poultry farmers related to statements concerning the *value of chickens*, namely ‘chickens have functional value’, and ‘humans are superior to chickens’, and statements concerning *naturalness*.

Moral convictions relating to opinions on the cases: A comparison between citizens and farmers

Moral convictions relating to the opinions on the cases regarding *Campylobacter* in broilers, avian influenza in laying hens, and dioxin in eggs are presented in the ANNEX I in Table 5.4, 5.5 and 5.6. For all three cases, the scores of the agree and disagree groups in citizens and poultry farmers show the same pattern. All respondents, both citizens and poultry farmers, who agreed with the choice of a husbandry system that benefits chicken welfare, gave higher scores for statements regarding chicken sentience, ‘chickens have intrinsic value’, *naturalness*, *fairness* and ‘a farmer should treat a chicken when it is ill’, and lower scores for the statements ‘chickens have functional value’ and ‘humans are superior to chickens’ than respondents who disagreed.

DISCUSSION

Society is increasingly concerned about poultry husbandry in general and chicken welfare in particular. To address these concerns, poultry husbandry systems have been adapted and the number of farms offering outdoor access to chickens has been growing. With these developments, new concerns have come to the fore about potential public health and food safety risks associated with keeping chickens in alternative and outdoor husbandry systems. As a result, a dilemma of choosing a system that improves chicken welfare or reduces public health and food safety risks has arisen. The question is how to address such dilemmas. Insight into stakeholders’ judgments of these dilemmas and their arguments and underlying moral convictions, may provide input for developing or adapting husbandry systems in such way that they can count on support from society. Therefore, the objective of this study was to 1) to gain insight into views of citizens as compared to poultry farmers on three cases representing a dilemma of improving chicken welfare or reducing public health risks;

2) the valuation of moral arguments relevant for the dilemma; and 3) the underlying moral convictions. To this end, a quantitative survey by means of an online questionnaire was conducted among Dutch citizens and poultry farmers. The citizens' sample was considered representative for Dutch citizens. It should be noted that due to the methods of invitation, the selection of poultry farmers might have been biased, for example towards more knowledgeable farmers.

Judgments of the cases and moral arguments

Citizens and poultry farmers judged three cases dealing with the choice of farmer for a husbandry system that benefits chickens or a system that reduces public health of food safety risks for *Campylobacter*, avian influenza, or dioxin in eggs. For all three cases, citizens agreed with the choice of a husbandry system that benefits chicken welfare at the expense of public health more often than did farmers. These results are in line with other studies that describe that, in general, citizens prefer husbandry systems with outdoor access (Chapter 2; Van Asselt et al., 2015b; Vanhonacker et al., 2016), while farmers often have negative attitudes towards outdoor systems (Chapter 2; Gocsik et al., 2016; Stadig et al., 2016; Van Asselt et al., 2015b). Of the three cases, farmers most often agreed with the *Campylobacter* case (30%), which represented a switch from a conventional indoor to a conventional plus system. Compared to the conventional system, the conventional plus system offers broilers more space and enrichment, and broilers are slaughtered at an older age. Nevertheless, the conventional plus system is also an indoor system. The relatively strong agreement of farmers with the *Campylobacter* case may also be explained by the farmers' preference for indoor systems (Chapter 2; Gocsik et al., 2016; Stadig et al., 2016; Van Asselt et al., 2015b).

For the *Campylobacter* and dioxin case, more citizens agreed than disagreed with a system that benefits chicken welfare at the expense of public health, while for the avian influenza case more citizens disagreed than agreed with a system that benefits chicken welfare at the expense of public health. The reason that citizens choose not to favour the outdoor system for the avian influenza case might be that in contrast to the other two cases avian influenza affects also hen health negatively and in case of an avian influenza outbreak chickens have to be culled. Citizens showed a higher agreement on the dioxin case than on the influenza and *Campylobacter* case. The

welfare improvement from an indoor non-cage to an organic system in the dioxin case is larger than in the other two cases. For a considerable group of citizens, this welfare improvement might be sufficient to outweigh the health risks for human, or they perceive the human health risks as small because eggs are controlled on dioxin levels. A considerable group of respondents, especially citizens, neither disagreed nor agreed with a system that benefits chicken welfare. The scores of these “neutral” respondents for the moral arguments were in between the scores of the disagree and agree groups. This neutral judgment might suggest that these respondents required more information to judge the case, or had less strong opinions than the disagree and agree groups, or viewed several arguments equally important and could not make a trade-off.

It is interesting to note that citizens and poultry farmers who made the same judgments of the cases use the same moral arguments. Those who agreed with a system that benefits chicken welfare scored the moral arguments regarding *naturalness*, *fairness*, and *wellbeing* of chickens higher, and the arguments ‘humans are superior to chickens’, ‘not harm human’, and ‘not harm chicken’ lower than the respondents who disagreed. The arguments regarding *naturalness* – ‘express natural behaviour’ and ‘opportunity to go outside’ – were scored considerably different by the agree and disagree respondents of the two stakeholder groups. This difference suggests that the judgment of the dilemma of improving chicken welfare or reducing public health risks is predominantly influenced by how important one views *naturalness* in relation to chickens and chicken welfare.

Moral convictions

In this study, citizens and poultry farmers agreed with most moral convictions presented. Citizens and farmers agreed on the strength of the convictions regarding not harm human and sentience of chicken, which was also found by Bergstra et al. (2015) in the context of pig husbandry. This agreement on sentience – chickens experience pain, and pleasure and boredom – may still lead to diverging views regarding a dilemma in a practical case, because other convictions, such as the conviction regarding *naturalness*, are balanced against it. In a practical case, attribute sentience to chickens may imply for a citizen respect for a natural life and for a farmer providing good care to his chickens.

Most moral convictions were not shared by citizens and farmers. Citizens recognized more often than farmers the importance of the intrinsic value of animals (Bergstra et al., 2015). Farmers valued the convictions regarding ‘humans are superior to chickens’, and ‘chickens have functional value’ higher than citizens. This suggests that for them, the value of chickens is mainly based on their usefulness to people. Also, for the convictions regarding *naturalness*, a big difference was found between citizens and farmers. Citizens perceived convictions regarding *naturalness*, such as ‘express natural behaviour’ and ‘natural life’, as more important than did farmers. This is in line with studies on stakeholders’ perceptions of animal welfare, which show that citizens view animal welfare predominantly in terms of leading natural lives and professionals as biological functioning and affective states of the animal (Bergstra et al., 2015; Fraser et al., 1997; Te Velde et al., 2002; Vanhonacker et al., 2008).

The scores for the moral convictions regarding a fair distribution of responsibility and costs showed some interesting results. Although citizens and poultry farmers agreed that the costs of improving chicken welfare and reducing public health risks may be charged in the price of eggs or meat, poultry farmers agreed with these statements more strongly than citizens did. Farmers will argue that they are responsible for producing eggs and chicken meat in accordance with minimal requirements for chicken welfare and risks for public health and food safety as laid down in legislation. When society calls for chicken welfare or public health and food safety above this statutory level, farmers might argue that they are not responsible to pay for these improvements. On the other hand, citizens might argue that the requirements as set in legislation are minimal requirements and farmers are responsible for health and welfare of their chickens, and therefore farmers should pay for the improvements.

In the questionnaire, the moral convictions regarding humans and chickens were asked independently from the cases. Because the moral arguments were associated with the judgments of the cases, and the moral arguments used in the cases were based on the moral convictions, it was expected that moral convictions would also be associated with the judgments of the cases. Indeed, in both citizens and poultry farmers the moral convictions were associated with the judgments, and especially the convictions regarding *naturalness*, and the *value of chickens* seemed relevant for the judgments. The people who disagreed with a judgment in favour of chicken welfare – a higher percentage of farmers than citizens – scored the moral convictions ‘humans are

superior to chickens’, and ‘chickens have functional value’ higher, and the convictions regarding sentience chickens and intrinsic value of chicken lower than those who agreed. These results confirm that the *value of chickens* – being sentient and having intrinsic value or having functional value (Cohen et al., 2012) – and *naturalness* (Bergstra et al., 2015), in terms of expressing natural behaviour, are relevant convictions for the way in which the interests of chickens are weighed against the interests of humans.

The convictions regarding sentience, the *value of chickens* and *naturalness*, are all related to ethical views on animal welfare. Sentience, the capacity to feel pain and emotions, is, according to several ethical theories, a reason to respect the species specific needs and interests of animals (e.g. Appleby et al., 2002; Bentham, 1789; Singer, 1995) and may be a reason to attribute to these animals intrinsic value (Heeger et al., 2001). Respect for the interests of animals may imply respect for the animal living its life according to its nature or telos (Rollin, 1981). This view was confirmed in citizens and farmers who believed that chickens have a right to a natural life. The respect for telos is contained in the concept of animal welfare that considers that good welfare means leading a natural life (Fraser, 2003; Fraser et al., 1997). Although ‘chicken or chicken products should not harm humans’ was an important moral conviction for both citizens and farmers, a proportion of the citizens and farmers judged the dilemma in favour of chicken welfare. For them, convictions regarding the interests of chickens may be strong enough to outweigh those regarding human health, and to cause them to judge the dilemma in favour of chicken welfare. People who view humans to be superior to chickens – in this study more poultry farmers than citizens – may value chickens predominantly for their functional value. They may perceive animal welfare in terms of biological functioning – health, growth and production rate – and view *naturalness* less important for chickens and their welfare. They will balance the values related to the interests of chickens against other values, such as ‘not harm human’. As a result, these people may judge the cases in favour of human health.

Context

The remaining question is: Why do different interest groups, such as citizens and farmers, value some moral convictions differently? The differences between them

might be explained by their context: whether or not someone is involved in poultry husbandry, which has been explained by the ‘three-layered concept of moral convictions’ by Cohen et al. (2010). Fundamental moral values, such as respect for autonomy, justice and *wellbeing*, are part of public morality (Beauchamp et al., 2009; Mepham, 2000). Being a farmer or being a member of the general public, however, influences the valuation of moral convictions, which are based on those fundamental moral values regarding either humans or animals. Moreover, the practical context of people, and thus also their interests, will influence the balancing of moral convictions. It has been shown that farmers’ decisions regarding husbandry systems are influenced by their farm characteristics and the possibility of converting to another – e.g. outdoor – system, risks of disease spread, and the economic consequences of a disease outbreak (Gocsik et al., 2015; Stadig et al., 2016). To elaborate on this, the public health risks of an avian influenza outbreak are small, because only a minority of avian influenza outbreaks are potentially a disease risk for humans. If avian influenza is diagnosed on a farm, chickens will be culled immediately, which implies that the human health risks is small. An influenza outbreak, however, has a high impact on the affected farm, because chickens will be culled, and an outbreak also affects other farms because animal transportation is halted and export restrictions imposed (Backer et al., 2011). This high impact of avian influenza outbreaks on farmers’ *wellbeing* and the viability of the farm will influence farmers’ moral convictions and arguments regarding *naturalness* and outdoor systems. Farmers might therefore have valued the intrinsic value of chickens lower and the functional value of chickens higher than did citizens. Another example is a farmer’s practical or economically inability to convert to an outdoor system may influence his opinion on the importance of *naturalness* for chickens.

Citizens, however, value chickens for their intrinsic value and do not take economic consequences or farm characteristics into consideration when they value moral convictions regarding chickens. Nowadays, only a small number of people are involved in livestock farming and farms are often “closed” systems, so that citizens are not always aware of the limitations that farmers have to deal with. Other examples of the context dependency of citizens’ views are food or livestock-related incidents. In the period March to April 2014, when this research was done, no animal disease outbreaks or food incidents occurred in the Netherlands. Citizens may have perceived the public health risks as presented in the cases in this study as general risks and not as personal

risks. In situations of animal disease outbreaks, such as avian influenza, or food incidents, such as the dioxin affair, people may feel anxious and uncertain about the risks, and may make different judgments and use different arguments from those we found in this study (Bults et al., 2011).

Framework

The framework used in this study to structure convictions and arguments relevant to the dilemma presented was based on existing multi-criteria frameworks and the debate on the dilemma. Although the framework might not be complete – for example, we did not include an argument for each moral conviction – the framework was useful to analyse moral convictions and arguments involved in a complex dilemma of improving animal welfare or public health risks. Based on the results, we can conclude that moral convictions related to the moral values value of chicken and *naturalness* are important for judging the dilemma of improving chicken welfare or reducing public health risks and should be considered in ethical frameworks when studying dilemmas in animal husbandry.

Conclusion and implications

Judgments by citizens and poultry farmers regarding the dilemma are related to their valuation of moral arguments and moral convictions, and are context-dependent. People, more citizens than farmers, who choose a husbandry system that benefits chicken welfare at the expense of public health value convictions related to the intrinsic value of chickens, sentience, and *naturalness* – expressing natural behaviour, natural lifespan and natural life – as more important than people who choose a system in favour of public health. Poultry farmers focus on the functional value of chickens and view a fair distribution of cost for welfare improvement and risks prevention important. Moreover, we argued that the judgments and moral convictions are context-dependent and this may explain the differences found between citizens and poultry farmers. To comply with societal concerns on poultry husbandry, moral convictions and arguments of both stakeholder groups should be considered. With that, successful innovations in poultry husbandry can be achieved.

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REFERENCES

- Appleby, M. C., & Sandoe, P. T. (2002). Philosophical Debate on the Nature of Well-being: Implications for Animal Welfare. *Animal Welfare*, 11(3), 283-294.
- Backer, J., Bergevoet, R., Fischer, E., Nodelijk, G., Bosman, K., Saatkamp, H., & Roermund, H. v. (2011). *Control of highly pathogenic avian influenza: epidemiological and economic aspects*. Retrieved from Den Haag: <http://library.wur.nl/WebQuery/wurpubs/fulltext/173727>
- Beauchamp, T. L., & Childress, J. F. (2009). *Principles of biomedical ethics* (6th ed.). New York / Oxford: Oxford University Press.
- Bentham, J. (1789). Duty to minimize suffering. In A. Linzey & P. A. B. Clarke (Eds.), *Political Theory and Animal Rights* (pp. 135-137). London: Pluto.
- Bergstra, T. J., Gremmen, B., & Stassen, E. N. (2015). Moral Values and Attitudes Toward Dutch Sow Husbandry. *Journal of Agricultural and Environmental Ethics*, 28(2), 375-401. doi:10.1007/s10806-015-9539-x
- Boogaard, B. K., Boekhorst, L. J. S., Oosting, S. J., & Sørensen, J. T. (2011a). Socio-cultural sustainability of pig production: Citizen perceptions in the Netherlands and Denmark. *Livestock Science*, 140(1-3), 189-200. doi:10.1016/j.livsci.2011.03.028
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011b). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, 5(9), 1458-1466. doi:10.1017/S1751731111000371
- Bouwknegt, M., Van De Giessen, A. W., Dam-Deisz, W. D. C., Havelaar, A. H., Nagelkerke, N. J. D., & Henken, A. M. (2004). Risk factors for the presence of *Campylobacter* spp. in Dutch broiler flocks. *Preventive Veterinary Medicine*, 62(1), 35-49. doi:10.1016/j.prevetmed.2003.09.003
- Bruijnis, M. R. N., Blok, V., Stassen, E. N., & Gremmen, H. G. J. (2015). Moral “Lock-In” in Responsible Innovation: The Ethical and Social Aspects of Killing Day-Old Chicks and Its Alternatives. *Journal of Agricultural and Environmental Ethics*, 28(5), 939-960. doi:10.1007/s10806-015-9566-7
- Bults, M., Beaujean, D. J., de Zwart, O., Kok, G., van Empelen, P., van Steenberg, J. E., . . . Voeten, H. A. (2011). Perceived risk, anxiety, and behavioural responses of the general public during the early phase of the Influenza A (H1N1) pandemic in the Netherlands: results of three consecutive online surveys. *BMC Public Health*, 11, 2. doi:doi:10.1186/1471-2458-11-2
- CBS Statistics Netherlands. Landbouw; gewassen, dieren en grondgebruik naar regio. Retrieved 04-04-2018 <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/8078oned/table?dl=1525B>
- Childress, J. F., Faden, R. R., Gaare, R. D., Gostin, L. O., Kahn, J., Bonnie, R. J., . . . Nieburg, P. (2002). Public health ethics: Mapping the terrain. *Journal of Law, Medicine and Ethics*, 30(2), 170-178.
- Cohen, N. E. (2010). General discussion *Thesis: Considering animals. Moral convictions concerning animals and judgement on the culling of healthy animals in animal disease epidemics*. Wageningen, the Netherlands: Wageningen University.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2009). Fundamental Moral Attitudes to Animals and Their Role in Judgment: An Empirical Model to Describe Fundamental Moral Attitudes to Animals and Their Role in Judgment on the Culling of Healthy Animals During an Animal Disease Epidemic. *Journal of Agricultural and Environmental Ethics*, 22(4), 341-359. doi:10.1007/s10806-009-9157-6

- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, 25(3), 353-367. doi:10.2752/175303712x13403555186334
- Cohen, N. E., & Stassen, E. N. (2016). Public moral convictions about animals in the Netherlands: culling healthy animals as a moral problem. In F. L. B. Meijboom & E. N. Stassen (Eds.), *The end of animal life: a start for ethical debate*. Wageningen: Wageningen Academic publishers.
- EFSA. (2011). Scientific Opinion on Campylobacter in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain. *EFSA Journal*, 9(4), 2105. doi:10.2903/j.efsa.2011.2105
- EFSA. (2012). Update of the monitoring of levels of dioxins and PCBs in food and feed. *EFSA Journal*, 10(7), 82. doi:10.2903/j.efsa.2012.2832
- Eurobarometer. (2005). *Attitudes of consumers towards the welfare of farmed animals* (229). Retrieved from Brussels, Belgium: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_229_en.pdf
- Fraser, D. (2003). Assessing animal welfare at the farm and group level: the interplay of science and values. *Animal Welfare*, 12(4), 433-443.
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6(3), 187-205.
- Gocsik, É., van der Lans, I. A., Lansink, A. G. J. M. O., & Saatkamp, H. W. (2016). Elicitation of preferences of Dutch broiler and pig farmers to support decision making on animal welfare. *NJAS - Wageningen Journal of Life Sciences*, 76, 75-86. doi:10.1016/j.njas.2015.11.006
- Gocsik, É., Van Der Lans, I. A., Oude Lansink, A. G. J. M., & Saatkamp, H. W. (2015). Willingness of Dutch broiler and pig farmers to convert to production systems with improved welfare. *Animal Welfare*, 24(2), 211-222. doi:10.7120/09627286.24.2.211
- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, 7(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Gremmen, B., Bruijnis, M. R. N., Blok, V., & Stassen, E. N. (2018). A Public Survey on Handling Male Chicks in the Dutch Egg Sector. *Journal of Agricultural and Environmental Ethics*. doi:10.1007/s10806-018-9712-0
- Harvey, D., & Hubbard, C. (2013). Reconsidering the political economy of farm animal welfare: An anatomy of market failure. *Food Policy*, 38(1), 105-114. doi:10.1016/j.foodpol.2012.11.006
- Heeger, R., & Brom, F. W. A. (2001). Intrinsic Value and Direct Duties: From Animal Ethics towards Environmental Ethics? *Journal of Agricultural and Environmental Ethics*, 14(2), 241-252. doi:10.1023/a:1011319921159
- Jensen, K. K., Forsberg, E., Gamborg, C., Millar, K., & Sandøe, P. (2011). Facilitating Ethical Reflection Among Scientists Using the Ethical Matrix. *Science and Engineering Ethics*, 17(3), 425-445. doi:10.1007/s11948-010-9218-2
- Knight, S., & Barnett, L. (2008). Justifying attitudes toward animal use: A qualitative study of people's views and beliefs. *Anthrozoös*, 21(1), 31-42.
- Knight, S., Vrij, A., Bard, K., & Brandon, D. (2009). Science versus human welfare? Understanding attitudes toward animal use. *Journal of Social Issues*, 65(3), 463-483.
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 179-194. doi:10.1016/s1573-5214(06)80021-7
- Lassen, J., Sandøe, P., & Forkman, B. (2006). Happy pigs are dirty! - conflicting perspectives on animal welfare. *Livestock Science*, 103(3), 221-230. doi:10.1016/j.livsci.2006.05.008
- McGlone, J. J. (2001). Farm animal welfare in the context of other society issues: Toward sustainable systems. *Livestock Production Science*, 72(1-2), 75-81. doi:10.1016/S0301-6226(01)00268-8
- Mepham, B. (2000). A framework for the ethical analysis of novel foods: The ethical matrix. *Journal of Agricultural and Environmental Ethics*, 12(2), 165-176.

- Michalopoulos, T., Korthals, M., & Hogeveen, H. (2008). Trading "ethical preferences" in the market: Outline of a politically liberal framework for the ethical characterization of foods. *Journal of Agricultural and Environmental Ethics*, 21(1), 3-27.
- Rollin, B. E. (1981). *Animal rights and human morality*: Prometheus Books.
- Rollin, B. E. (2004). Annual Meeting Keynote Address: Animal agriculture and emerging social ethics for animals. *Journal of Animal Science*, 82(3), 955-964.
- Rollin, B. E. (2007). Cultural variation, animal welfare and telos. *Animal Welfare*, 16(SUPPL.), 129-133.
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Singer, P. (1995). *Animal liberation* (Second ed.). London: Random House.
- Sommer, H. M., Heuer, O. E., Sørensen, A. I. V., & Madsen, M. (2013). Analysis of factors important for the occurrence of *Campylobacter* in Danish broiler flocks. *Preventive Veterinary Medicine*, 111(1-2), 100-111. doi:10.1016/j.prevetmed.2013.04.004
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2016). Survey of egg farmers regarding the ban on conventional cages in the EU and their opinion of alternative layer housing systems in Flanders, Belgium. *Poultry Science*, 95(3), 715-725. doi:10.3382/ps/pev334
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2015). Opinion of Belgian egg farmers on hen welfare and its relationship with housing type. *Animals*, 6(1), 1-11. doi:10.3390/ani6010001
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015a). *Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians*. Paper presented at the 12th EurSafe Conference. Know your food: Food ethics and innovation, Cluj-Napoca, Roemenia. <http://edepot.wur.nl/344161>
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015b). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians. In D. E. Dumitras, I. M. Jitea, & S. Aerts (Eds.), *Know your food. Food ethics and innovation*. (pp. 138-143). Wageningen: Wageningen Academic Publishers Books.
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2017, 5-8 september). *Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians*. Paper presented at the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level, Ede, the Netherlands.
- Van Asselt, M., Poortvliet, P. M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2018). Risk perceptions of public health and food safety hazards in poultry husbandry by citizens, poultry farmers and poultry veterinarians. *Poultry Science*, 97(2), 607-619. doi:10.3382/ps/pex325
- Vanhonacker, F., Tuytens, F. A. M., & Verbeke, W. (2016). Belgian citizens' and broiler producers' perceptions of broiler chicken welfare in Belgium versus Brazil. *Poultry Science*, 95(7), 1555-1563. doi:10.3382/ps/pew059
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Verbeke, W. (2009). Stakeholder, citizen and consumer interests in farm animal welfare. *Animal Welfare*, 18(4), 325-333.
- Verhoog, H., Lammerts Van Bueren, E. T., Matze, M., & Baars, T. (2007). The value of 'naturalness' in organic agriculture. *NJAS - Wageningen Journal of Life Sciences*, 54(4), 333-345. doi:10.1016/S1573-5214(07)80007-8
- Warren, M. A. (1997). *Moral status: Obligations to persons and other living things*: Oxford University Press, USA.

ANNEX I: Opinions on the cases in relation to moral convictions

ANNEX I: Opinions on the cases in relation to moral convictions

Table 5.4 Means for moral convictions of citizens (n=2259) and poultry farmers (n=100), who disagree (D), are neutral (N) or agree (A) with the choice of a husbandry system that benefits broiler welfare in the Campylobacter case (1 = strongly disagree, 5 = strongly agree)

Clusters of Moral values		Citizens			Poultry farmers		
		D n = 286	N n = 1023	A n = 950	D n = 23	N n = 47	A n = 30
Value of chickens	Moral convictions						
	Chickens experience pain	4.06 ^a	4.08 ^a	4.42 ^b	4.13	4.17	4.37
	Chickens experience pleasure and boredom	3.60 ^a	3.74 ^a	4.01 ^b	3.48	3.53	3.93
	Chickens have intrinsic value	3.34 ^a	3.44 ^a	3.68 ^b	2.83 ^a	3.26	3.60 ^b
	Chickens have functional value	3.44 ^a	3.40 ^a	3.04 ^b	4.57	4.36	4.07
Naturalness	Humans are superior to chickens	4.02 ^a	3.87	3.80 ^b	4.65	4.72	4.57
	Chickens should express natural behaviour	3.70 ^a	3.86 ^b	4.17 ^c	3.26 ^a	3.30	3.93 ^b
	Chickens should reach their natural lifespan	3.18 ^a	3.43 ^b	3.47 ^b	2.00	2.19	2.47
	Chickens have right to a natural life	3.58 ^a	3.77 ^b	4.04 ^c	2.87	2.70 ^a	3.23 ^b
	Costs of improving chicken welfare may be charged in price of eggs or meat	3.76 ^a	3.85 ^a	4.15 ^b	4.65	4.77	4.80
Fairness	Costs of reducing public health risks may be charged in price of eggs or meat	3.87 ^a	3.78 ^a	4.06 ^b	4.39	4.72	4.53
	Consumers are co-responsible for chicken welfare by their purchasing behaviour	3.74 ^a	3.81 ^a	4.16 ^b	4.35	4.60	4.80
	Consumers themselves should reduce health risks of chicken products	3.86 ^a	3.84 ^a	4.13 ^b	4.43	4.64	4.33
	Farmers should treat chickens with respect to their own value	3.76 ^a	3.85 ^a	4.15 ^b	3.87	4.28	4.20
	A farmer should treat a chicken when it is ill	3.85	3.87 ^a	4.00 ^b	4.35	4.28	4.00
Wellbeing	Chickens or chicken products should not harm human health	4.58 ^a	4.36 ^b	4.47 ^a	4.61	4.38	4.30

^{a,b,c} Means within a stakeholder group within a row with different superscripts indicate a significant difference ($p < 0.05$) in means (Post-hoc Games Howell multiple comparisons test)

Table 5.5 Means for moral convictions of citizens (n=2259) and poultry farmers (n=100), who disagree (D), are neutral (N) or agree (A) with the choice of a husbandry system that benefits hen welfare in the avian influenza case (1 = strongly disagree, 5 = strongly agree)

Clusters of moral values	Citizens			Poultry farmers		
	D n = 721	N n = 1004	A n = 534	D n = 74	N n = 18	A n = 8
Moral convictions						
Value of chickens						
Chickens experience pain	4.17 ^a	4.09 ^a	4.51 ^b	4.09 ^a	4.50 ^b	4.75 ^b
Chickens experience pleasure and boredom	3.71 ^a	3.77 ^a	4.13 ^b	3.49 ^a	3.78 ^a	4.75 ^b
Chickens have intrinsic value	3.37 ^a	3.48 ^a	3.82 ^b	3.11	3.56	4.00
Chickens have functional value	3.53 ^a	3.27 ^b	2.85 ^c	4.45	4.11	3.63
Humans are superior to chickens	4.07 ^a	3.85 ^b	3.61 ^c	4.76	4.78	3.50
Naturalness						
Chickens should express natural behaviour	3.80 ^a	3.90 ^b	4.34 ^c	3.34 ^a	3.56 ^a	4.62 ^b
Chickens should reach their natural lifespan	3.24 ^a	3.43 ^b	3.63 ^c	2.18	2.17	2.88
Chickens have right to a natural life	3.68 ^a	3.80 ^b	4.20 ^c	2.81	2.83	3.88
Fairness						
Costs of improving chicken welfare may be charged in price of eggs or meat	3.88 ^a	3.93 ^a	4.16 ^b	4.72	4.83	4.88
Costs of reducing public health risks may be charged in price of eggs or meat	3.92	3.85 ^a	4.01 ^b	4.66	4.72	3.63
Consumers are co-responsible for chicken welfare by their purchasing behaviour	3.84 ^a	3.86 ^a	4.26 ^b	4.57 ^a	4.56	5.00 ^b
Consumers themselves should reduce health risks of chicken products	3.90 ^a	3.90 ^a	4.19 ^b	4.58	4.22	4.38
Farmers should treat chickens with respect to their own value	3.84 ^a	3.90 ^a	4.24 ^b	4.19	3.83 ^a	4.62 ^b
Wellbeing						
A farmer should treat a chicken when it is ill	3.90 ^a	3.87 ^a	4.05 ^b	4.26	3.94	4.38
Chickens or chicken products should not harm human health	4.55 ^a	4.35 ^b	4.44 ^b	4.41	4.44	4.38

^{a,b,c} Means within a stakeholder group within a row with different superscripts indicate a significant difference ($p < 0.05$) in means (Post-hoc Games Howell multiple comparisons test)

Table 5.6 Means for moral convictions of citizens (n=2259) and poultry farmers (n=100), who disagree (D), are neutral (N) or agree (A) with the choice for a husbandry system that benefits hen welfare in the dioxin case (1 = strongly disagree, 5 = strongly agree)

Clusters of moral values	Moral convictions	Citizens			Poultry farmers		
		D n = 227	N n = 903	A n = 1129	D n = 54	N n = 29	A n = 17
Value of chickens	Chickens experience pain	3.91 ^a	4.02 ^a	4.43 ^b	4.00 ^a	4.41 ^b	4.59 ^b
	Chickens experience pleasure and boredom	3.48 ^a	3.70 ^b	4.01 ^c	3.33 ^a	3.83	4.29 ^b
	Chickens have intrinsic value	3.11 ^a	3.40 ^b	3.71 ^c	3.04 ^a	3.34	3.82 ^b
	Chickens have functional value	3.78 ^a	3.39 ^b	3.04 ^c	4.52	4.21	3.88
	Humans are superior to chickens	4.22 ^a	3.89 ^b	3.76 ^c	4.81 ^a	4.76	4.00 ^b
Naturalness	Chickens should reach their natural lifespan	3.04 ^a	3.33 ^b	3.56 ^c	2.22	2.10	2.47
	Chickens have right to a natural life	3.44 ^a	3.70 ^b	4.06 ^c	2.80	2.79	3.41
	Chickens should express natural behaviour	3.57 ^a	3.80 ^b	4.19 ^c	3.30 ^a	3.45 ^a	4.12 ^b
Fairness	Costs of improving chicken welfare may be charged in price of eggs or meat	3.60 ^a	3.82 ^b	4.16 ^c	4.69	4.86	4.76
	Costs of reducing public health risks may be charged in price of eggs or meat	3.72 ^a	3.77 ^a	4.06 ^b	4.61	4.83	4.12
	Consumers are co-responsible for chicken welfare by their purchasing behaviour	3.63 ^a	3.73 ^a	4.18 ^b	4.56	4.59	4.76
	Consumers themselves should reduce health risks of chicken products	3.66 ^a	3.82 ^a	4.15 ^b	4.63	4.41	4.24
Wellbeing	Farmers should treat chickens with respect to their own value	3.63 ^a	3.79 ^b	4.17 ^c	4.13	4.07	4.41
	A farmer should treat a chicken when it is ill	3.76 ^a	3.80 ^a	4.05 ^b	4.30	4.03	4.24
	Chickens or chicken products should not harm human health	4.56 ^a	4.32 ^b	4.50 ^a	4.44	4.41	4.29

^{a,b,c} Means within a stakeholder group within a row with different superscripts indicate a significant difference ($p < 0.05$) in means (Post-hoc Games Howell multiple comparisons test)



Views on laying hen husbandry: A farm visit with citizens

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Submitted



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ABSTRACT

The general public has expressed concerns regarding animal welfare and public health in relation to livestock husbandry. These concerns are predominantly related to naturalness, namely the animals' ability to lead natural lives and a natural environment for keeping livestock. It is not clear what citizens consider to be natural and what their views are on an innovative husbandry system, which takes account of these concerns about naturalness and public health. In order to achieve societal support for laying hen husbandry, the opinions of citizens should be considered. Therefore, during a farm visit we studied citizens' views on an innovative laying hen husbandry system with a large covered free-range area, and related aspects such as hen welfare, hen health and public health risks. Two groups of nine participants filled out a questionnaire, partly before and partly while seeing the hen husbandry system. Results showed that participants were predominantly positive regarding the systems in general, and regarding hen health, hen welfare and public health risks. However, the participants expressed concerns about the space for hens to move around and perform natural behaviour. This confirms that citizens focus on the welfare concept "leading natural lives". The participants' views on naturalness could be described as "a natural environment with space to move around and express natural behaviour". Based on the opinions of participants during the farm visit, it was concluded that the husbandry system with a large covered veranda was an acceptable husbandry system, which takes account of concerns regarding animal welfare and public health. Suggestions have been made to improve hen husbandry systems in accordance with citizens' concerns.

Key words: animal welfare, farm visit, laying hen husbandry system, naturalness, public perceptions

INTRODUCTION

In the public debate about livestock production, the general public has expressed concerns regarding issues such as intensive animal husbandry systems, megafarms, animal welfare, and public health (e.g. Bergstra et al., 2017; Boogaard et al., 2008; Hansen et al., 2003; Harper et al., 2001; Kraaij-Dirkzwager et al., 2017). The concerns about livestock husbandry predominantly focus on animal welfare and the animals' ability to lead natural lives (Evans et al., 2008; Fraser, 2008; Fraser et al., 1997; Te Velde et al., 2002). Citizens view a natural way of keeping laying hens, such as in free-range and organic systems, as the preferred way of keeping chickens (Chapter 2, Van Asselt et al., 2015). They perceive chicken welfare in outdoor husbandry systems as better than in indoor systems (Chapter 3, Van Asselt et al., 2017). In addition, citizens perceive public health and food safety risks in outdoor systems as lower than in indoor systems and perceive food products produced in more animal-friendly systems as healthier (Aertsens et al., 2009; Eurobarometer, 2007; Harper et al., 2002; Van Asselt et al., 2018). Moreover, naturalness is often referred to in the public debate about good livestock husbandry (Miele, 2017).

It is not entirely clear what constitutes leading natural lives and a natural environment for livestock husbandry, hereinafter referred to as “naturalness” (Bergstra et al., 2015; Miele, 2017; Ventura et al., 2014). The general public associates naturalness in relation to animal welfare with possibilities to express natural behaviour (Bergstra et al., 2015; Lassen et al., 2006; Te Velde et al., 2002; Vanhonacker et al., 2008), freedom of movement (Bergstra et al., 2015; Lassen et al., 2006), outdoor access (Bergstra et al., 2015; Boogaard et al., 2008; Lassen et al., 2006), and social contact between animals (Bergstra et al., 2015). Furthermore, it seems that the general public also refers to naturalness as an indicator for good livestock husbandry, good animal health, and consequently low public health and food safety risks. If we understand better how citizens interpret naturalness, it will be possible to incorporate this interpretation of naturalness into livestock husbandry systems (Bergstra et al., 2015). Some farmers have tried to take into account societal concerns regarding hen welfare, naturalness and public health, and have invested in innovative husbandry systems, such as Roundel (Groot Koerkamp et al., 2008; Spoelstra et al., 2013), or the more recently developed free-range systems with a large covered free-range area.

These innovative systems try to take into account societal concerns as well as other issues such as environmental impact and economic viability of the farm. Efforts of farmers to address public concerns have led to innovations, but the question is how does the general public view such system. Nowadays, citizens have incomplete insight into the real-life conditions on a farm (Boogaard et al., 2006). Farm visits by citizens to an innovative laying hen farm that considers aspects of public concern such as hen welfare, naturalness and public health risks, provide an opportunity to study citizens' views on such systems in a real-life situation. Therefore, the first objective of this paper is to gain insight into citizens' views on hen health, hen welfare, public health risks, and naturalness. The second objective is to gain insight into how citizens view the influence of naturalness on hen health, welfare and public health risks, and the third is to find out their opinions on an innovative hen husbandry system in general, and in relation to hen health, hen welfare, public health risks, and naturalness.

MATERIAL AND METHODS

Citizens' views were studied by having the participating citizens fill out a questionnaire during a visit to an innovative laying hen farm. The farm has been awarded the Better Life Mark (Beter Leven Keurmerk) with three stars. The Better Life Mark was introduced by the Dutch Society for the Protection of Animals to rate the welfare-friendliness of animal products originating from various husbandry systems. Three stars indicates the highest level of animal welfare and is assigned to products from organic farms and non-organic products produced in accordance with welfare standards comparable with those of organic products. The barn visited consists of four separate units, each with around 6,000 Lohmann Brown-Lite hens per unit, making a total of 23,700 hens at a maximum of 6.7 hens per m². The hens' beaks were not trimmed. On the day of the farm visit, the age of the hens was 24 weeks.

The barn visited accommodates two rows of multi-tiered aviaries, and on either side of the aviary area there is a free-range area. These free-range areas are seven metres wide and are accessible along the entire length of the aviary area during daylight hours. The free-range area is covered with transparent roof plates, which let in daylight. The sides of the barn consist of 0.5 metres of transparent plastic plates at the bottom and above that a transparent curtain. When the outside temperature is warm

enough, both the roof cover plates and the side curtains open automatically. When opened, the free-range area is only separated from the outside by bird netting. On the day of the farm visit, the roof and curtains were closed, because the outside temperature was too low. The free-range area is enriched with bales of chopped Lucerne, containers with bamboo, and hiding places for the hens. The floor bedding in the aviary area consists of sand and in the free-range area of sand and some straw. Twice a day, the farmer scatters grain in the free-range area.

Farm visit

The farm visit took place with two groups of nine non-farmer citizens on 10 February 2018. The farm is situated in the centre of the Netherlands. Participants were selected and invited by CentERdata (www.centerdata.nl), a research institute specialized in online surveys, by means of the CentERpanel. CentERdata invited 467 people from the CentERpanel, who live in the eastern central area of the Netherlands, to participate in the farm visit. Out of this group, 76% (n = 358) responded whether or not they wished to participate and of these, 18.4% (n = 66) were interested in participating in the farm visit on the selected date. Of these 66 citizens, CentERdata selected 18 participants based on a normal distribution of the Dutch population with respect to gender, age, educational level, and urbanization level of current residence. Participants were offered financial compensation of 50 euros to ensure that not only people with an interest in (poultry) farming would participate. The socio-demographic characteristics of the participants are presented in Table 6.1.

Table 6.1 Socio-demographic characteristics of the participants (n = 18)

		count	%	CBS ¹ %
Gender	Male	10	55.6	49.2
	Female	8	44.4	50.8
Age	25 - 34 years	2	11.1	29.3
	35 - 54 years	5	27.8	34.2
	> 55 years	11	61.1	36.5
Education	Low	4	22.2	30.9
	Intermediate	4	22.2	41.0
	High (BSc / MSc)	10	55.6	28.1

¹ Data of CBS Statistics Netherlands dated 01-03-2014

Participants in the farm visit were received in the visitors' room of the farm. From this room, participants have a good view of the hens in the aviary system and in the free-range area. The questionnaire consisted of three parts. For the first part of the questionnaire, the view of the hens was blocked by blinds. The farm visit started with a short introduction by the researcher to explain the farm visit and the questionnaire. While the participants were filling in the questionnaire, they did not receive answers to any questions.

After part A of the questionnaire had been filled in, the blinds were removed so that the participants could view the hens in both the aviary areas and the free-range area. Then the following information was given: 1) these hens are kept for the production of consumption eggs; 2) in the aviary area, feed and water is supplied, hens lay their eggs in nests and can sit on perches; a covered range is situated on either side of the barn; 3) the curtains and roof plates of the covered range are opened in good weather; 4) 23,700 hens are kept in four compartments; 5) the hens are 24 weeks of age, have been on this farm since the age of 17.5 weeks, and started to lay eggs about 4 weeks ago. Participants then completed parts B and C of the questionnaire. During this part of the research, the farmer scattered grain in the free-range area.

Questionnaire

The on-farm questionnaire was divided into three parts: A) questions before viewing the hens, B) questions while viewing the hens and C) questions on the participants' background. The questionnaire included closed and open questions. The closed questions could be answered on 5-point Likert scales. For some of the open questions, the participants were asked to give answers listing multiple aspects, up to a maximum of five. We chose to ask for a maximum of five aspects in order to stimulate participants to put down only those aspects that they found most important. The complete questionnaire can be found in Appendix I.

Part A contained questions on the following subjects:

- Views on the needs of hens for good welfare
- Concerns about hen welfare and about public health risks
- Views on naturalness in three ways:
 - o As a conceptual approach: what is a natural way of keeping animals?

- As consequences for a hen husbandry system
- As consequences for hens
- Influence of a natural way of keeping hens on hen health, hen welfare, and public health risks

Part B included questions regarding views on the farm for the following subjects:

- Views on the husbandry system in general
- Views on hen health, hen welfare, and public health risks in the systems
- Views on naturalness of the system
- Naturalness of aspects in the systems,
- What do you miss on the farm?

Part C consisted of questions on socio-demographic characteristics of the participants, such as gender, age and educational level.

Analyses

For the closed questions, totals per Likert scale category were counted and presented in tables or in the text. For open questions, content analysis was done to identify concerns and perceptions regarding hen health and welfare, public health, naturalness, and the husbandry system. First, all items mentioned by the participants were transcribed. Second, items were analysed in order to note (sub)themes, and subsequently organized by subthemes and main themes. The categorization into subthemes and themes was discussed with researchers on animal welfare, health and epidemiology. The items were then definitively coded in main themes. If participants mentioned more than one item per main theme, then these items were considered as one item for that main theme. In the results section, we will present the number of items per main theme and refer to these main themes as “*aspects*”. The total sum of the items per main theme – *aspects* – is presented in tables or in the text in parentheses behind the specific aspects. Some responses of the participants are quoted in the results section to illustrate certain aspects.

RESULTS

Questionnaire Part A

This part of the questionnaire contained questions on the participants' current views on hen welfare, hen health, public health risks, and naturalness, and were answered before exposure to the farm visit.

Views and concerns on hen welfare

For the open question "What does a hen need for good welfare?", the participants mentioned different aspects of animal welfare (Table 6.2). All respondents mentioned aspects regarding good feed and water, and most of them mentioned space to move around. To a lesser extent, natural and social behaviour, and good climate and daylight were aspects of concern.

Table 6.2 Aspects needed for good hen welfare according to the participants (n = 18) and reasons for welfare concern according to the "concerned" participants (n = 10)

	Needs for good welfare	Reasons for welfare concerns
Good feed & water	18	3
Space to move around	14	9
Natural & social behaviour	9	3
Climate & daylight	9	1
Good care	5	1
Outdoor access	4	1
Restfulness	4	1
Animal health & hygiene	3	4
Good housing	3	2
Public health risks	0	3

As a response to the open question "Are you concerned about hen welfare", 10 participants (56%) answered that they were concerned about hen welfare, 6 participants (33%) were not concerned about hen welfare, and 2 participants (11%) answered "I do not know". The concerned participants mentioned as reasons for their concern predominantly aspects regarding space to move around (Table 6.2). Of the six unconcerned participants, four indicated that they were not concerned because they have confidence in requirements for and inspections of hen welfare as laid down in legislation. Of the two participants who answered "I do not know", one did not give any explanation, and the other participant, explained: "*In the media, different*

messages are presented about the situation of hens. What one party describes as harmful for hens is not a problem for hens according to another party.”

Concerns about public health risks

The open question “Are you concerned about becoming ill from chickens or chicken products?” was answered with “yes” by seven out of the 18 participants (39%), while 11 respondents (61%) answered “no”. Participants who were concerned (n = 7) mentioned as reasons for their concern: use of antibiotics and other treatments (4); too many hens together (3); chicken feed as source of public health risks (2); Salmonella spp. (1); less trust after Fipronil affair (1); freshness of meat and eggs; and fast growth (1). Unconcerned participants (n = 11) reported the following reasons for not being concerned: trust in inspections and legislation (7); responsibility of consumer to prepare chicken products properly (2); one participant answered: “the media paid too much attention to the Fipronil affair, even though there was no public health risk”, and one participant did not give a reason for not being concerned.

Views on naturalness

Three open questions regarding naturalness were asked. The responses to the first question regarding naturalness, “What is a natural way of keeping animals?” primarily mentioned: sufficient space to move around, opportunities to express natural and social behaviour, good housing, climate and daylight, and outdoor access (Table 6.3). Six participants mentioned a natural environment, but did not explain what a natural environment is. There were four references by participants to feed: good feed (1), sustainable feed (1), and natural way of feeding (2). It is interesting to note that four participants referred to respect for the intrinsic value of chickens.

The second question regarding naturalness, “What should natural housing for hens look like?”, was predominantly answered with references to space to move around (Table 6.3). To a lesser extent, participants mentioned outdoor access and a natural environment, such as natural bedding material (3). It is interesting that three participants mentioned cleanliness.

Table 6.3 Views of the participants on naturalness: a natural way of keeping animals, natural housing for hens and natural hens

	Natural way of keeping animals	Natural housing for hens	Natural hen
Space to move around	11	15	0
Natural & social behaviour	7	5	7
Good housing, climate & daylight	7	5	0
Outdoor access	6	7	0
Natural environment	6	6	0
Good feeding	4	4	2
Respect intrinsic value	4	0	2
Good care	2	0	0
Clean	0	3	0
Good health	0	0	12

For the third question regarding naturalness “How can you see from a hen that it is being kept in a natural way?”, participants predominantly referred to aspects regarding good health (Table 6.3). Items categorized under good health were for example: alert hen, good feather condition, no injuries, or no lameness. Participants (n = 7) also often mentioned aspects of natural & social behaviour. One participant referred specifically to abnormal behaviour. Two participants answered “no beak trimming”, which was categorized under respect for intrinsic value. Two participants referred to good feeding by answering “no emaciation”.

Influence of naturalness on animal health, welfare and public health risks

Participants were asked to score the influence of naturalness on 1) hen health, 2) hen welfare, and 3) public health risks, and they were asked to explain their answers. One participant did not fill in the first question. In answer to the first closed question “What is the influence on hen health of a natural way of keeping hens?”, 15 out of 17 participants indicated that naturalness leads to better hen health (Table 6.4a). These participants used diverse arguments to explain why naturalness leads to better hen health, such as: less stress (5), better hen health (4), good feed (2), more space (2), and less use of antibiotics. Two respondents answered that this also applies to humans. One participant thought that naturalness has a negative influence on hen health, because “outside hygiene is not optimal and therefore more chance of diseases”. The participant who scored neutral, answered that “One does not know what the hens eat” and “if hygiene is in order, it will be okay”. Some participants scored the influence of naturalness on hen health as positive, but mentioned both

positive and negative effects of naturalness on hen health. For example, one participant explained: “they feel better” and “you cannot keep an eye on them and therefore less insight into diseases”. Another participant explained: “less medicine and thus more chance of disease”, as well as “less medicine and therefore better resistance against diseases”.

Table 6.4 Influence of naturalness on a) hen health, b) hen welfare and c) public health on 5-point Likert scales according to the participants

a) Influence of naturalness on hen health (n = 17)

Less good health				Better health
0	1	1	4	11

b) Influence of naturalness on hen welfare (n = 18)

Less good welfare				Better welfare
0	0	2	5	11

c) Influence of naturalness on public health risks (n = 17)

Less risks				More risks
2	2	10	1	2

With regard to the second question on the influence of *naturalness*, “What is the influence on hen welfare of a natural way of keeping animals?”, almost all participants thought that *naturalness* has a positive influence on animal welfare (Table 6.4b). Three participants referred for their answer to the previous question about the influence of *naturalness* on hen health. Nine participants viewed this influence as being positive, because hens have more opportunities to express their natural behaviour and / or have less stress (9). Others found it positive because of more space (2), small groups are better for welfare (1), better feed (1), fewer diseases (1), and two participants referred to the fact that it is also better for humans. Two respondents scored neutral. One of these neutral respondents, explained her neutral score with “*It does not matter how hens are kept; they probably do not know any better*”.

The third question on *naturalness* regarded the influence of a natural way of keeping hens on risks for public health. The answers show a diverse pattern of scores (Table 6.4c). Most participants gave a neutral score, while four participants thought that *naturalness* leads to fewer public health risks and three participants believed that

naturalness leads to more public health risks. One participant answered that he had no idea and did not fill in a score. Participants who scored a higher risk gave as the reason for their risk score the fact that they think there are more risks outdoors. Participants who scored that a natural way of keeping hens leads to fewer risks gave different explanations for their scores: hens have better resistance against diseases and less use of antibiotics. Five participants who scored neutral explained their neutral scores by the fact that outdoor or naturally kept hens are more likely to contract a disease. Two participants who scored neutral answered that legislation and inspections will ensure low risks for humans.

Questionnaire Part B

After participants had viewed the husbandry system with the hens in the aviary and in the free-range area, they were asked to fill in parts B of the questionnaire.

First impression of the system

The first question was an open question about their first impression of the housing system and hens. Of the 18 participants, nine participants were predominately positive, two predominantly negative and seven were positive about some aspects and negative about others. In Table 6.5 aspects mentioned by the participants are organized in positive and negative aspects. Participants expressed positive opinions about the space for the hens and the housing in general. Negative opinions predominantly regarded the high number of hens and the space available, especially in the aviary area part of the system. For example, a participant answered: *“Too many hens indoors, free-range area looks more pleasant and hens have space to move around”*, or another participant: *“A lot of space, but also many hens. If free-range is accessible, enough space, but when it is closed, it may be too crowded.”*

Table 6.5 First impression of the housing systems and hens: number of aspects mentioned by participants (n = 18) categorized in positive and negative aspects

Positive aspects	n	Negative aspects	n
Enough space	10	Too many hens	8
Good housing	9	Not enough space	6
Hens look healthy / happy	8	It looks outdated	1
Natural behaviour	6	Not enough pleasure	1
Free-range area looks pleasant	4	Compartments	1
Good feed	1		

The answers to the next open question “What do you notice?” mainly addressed the number of hens, space and naturalness. Again, the aspects mentioned are organized in positive and negative aspects (Table 6.6). Space and naturalness were considered in either a positive or a negative way by participants. Nine participants viewed the system as natural or mentioned elements that they perceived as natural, such as straw or bamboo. In contrast, three participants remarked that there was no “real” outdoor space or they felt there was a lack of greenery. Regarding space, six participants thought that there was enough space for the hens, while two participants thought that there was not enough space. Ten participants remarked that there were many hens, and four of them referred specifically to the aviary area. Two participants answered that hens did not have enough space to move around.

Table 6.6 Aspects about the husbandry systems mentioned by the participants (n = 18) categorized in positive and negative aspects

Positive aspects	n	Negative aspects	n
Natural elements (e.g. straw, bamboo)	9	Many hens	10
Enough space	6	Not natural	3
Natural behaviour	5	Not enough space	2
Good feeding	4	Little pleasure	1
Clean	4	No artificial light in free-range	1
Light	2		
Roof range may open and close	3		
Compartments	3		
Hens look good	2		
Peaceful	2		
Ventilation	2		

Views on hen health, welfare and public health risks in the system

The next question concerned the participants’ views on hen health and hen welfare and their explanation of these views. All the participants scored hen health and welfare in the systems between neutral and good (Table 6.7a and b). One of the participants who scored hen health neutral answered that he did not know, but that the hens looked well and had good feather condition. The other participant who scored hen health as neutral remarked that the hens were young and had not yet reached their adult weight. The participants (n = 16) who scored hen health as good answered that they could see that the hens were healthy because the hens had good feather condition (13), expressed natural behaviour (10), the hens look good (9), no sign of injuries or lameness (5), good-looking combs or beaks (3), and they were not thin (3).

Fourteen participants scored the hen welfare as good (Table 6.7b). To explain these positive views on hen welfare, the following answers were given: expression of natural behaviour (7), space to move around (6), good health (4), outdoor access (3), good feather condition (1), good-looking combs (1), and good housing (1). The three participants who scored neutral explained their scores with: limited space to move around (2), doubts about feed and water availability (2), no natural life (2), and no natural environment (1).

Table 6.7 Views of the participants (n = 18) on a) Hen health, b) Hen welfare and c) Public health risks in the system on 5-point Likert scales

a) Hen health

Poor health		Good health		
0	0	2	8	8

b) Hen welfare

Poor welfare		Good welfare		
0	0	4	8	6

c) Public health risks

Low risks		High risks		
11	4	2	1	0

When asked what the risks for public health are when hens are kept in such systems, most of the participants (n = 15) scored the public health risks as low, but two of them scored the public health risks as neutral and one scored a risk (Table 6.7c). Reasons to score the risks as low were: hens have no contact with the environment (10), good hygiene measures (8), trust in farmers, inspections and legislation (4), healthy hens (1), and thus little use of antibiotics (1). Those participants who scored neutral or a risk gave as reasons for their answers: many hens together (2), farmer tries to prevent risks, but may not be successful (2), introduction of diseases into the flock by the farmer (2).

Views on *naturalness*

Questions regarding naturalness during exposure to the farm addressed the extent to which the hens were kept in a natural way, and the naturalness of several aspects on the farm. First, participants scored to what extent they felt that the hens were kept in a natural way (Table 6.8). Nine participants scored that the hens were kept in a natural way, two scored that the hens were not kept in a natural way, and seven participants viewed the way of keeping the hens as neither natural nor unnatural. Next, the participants were asked to mention aspects of the husbandry system that they considered to be natural. Participants mentioned the following aspects: free-range area (10), space to move around (10), expression of natural behaviours (9), daylight (6), way of providing feed (6), straw (4), natural environment (3), and bedding material (2). Three out of ten participants who saw the free-range area as being natural specifically referred to fresh air. To the question “What aspects are not natural?”, they answered: no “real” outdoor area (9), the design of the barn and aviary (7), many hens (7), methods for feed and water supply (5), limited possibilities to express natural or social behaviour (4), climate (1), and bedding material (1). Four of the respondents who answered that there was no “real” outdoor area referred specifically to grass or pasture. One participant answered that “*nothing*” was unnatural.

Table 6.8 Views of the participants (n = 18) on the extent to which hens are kept in a natural way on a 5-point Likert scale

Not natural				Natural
0	2	7	6	3

The participants were further asked to indicate for 12 aspects of the husbandry system the influence on naturalness (Table 6.9). On the whole, most aspects were considered to have some influence on naturalness. Aspects that were seen as influencing naturalness were: daylight, floor bedding in aviary area and in the covered range, the covered range, size of the covered range, and the bales of Lucerne. Aspects with a lower influence on naturalness were: closing of the range in bad weather, number of hens per group.

Table 6.9 Views of the participants (n = 18) on the influence of various aspects on *naturalness* on a 5-point Likert scale

	No influence on <i>naturalness</i>				Influences <i>naturalness</i>
Daylight	0	1	2	4	10
Floor bedding	1	0	4	6	7
Floor bedding in covered range	0	0	4	5	9
Presence of covered range	1	0	6	3	8
Size of covered range	0	2	3	6	7
Range is covered with plates	2	1	7	3	5
Range's plates and curtains are closed in bad weather	3	5	4	3	3
Space per hen	0	3	6	3	6
Number of hens per group	3	4	6	1	4
Bales of Lucerne	0	0	6	7	5
Containers with bamboo	0	2	9	2	5
Hiding places	1	3	2	5	7

What do you miss on this farm?

The last question of Part B was “What do you miss on this farm?”. Six participants answered this question with “nothing”. Those participants who missed something (n = 12) mentioned: more opportunities to express natural behaviour (5), more natural bedding material (4), the presence of trees, plants or grass (4), hiding or shelter places (3), or “real” outdoor access (3).

DISCUSSION

A farm visit was carried out to gain insight into citizens' views on an innovative hen farm in general, and in relation to hen health, hen welfare, public health risks, and *naturalness* in particular. The farm visit was conducted with two groups of nine citizens each. Compared with the Dutch population as a whole, males, older people and people with a high educational level were somewhat overrepresented in the sample of citizens participating in the farm visit. From literature we know that people's socio-demographic characteristics are associated with views on animals. For example, older males with a lower educational level are less often concerned about animal welfare than females, with a higher educational level (Chapter 3; Cohen et al., 2012; Kendall et al., 2006). In our sample, however, neither of these two groups was overrepresented.

Therefore, the results give a good impression of the ways in which citizens view an innovative laying hen farm.

The farm visit with citizens took place on a laying hen farm with a new and innovative husbandry system that addresses concerns about hen welfare – especially those related to leading natural lives – and about public health risks. The biggest difference compared with the “conventional” free-range system with outdoor access is that this system has a covered free-range area. Moreover, in the free-range area several enrichment materials are offered, such as Lucerne on the floor, bales of chopped Lucerne, hiding places, and grain is scattered twice a day. The free-range area and enrichment materials stimulate the hens to express their natural behaviour. The roof on the free-range area prevents certain public health hazards that may be increased in outdoor husbandry systems, such as the chance of the introduction of avian influenza (EFSA Panel on Animal Health and Welfare et al., 2017; Gonzales et al., 2013; Koch et al., 2006) and increased uptake of dioxin from the environment (EFSA, 2012; Kijlstra et al., 2007; Pussemier et al., 2004; Schoeters et al., 2006; Van Overmeire et al., 2006; Van Overmeire et al., 2009). In addition, the covered range protects the hens from predation and cold and wet weather conditions, and might help to prevent certain diseases in hens. Therefore, a free-range system with large covered free-range area may be a successful future husbandry system that considers both the interests of humans and of chickens.

Opinions on the husbandry system in general

Of the citizens who participated in the farm visit 50% expressed positive views on the hen husbandry system, 39% were predominantly positive, but expressed some concerns, and 11% were predominantly negative. Concerns regarded predominately the large number of hens and the limited space to move around, and a minority referred to *naturalness*. One interesting point was that half of the respondents thought that the hens had enough space and they viewed it as a good husbandry system. Although on this farm the hens are kept at a maximum of 6.7 hens/m² in the aviary area, instead of the 9 hens/m² in conventional systems, a minority of the participants thought that the hens still had too little space. It has to be noted that most of the respondents who found that hens did not have enough space referred to the aviary area, and those who found that there was enough space referred to the free-range

area. A minority of three participants indicated that they missed a “real” outdoor. The reactions regarding the first impression predominantly mentioned animal welfare aspects, which suggests that the opinions on the husbandry systems are primarily determined by views on hen welfare.

Opinions on welfare

Concerns about animal welfare are related to different ethical views on the subject. Based on these different ethical views, three concepts of animal welfare have been distinguished (Broom, 1991; Fraser, 1995, 2003; Fraser et al., 1997; Tannenbaum, 1991). The first view on animal welfare focuses on the *biological functioning* of animals, such as good health and productivity. The second view focuses on the *affective states* of the animals – such as pain, anxiety and stress – and the third view focuses on *leading natural lives* (Broom, 1991; Fraser, 2003; Fraser et al., 1997). Although some of the participants felt that the barn accommodated too many hens and did not provide the hens with enough space, none of the participants scored the health and welfare of the hens as negative. With regard to hen welfare in general and specifically to hen health, it has to be considered that the age of the hens at the time of the farm visit was 24 weeks and at that time all the hens looked good, because they had good feather condition and good general condition. Hens at the end of the laying period may have less good feather or general condition. Therefore, the participants’ views on hen health and welfare might have been positively biased by the favourable appearance of the hens at the start of their laying period. When the flock is well-managed and there is minimal disease or feather pecking, it can be expected that hens will retain their good appearance and that the participants’ views will be representative of the whole laying period.

As an explanation for their views on hen welfare, the participants referred most often to the animal welfare aspects related to the welfare concept *leading natural lives*, namely expression of natural behaviours and space to move around. These findings are in accordance with literature, which indicates that citizens view animal welfare predominantly in terms of possibilities of *leading natural lives*, and to a lesser extent in relation to *biological functioning* or *affective states* (Bracke et al., 2005; Fraser et al., 1997; Te Velde et al., 2002).

Before exposure to the farm, the participants were asked what hens need for good welfare. Participants mainly mentioned environment-based welfare aspects, such as good feed and water, space to move around, good climate and daylight. They mentioned less often animal-based welfare aspects, such as natural and social behaviour. These environment-based welfare aspects represent the minimum needs of hens, which may explain why participants referred mainly to these welfare aspects. When asked about their concerns about hen welfare, 56% of the participants answered that they were concerned. Participants expressed relatively few concerns regarding feeding, climate and daylight, which may imply that citizens trust farmers to provide good feed and a good climate. The concerns expressed regarding hen welfare focused primarily on space to move around, which has also been a concern for others regarding animal welfare in general (Vanhonacker et al., 2009) or for pig husbandry (Bergstra et al., 2017). Concerns before exposure and after exposure to the farm were predominantly related to space to move around.

Public health

Outdoor poultry husbandry systems have been associated with increased public health and food safety risks for certain hazards such as avian influenza (EFSA Panel on Animal Health and Welfare et al., 2017; Gonzales et al., 2013; Koch et al., 2006) and increased dioxin levels in eggs (EFSA, 2012; Pussemier et al., 2006; Schoeters et al., 2006; Van Overmeire et al., 2006). Citizens, however, perceive the public health risks for these hazards in outdoor systems as lower than in indoor systems (Van Asselt et al., 2018). During the farm visit, participants perceived the risks of public health hazards as low when hens are kept in this type of husbandry system. The participants' risk perceptions regarding public health hazards associated with a husbandry system with a large covered free-range area seem in accordance with the risk perceptions of citizens regarding free-range and organic systems with outdoor access (Van Asselt et al., 2018).

Before exposure to the farm, less than one-third of the participants expressed concerns about public health risks of chickens or chicken products. These concerns related mainly to the use of antibiotics and other medicines, and large numbers of hens kept at high stocking densities, which is in accordance with the findings for pig husbandry (Bergstra et al., 2017), and for animal welfare in general (Vanhonacker et

al., 2009). It is notable that participants who did not express concerns regarding public health risks gave as their explanation the fact that they trust farmers to meet the requirements laid down in legislation and they have confidence in inspections and risk prevention by farmers and authorities. It is interesting that participants assessed the public health risks as low while they were seeing the farm. As reasons for these low risk perceptions during the farm visit, they once again gave trust in farmers, inspections and legislation to adequately prevent risks. Although the participants expressed concerns about public health risks associated with hen husbandry before exposure to the farm, visiting the farm seemed to reduce these concerns.

Naturalness

Public concerns regarding livestock husbandry and animal welfare have focused on the aspect of *leading natural lives* (Evans et al., 2008; Fraser, 2008; Fraser et al., 1997; Te Velde et al., 2002). A way to increase societal support for hen husbandry might be to address public concerns regarding *naturalness*. Half of the citizens who participated in the farm visit thought that the hens were kept in a natural way, while a minority of two participants viewed it as unnatural. The participants viewed *naturalness* in relation to hen welfare as possibilities to perform natural and social behaviour, freedom of movement and outdoor access, which is in line with previous research (Bergstra et al., 2015; Boogaard et al., 2008; Lassen et al., 2006; Te Velde et al., 2002). However, participants also mentioned daylight as an aspect of *naturalness*. The participants evaluated the covered free-range area as natural, though participants nevertheless remarked that they missed a “real” outdoor area and pasture.

Before exposure to the farm visit participants were of the opinion that *naturalness* influences both hen health and hen welfare. The main reasons for these views were that the hens will suffer less stress and less diseases and thus enjoy better health, and also have more opportunities to express natural behaviour, suffer less stress and thus enjoy better welfare. It has been suggested that *naturalness* is also associated with public health (Aertsens et al., 2009; Eurobarometer, 2007; Harper et al., 2002; Van Asselt et al., 2018). However, we could not confirm this. Only a minority of the participants thought that *naturalness* influences the risks of public health hazards. Some of them thought that *naturalness* influences public health risks positively and others believed the influence is negative.

Various aspects of the husbandry systems were considered to be natural, namely the free-range area, space to move around, and expression of natural behaviours. Fresh air seemed to be an important aspect of *naturalness* for some respondents. The aviary area, however, was valued as unnatural as regards available space, the number of hens, and the design. The participants' views on *naturalness* involve animal aspects and environmental aspects and can be described as “a natural environment with space to move around and express natural behaviour”.

Conclusions and implications

Naturalness was positively associated with hen welfare and hen health, but no clear association could be found with public health risks. *Naturalness* was predominantly associated with environmental aspects, such as space to move around, daylight and fresh air, and to a lesser extent with animal aspects such as possibilities to express natural behaviour, e.g. in a free-range area. To comply with citizens' perceptions of hen welfare and *naturalness*, some adjustments for a husbandry system like that of the farm visit may be suggested. Lower stocking densities in the aviary section, a less industrial design and more daylight especially in this part of the farm may reduce public concerns regarding hen welfare. Also, smaller units with fewer hens may be evaluated as being better. The bedding material with some straw as used in the free-range area was evaluated as positive and is recommended for use in the aviary area as well. Based on the views of the participants, we suggest that husbandry systems in general implement some enrichment such as bales of Lucerne, hiding places, and green plants or trees. These enrichments seem relatively easily to implement in husbandry systems, provide a natural look, and may also stimulate natural behaviour in hens.

Although participants expressed concerns regarding space to move around and perform natural behaviours, views on the system with a large covered free-range area for laying hens were mainly positive. Only a minority of the participants missed a “real” outdoor access. The participants in the farm visit also evaluated the aspects hen welfare, risks of public health hazards and animal and environmental aspects of *naturalness* as good. This suggests that the husbandry system with a large covered free-range area, which addresses public concerns about hen welfare and public health, by providing a large covered free-range area, as well as enrichment such as litter with

straw, bales of chopped Lucerne, hiding places, and grain, is an acceptable husbandry system for the general public.

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REFERENCES

- Aertsens, J., Verbeke, W., Mondelaers, K., & van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: A review. *British Food Journal*, *111*(10), 1140-1167. doi:10.1108/00070700910992961
- Bergstra, T. J., Gremmen, B., & Stassen, E. N. (2015). Moral Values and Attitudes Toward Dutch Sow Husbandry. *Journal of Agricultural and Environmental Ethics*, *28*(2), 375-401. doi:10.1007/s10806-015-9539-x
- Bergstra, T. J., Hogeveen, H., & Stassen, E. N. (2017). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values*, *34*(2), 393-405. doi:10.1007/s10460-016-9721-4
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2006). Elements of societal perception of farm animal welfare: A quantitative study in The Netherlands. *Livestock Science*, *104*(1-2), 13-22. doi:10.1016/j.livsci.2006.02.010
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2008). Defining sustainability as a socio-cultural concept: Citizen panels visiting dairy farms in the Netherlands. *Livestock Science*, *117*(1), 24-33.
- Bracke, M. B. M., de Greef, K. H., & Hopster, H. (2005). Qualitative stakeholder analysis for the development of sustainable monitoring systems for farm animal welfare. *Journal of Agricultural and Environmental Ethics*, *18*(1), 27-56. doi:10.1007/s10806-004-3085-2
- Broom, D. M. (1991). Animal welfare: concepts and measurement. *Journal of Animal Science*, *69*(10), 4167-4175.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, *25*(3), 353-367. doi:10.2752/175303712x13403555186334
- EFSA. (2012). Update of the monitoring of levels of dioxins and PCBs in food and feed. *EFSA Journal*, *10*(7), 82. doi:10.2903/j.efsa.2012.2832
- EFSA Panel on Animal Health and Welfare, More, S., Bicout, D., Bøtner, A., Butterworth, A., Calistri, P., . . . Stegeman, J. A. (2017). Avian influenza. *EFSA Journal*, *15*(10), 4991. doi:10.2903/j.efsa.2017.4991
- Eurobarometer. (2007). *Attitudes of consumers towards the welfare of farmed animals (270)*. Retrieved from http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_270_en.pdf
- Evans, A., & Miele, M. (2008). *Consumers' views about farm animal welfare: Part II European comparative report based on focus group research*. Retrieved from
- Fraser, D. (1995). Science, Values and Animal Welfare: Exploring the 'Inextricable Connection'. *Animal Welfare*, *4*(2), 103-117.
- Fraser, D. (2003). Assessing animal welfare at the farm and group level: the interplay of science and values. *Animal Welfare*, *12*(4), 433-443.
- Fraser, D. (2008). Understanding animal welfare. *Acta Veterinaria Scandinavica*, *50*(Suppl 1):S1. doi:10.1186/1751-0147-50-s1-s1
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, *6*(3), 187-205.
- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, *7*(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Groot Koerkamp, P. W. G., & Bos, A. P. (2008). Designing complex and sustainable agricultural production systems: an integrated and reflexive approach for the case of table egg production in the Netherlands. *NJAS - Wageningen Journal of Life Sciences*, *55*(2), 113-138. doi:10.1016/S1573-5214(08)80032-2

- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, 41(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Harper, G. C., & Henson, S. (2001). *Consumer concerns about animal welfare and the impact on food choice* (Final report). Retrieved from http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf
- Harper, G. C., & Makatouni, A. (2002). Consumer perception of organic food production and farm animal welfare. *British Food Journal*, 104(3-5), 287-299. doi:10.1108/00070700210425723
- Kendall, H. A., Lobao, L. M., & Sharp, J. S. (2006). Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology*, 71(3), 399-428. doi:10.1526/003601106778070617
- Kijlstra, A., Traag, W. A., & Hoogenboom, L. A. P. (2007). Effect of Flock Size on Dioxin Levels in Eggs from Chickens Kept Outside. *Poultry Science*, 86(9), 2042-2048.
- Koch, G., & Elbers, A. R. W. (2006). Outdoor ranging of poultry: a major risk factor for the introduction and development of High-Pathogenicity Avian Influenza. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 179-194. doi:10.1016/s1573-5214(06)80021-7
- Kraaij-Dirkzwager, M., van der Ree, J., & Lebret, E. (2017). Rapid Assessment of Stakeholder Concerns about Public Health. An Introduction to a Fast and Inexpensive Approach Applied on Health Concerns about Intensive Animal Production Systems. *Int J Environ Res Public Health*, 14(12). doi:10.3390/ijerph14121534
- Lassen, J., Sandøe, P., & Forkman, B. (2006). Happy pigs are dirty! - conflicting perspectives on animal welfare. *Livestock Science*, 103(3), 221-230. doi:10.1016/j.livsci.2006.05.008
- Miele, M. (2017) Consuming animals, constructing naturalness. Vol. 24. *Research in Rural Sociology and Development* (pp. 245-263): Emerald Publishing Limited.
- Pussemier, L., Larondelle, Y., Carlos, V. P. C., & Huyghebaert, A. (2006). Chemical safety of conventionally and organically produced foodstuffs: a tentative comparison under Belgian conditions. *Food Control*, 17(1), 14-21. doi:10.1016/j.foodcont.2004.08.003
- Pussemier, L., Mohimont, L., Huyghebaert, A., & Goeyens, L. (2004). Enhanced levels of dioxins in eggs from free range hens; a fast evaluation approach. *Talanta*, 63(5), 1273-1276. doi:10.1016/j.talanta.2004.05.031
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Spoelstra, S. F., Groot Koerkamp, P. W. G., Bos, A. P., Elzen, B., & Leenstra, F. R. (2013). Innovation for sustainable egg production: Realigning production with societal demands in The Netherlands. *World's Poultry Science Journal*, 69(2), 279-298. doi:10.1017/S0043933913000305
- Tannenbaum, J. (1991). Ethics and animal welfare: The inextricable connection. *Journal of the American Veterinary Medical Association*, 198(8), 1360.
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians. In D. E. Dumitras, I. M. Jitea, & S. Aerts (Eds.), *Know your food. Food ethics and innovation*. (pp. 138-143). Wageningen: Wageningen Academic Publishers Books.
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2017, 5-8 september). *Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians*. Paper presented at the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level, Ede, the Netherlands.
- Van Asselt, M., Poortvliet, P. M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2018). Risk perceptions of public health and food safety hazards in poultry husbandry by citizens, poultry farmers and poultry veterinarians. *Poultry Science*, 97(2), 607-619. doi:10.3382/ps/pex325

- Van Overmeire, I., Pussemier, L., Hanot, V., De Temmerman, L., Hoenig, M., & Goeyens, L. (2006). Chemical contamination of free-range eggs from Belgium. *Food Additives & Contaminants*, 23(11), 1109-1122. doi:10.1080/02652030600699320
- Van Overmeire, I., Pussemier, L., Waegeneers, N., Hanot, V., Windal, I., Boxus, L., . . . Goeyens, L. (2009). Assessment of the chemical contamination in home-produced eggs in Belgium: General overview of the CONTEGG study. *Science of the Total Environment*, 407(15), 4403-4410. doi:10.1016/j.scitotenv.2008.10.066
- Vanhonacker, F., Verbeke, W., Van Poucke, E., Buijs, S., & Tuytens, F. A. M. (2009). Societal concern related to stocking density, pen size and group size in farm animal production. *Livestock Science*, 123(1), 16-22. doi:10.1016/j.livsci.2008.09.023
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, 116(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Ventura, B. A., von Keyserlingk, M. A. G., & Weary, D. M. (2014). Animal Welfare Concerns and Values of Stakeholders Within the Dairy Industry. *Journal of Agricultural and Environmental Ethics*, 28(1), 109-126. doi:10.1007/s10806-014-9523-x

APPENDIX 6.1: Questionnaire

Part A included questions on the following subjects:

1	What does a hen need for good welfare?	Open, max. 5 items
2	Are you concerned about hen welfare?	Open
2a	Why are you (not) concerned about hen welfare?	Open, max. 5 items
3	Are you concerned about becoming ill from hens or chicken products?	Open
3a	Why are you (not) concerned about becoming ill from hens or chicken products?	Open, max. 5 items
4	What is a natural way of keeping animals?	Open, max. 5 items
5	What should a farm, where hens are kept in a natural way, look like?	Open
6	How can you see from a hen that it is kept in a natural way?	Open
7	What is the influence on hen health of a natural way of keeping chicken?	Closed; less good - better health
7a	Why do you think that?	Open
8	What is the influence on hen welfare of a natural way of keeping chicken?	Closed; less good - better welfare
8a	Why do you think that?	Open
9	What is the influence on public health of a natural way of keeping chicken?	Closed; less risks - more risks
9a	Why do you think that?	Open

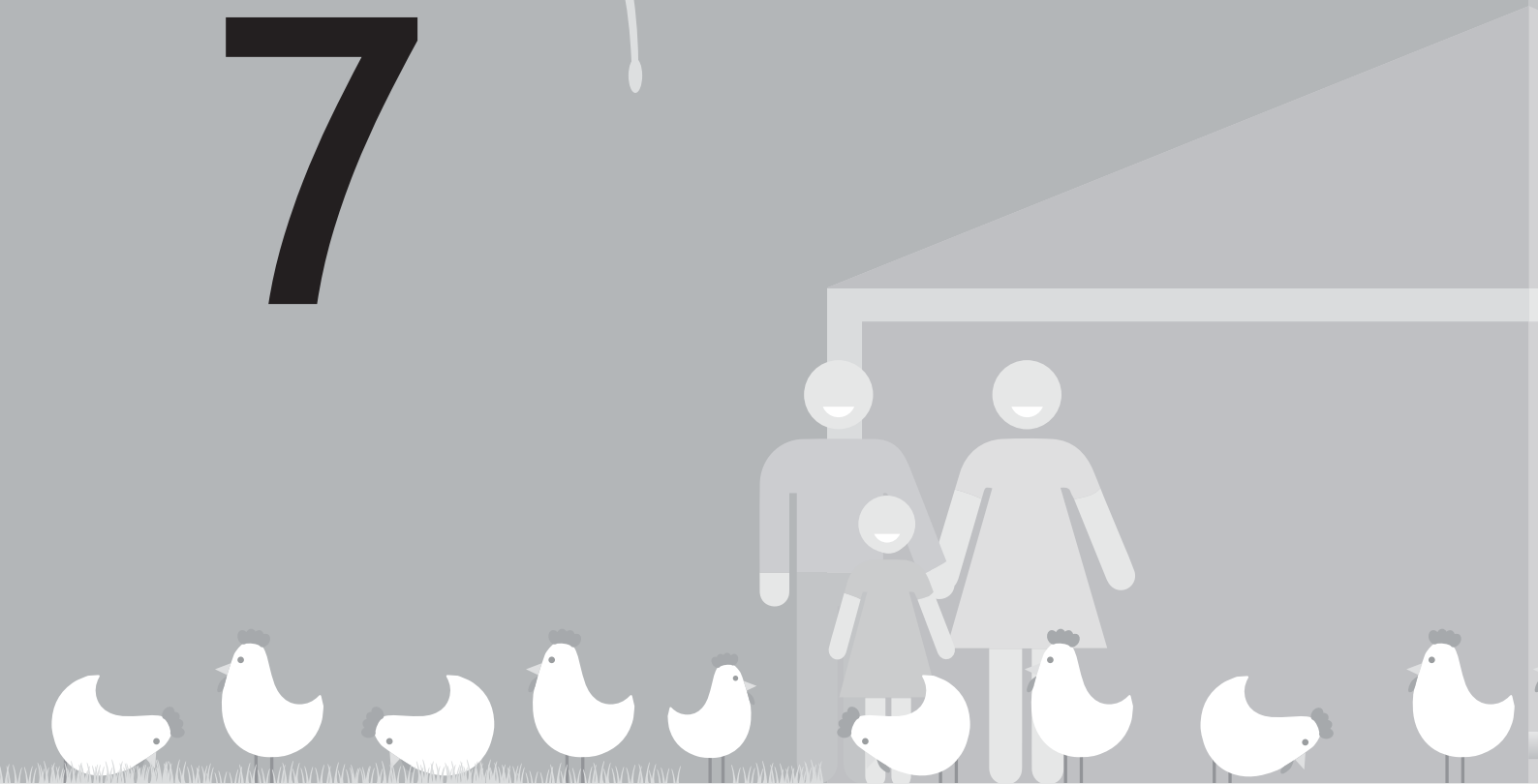
Part B included questions on the following subjects:

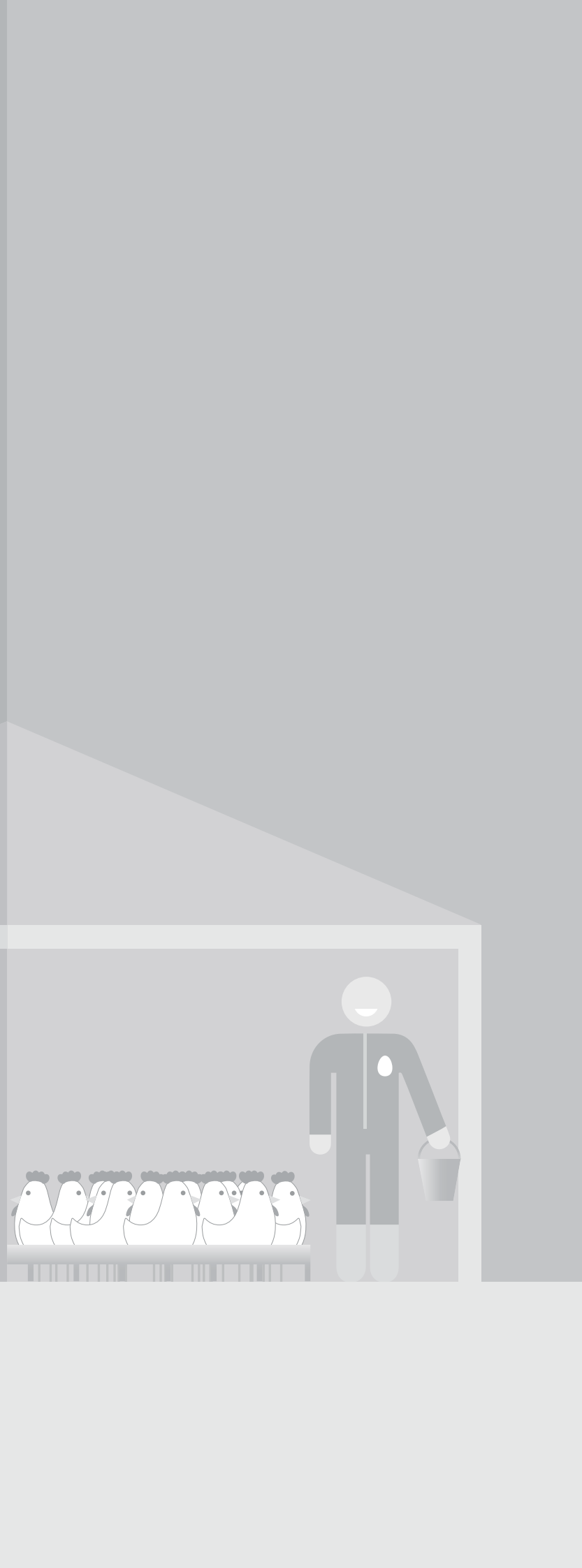
11	What is your first impression of this housing type?	Open
12	What do you notice?	Open; max 5 items
13	What do you think of hen health?	Closed; poor health- good health
13a	Why do you think that?	Open
14	What do you think of hen welfare?	Closed; poor welfare - good welfare
14a	Why do you think that?	Open
15	What do you think of public health risks?	Closed; low risk - high risk
15a	Why do you think that	Open
16	Are these hens kept in a natural way?	Closed; Not natural - natural
16a	Which aspects are natural?	Open; max 5 items
16b	Which aspects are not natural?	Open; max 5 items
17	To what extent do aspects contribute to a natural environment for hens?	Closed; No - contribute to naturalness
18	What do you think is missing in this housing system?	open



General discussion

7





INTRODUCTION

Increased public attention to animal welfare, has stimulated farmers to keep chickens in husbandry systems that are potentially beneficial for chicken welfare, for example by offering chickens outdoor access. At the same time people have become increasingly concerned about public health and food safety risks related to livestock farming (Chapter 3, Bergstra et al., 2017a; Hansen et al., 2003; Harper et al., 2001; Verbeke et al., 2000). Keeping chickens in systems with outdoor access may, however, increase the risks of certain public health and food safety hazards, such as *Campylobacter*, Avian influenza and increased dioxin levels in eggs (EFSA, 2011, 2012; EFSA Panel on Animal Health and Welfare et al., 2017; Kijlstra et al., 2009). Consequently, when a choice is being made to build or design a new poultry husbandry system, a conflict may occur between chicken welfare and public health risks. Judgment of this dilemma and evaluation of issues such as chicken welfare and public health and food safety risks may differ within and between groups of people, such as citizens and professionals involved in poultry husbandry. Different stakeholder groups have been shown to differ in their moral convictions regarding animals and humans (Bergstra et al., 2017b; Cohen, 2010). These moral convictions may play a role in the evaluation of issues such as animal welfare and public health and food safety risks, and in the judgment of the dilemma.

To retain a licence to produce chicken eggs and meat in the future, public acceptance is relevant for poultry husbandry (Thompson et al., 2011). Current poultry husbandry systems have been designed based on input of professionals from the field of poultry husbandry, but seem not to address adequately societal concerns (Weary et al., 2016). Society expresses their opinions about livestock husbandry – in particular negative opinions about intensive farming systems – by engaging in societal debates, social media, NGO campaigns, and political voting, for example on for the ‘Animal Party’ (Partij voor de Dieren). Although these public opinions are often based on people’s (limited) knowledge’, they do reflect their moral values considering humans and animals, and convictions and perceptions related to livestock husbandry (Boogaard et al., 2011a; Boogaard et al., 2011b; Te Velde et al., 2002). To increase societal support the poultry husbandry sector may need to consider the societal opinions. Insight into moral convictions and perceptions regarding hen husbandry and related dilemmas may help to explain why people have concerns and may give guidance for future

innovations. Relevant stakeholders are professionals working in poultry husbandry, such as poultry farmers and poultry veterinarians, as well as the general public – hereinafter referred to as citizens.

The main objective of this thesis was to study stakeholder opinions on the conflict between chicken welfare and public health and food safety risks¹. The judgment of such a dilemma will be influenced by views on poultry husbandry systems and on the issues involved, such as chicken welfare, public health and food safety risks, (Chapter 2); perceptions of chicken welfare in different systems, and of chicken welfare aspects (Chapter 3); perceptions of risks to public health and food safety hazards in different systems, and factors influencing risk perceptions (Chapter 4); and moral convictions and moral arguments regarding humans and animals related to the conflict between chicken welfare and public health and food safety risks (Chapter 5). To study the implications of the results of Chapters 2 to 5 and to gain insight into citizens' perceptions of an innovative laying hen farm, a farm visit was included in this study (Chapter 6). The findings of Chapters 2 to 6 will be discussed here.

We will first discuss the views of citizens, poultry farmers and poultry veterinarians on the preferred husbandry system, their perceptions of chicken welfare, and the association between perceptions of chicken welfare and the preferred for a husbandry system. Second, stakeholders' risk perceptions of three public health hazards and the role of intuitive feelings, also referred to as affect, will be discussed. Next, we will reflect on moral convictions of citizens and farmers related to chickens and humans, and the association of these conviction with the judgment of the conflict between chicken welfare and public health risks. Based on the previous discussion we will explain the differences between stakeholder groups regarding moral convictions and judgments. The views of citizens on hen husbandry during a farm visit, as well as the implications of the present thesis for future poultry husbandry, will then be discussed. Finally, the overall conclusions of this thesis are presented.

¹ For the further discussion when we refer to public health, we mean public health and food safety risks, because food safety is a part of public health.

PREFERRED HUSBANDRY SYSTEM

To comply with societal demands for welfare-friendly husbandry systems, the number of poultry farms offering outdoor access to chickens, such as free-range systems or organic husbandry systems, has been growing (CBS Statistics Netherlands, 2018). Nowadays, consumers are more likely than they were in the past to buy chicken products from those farms that comply with welfare requirements that are above the minimum set in EU or national legislation. Chapter 2 of this thesis shows that citizens prefer outdoor husbandry systems. Of the citizens, 73% preferred a laying hen husbandry system with outdoor access, namely a free-range or an organic system. Most of the poultry farmers (71%) and poultry veterinarians (93%), however, preferred an indoor system – colony cages or an indoor non-cage system – for keeping laying hens. In the context of broiler husbandry, citizens also preferred predominantly outdoor broiler husbandry systems, while the professional groups preferred predominantly indoor systems (Van Asselt et al., 2015; Vanhonacker et al., 2016). These results demonstrate a disagreement between citizens and the two professional groups on how chickens should be kept.

It is important to note that we chose to provide respondents not with information about the husbandry systems, because we were interested in respondents' moral convictions and perceptions related to poultry husbandry. A reason to focus on moral convictions and perceptions is that the 'knowledge deficit' of lay citizens as explanatory factor of public concerns and perceptions has been questioned to be the cause for the differences between perceptions of citizens and professionals (Hansen et al., 2003). Little association was found between knowledge and perceptions of citizens (Boogaard et al. 2011a; Ventura et al. 2016), while moral values and convictions are associated with perceptions (Te Velde et al., 2002; Vanhonacker et al., 2008; Boogaard et al., 2011a). Moral values and convictions form our attitudes towards humans and animals (Cohen et al., 2009), perceptions of animal welfare (Fraser et al., 1997; Boogaard et al., 2011a), and what is an acceptable level of risk (Hansen et al., 2003; Ueland et al., 2012). When conflicts between different issues – like animal welfare and public health risks – come to the fore, the balancing of these issues is influenced by moral values and convictions and will differ between people.

Another reason for not providing respondents with information is the difficulty to select and provide unbiased information (Sturgis et al., 2010), especially about complex issues, such as livestock husbandry systems and the effect on animal welfare and public health risks. We also considered the fact that information provision in questionnaires may cause a higher dropout of participants, in particular of participant with a lower educational level (Sturgis et al., 2010). Therefore, we did not provide the respondents with information in Chapter 2, and we provided the respondents in Chapter 3 and 4 with limited information about the husbandry systems (Table 3.1 and Table 4.1).

Preferring the one system or the other is likely to be related to the perceived importance of a variety of poultry husbandry issues, such as chicken welfare, and public health and food safety risks, and to the evaluation of such issues for the different husbandry systems. To answer the question “Why do stakeholder groups prefer different poultry husbandry systems?”, the stakeholders’ views on the importance of poultry husbandry issues were studied (Chapter 2). All stakeholder groups perceived *food safety* and *hen health* as the two most important issues of the 10 issues presented, independently of their preference for a certain husbandry system. Moreover, citizens, poultry farmers and poultry veterinarians agreed on the importance of *hen welfare*. However, the fact that different stakeholder groups all considered these issues to be important does not mean that they evaluated these issues in the same way. Differences in perceptions of issues such as chicken welfare may cause different perceptions of the best husbandry system for keeping chickens. Therefore, it is interesting to study the perceptions regarding hen welfare in the four different husbandry systems, and the perception of different aspects of hen welfare.

PERCEPTIONS OF CHICKEN WELFARE

The three stakeholder groups perceived hen welfare as an important issue of hen husbandry (Chapter 2). Preferences of the three stakeholder groups for a certain husbandry system (Chapter 2) were in line with their evaluation of hen welfare in the systems (Chapter 3). Citizens gave the highest score to the welfare of laying hens in organic systems, followed by the welfare of hens in the free-range system with outdoor access (Chapter 3). By contrast, poultry farmers and poultry veterinarians

gave the highest score to hen welfare in the indoor non-cage systems, followed by the welfare of hens kept in colony cages, and they gave the welfare of hens kept in organic systems the lowest score (Chapter 3). This is an interesting result, because the perceptions of the farmers and veterinarians regarding hen welfare in different husbandry systems are not in line with certification programmes such as the Better Life Mark (Beter Leven Keurmerk) of the Dutch Society for the Protection of Animals (Van Wijk-Jansen et al., 2009). According to the Better Life Mark, the highest level of chicken welfare is assigned to products from organic farms and non-organic products produced in accordance with welfare standards comparable with those of organic products. Hence, the views of citizens on the welfare of chicken kept in the different systems are more in accordance with the Better Life Mark than the views of the poultry farmers and veterinarians.

Concepts of chicken welfare

How people view the welfare of hens kept in different husbandry systems may depend on, among other things, how they view good animal welfare and what is for them a good quality of animal life. Based on different ethical perspectives, three concepts of animal welfare have been distinguished (Fraser, 1995, 1999; Fraser et al., 1997; Tannenbaum, 1991). The first concept of animal welfare focuses on the *biological functioning* of the animals, such as good health and productivity. The second concept focuses on *affective states* of animals, such as pain, anxiety and stress, and the third concept focuses on *leading natural lives*, such as being able to perform natural behaviours (Broom, 1991; Fraser, 2003; Fraser et al., 1997). The literature states that farmers and veterinarians view animal welfare predominantly in terms of *biological functioning*, while citizens view animal welfare in terms of *leading natural lives* (Bracke et al., 2005; Te Velde et al., 2002; Vanhonacker et al., 2008).

To explain stakeholders' preference for a certain husbandry system, it was important to study their evaluation of hen welfare in different husbandry systems and their valuation of the three concepts of welfare: *biological functioning*, *affective states* of animals and *leading natural lives*. Therefore, in Chapter 3 we studied the perceptions of different hen welfare aspects derived from the three different animal welfare concepts. These welfare aspects were chosen based on the analyses of literature on the perceptions of animal welfare, the stakeholder debate and the main public concerns

regarding hen welfare (e.g. Bergstra et al., 2015; Bergstra et al., 2017b; Boogaard et al., 2006, 2008; Bracke et al., 2005; Fraser et al., 1997; Lassen et al., 2006; Te Velde et al., 2002; Vanhonacker et al., 2009b; Vanhonacker et al., 2008; Ventura et al., 2014). In our study, we selected aspects of chicken welfare for all three concepts. Citizens' concerns focus in particular on the animal welfare concept *leading natural lives* (Bracke et al., 2005; Fraser, 2003; Fraser et al., 1997; Tuyttens et al., 2010; Vanhonacker et al., 2008). To gain insight into how people view *leading natural lives* we selected more aspects for the concept *leading natural lives* than for the other two animal welfare concepts.

For the concept *biological functioning*, we selected the aspects *hens lay many eggs, a treated beak* and *mortality* (e.g. Bergstra et al., 2017a; Fraser, 2009; Fraser et al., 1997; Vanhonacker et al., 2008). The aspects *pain, anxiety or stress* and *injuries* were chosen to be studied for the concept *affective states* (e.g. Bergstra et al., 2017a; Fraser, 2009; Fraser et al., 1997; Vanhonacker et al., 2008). For the concept *leading natural lives*, we included the aspects *space to move around freely, environment meets natural needs, outdoor access, scratching and dust bathing opportunities, enrichment, and ad lib. feed and water* (e.g. Bergstra et al., 2015; Bergstra et al., 2017a; Boogaard et al., 2006, 2008; Fraser, 2009; Fraser et al., 1997; Lassen et al., 2006; Vanhonacker et al., 2009b; Vanhonacker et al., 2008). The clustering of welfare aspects per concept was done based on the literature, but the clustering of some aspects can be questioned. For example, we included *beak treatment* in the concept *biological functioning*. From a farmers' perspective, *beak treatment* helps to prevent feather pecking and may increase productivity and for that reason beak treatment was clustered in the concept *biological functioning*. From a citizens' perspective however, one might argue that beak trimming affects the integrity of the hens and should be allocated to the concept *leading natural lives*. This implies that the results related to the concepts of hen welfare should be interpreted with care.

The valuations by citizens, farmers and veterinarians of aspects of chicken welfare for each concept of animal welfare are presented in Figure 7.1. The three stakeholder groups take the view that all three concepts of welfare influence chicken welfare. Citizens considered the influence on chicken welfare of the concept *leading natural lives* had the highest value, followed by *affective states*, and they considered the influence of *biological functioning* to have the lowest influence on welfare of the three

concepts. Our results confirm that for citizens, aspects of the concept *leading natural lives*, such as *space to move around freely*, *environment meets natural needs*, *outdoor access*, *scratching and dust bathing opportunities*, *enrichment*, and *ad lib. feed and water*, considerably influence hen welfare and are the subject of citizens' concerns (Bracke et al., 2005; Fraser, 2003; Fraser et al., 1997; Te Velde et al., 2002; Tuyttens et al., 2010; Vanhonacker et al., 2008).

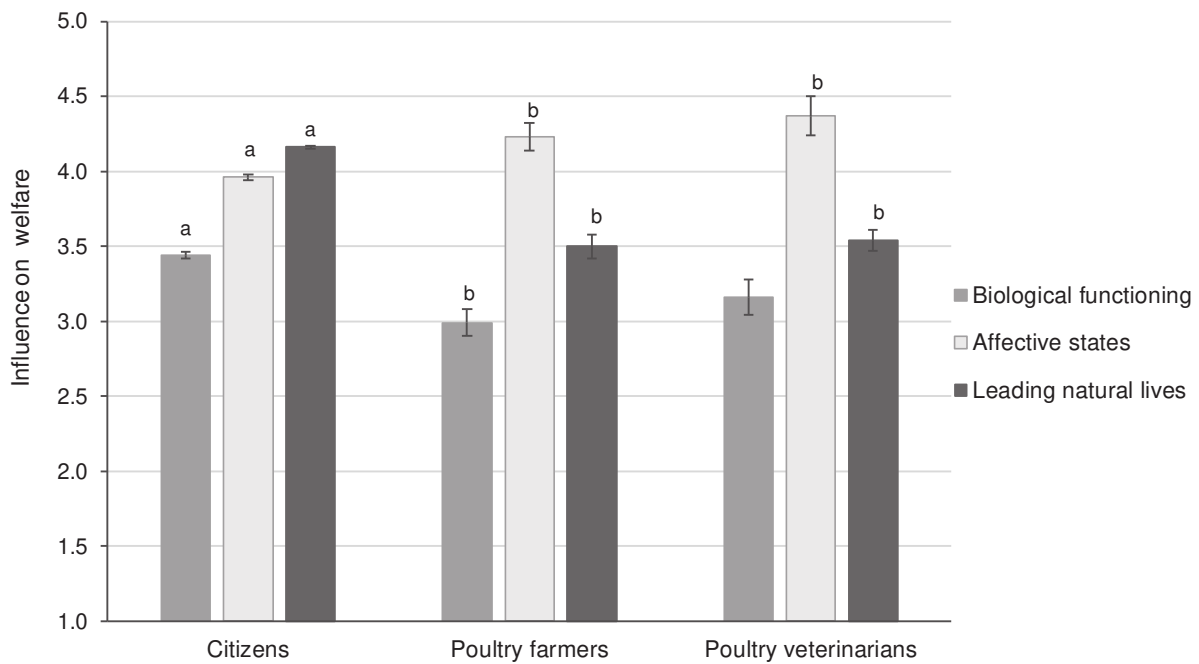


Figure 7.1 Mean score (\pm SE) per concept of chicken welfare given by three stakeholder groups – citizens ($n = 2259$), poultry farmers ($n = 100$), poultry veterinarians ($n = 41$) – on a five-point Likert scale ranging from 1 = absolutely no influence on welfare to 5 = absolutely influences welfare

^{a, b} Means scores of a welfare concept with different superscripts indicate a significant difference ($p < 0.05$) between stakeholder groups

Poultry farmers and veterinarians gave the concept *biological function* a lower score than the concepts *affective states* and *leading natural lives*. According to the literature, farmers and veterinarians have a predominantly function-based view on animal welfare (Bracke et al., 2005; Fraser et al., 1997; Te Velde et al., 2002; Tuyttens et al., 2010). This implies that when a chicken functions well biologically, e.g. lays many eggs, people with this function-based view perceive the welfare of this chicken as good. We may conclude that, according to farmers and veterinarians, the aspects of the concept *biological functioning* as we studied them, including *hens lay many eggs*, *a treated beak* and *mortality*, do not influence chicken welfare, and for them these aspects are not of real concern for the welfare of hens.

The two professional groups gave the influence on welfare of the concept *affective states* a distinctly higher score than the influence of the concepts *leading natural lives* and *biological functioning*. Farmers and veterinarians are aware that pain and stress negatively affect the animals, animal health, welfare and their growth and production rates. The concept *affective states* of chickens, including the aspects *pain, anxiety or stress* and *injuries*, is a concern of farmers and veterinarians. Comparing the scores of the citizens with the scores of the two professional groups for the welfare concepts reveals that for citizens, the concept *leading natural lives* is subject of concern and for farmers and veterinarians it is *affective states* of chickens. These different views on chicken welfare may affect the preference for a husbandry system.

Perceptions of chicken welfare and preferred husbandry system

In outdoor husbandry systems, chickens have more space and a more natural environment to express natural behaviour than in indoor systems (Bestman et al., 2014; Freire et al., 2013; Lay Jr et al., 2011; Shimmura et al., 2010). In indoor husbandry systems, such as colony cages or indoor non-cage systems, chickens have fewer possibilities to perform natural behaviour than in outdoor systems, but chickens have lower risks of on injury, pain, anxiety and stress due to diseases than in outdoor systems (Freire et al., 2013; Lay Jr et al., 2011; Shimmura et al., 2011; Shimmura et al., 2010). In outdoor systems, however, other disease risks, higher mortality rates and lower efficiency than in indoor systems are reported (Freire et al., 2013; Lay Jr et al., 2011; Shimmura et al., 2011; Shimmura et al., 2010). Citizens gave a high value to the influence on welfare of aspects of the concept *leading natural lives*, which may explain why citizens consider the welfare of chickens in outdoor systems to be higher than in indoor systems. Citizens may not be aware of the side effects of outdoor systems. In contrast, poultry farmers and veterinarians are aware of the side effects of the outdoor systems, such as increased contact with infectious agents and predators, and bad weather conditions (Knierim, 2006). Moreover, they consider the influence on hen welfare of the concept of animals' *affective states* – including *pain, anxiety or stress, and injuries* – to be substantially higher than the other two concepts, which explains why veterinarians and farmers accord a lower value to welfare in outdoor systems than to that in indoor systems, and may explain their preference for indoor husbandry systems.

To explore the association between views on chicken welfare and the preferred systems, Figure 7.2 presents the mean scores given by citizens and poultry farmers for three concepts of welfare for each preferred system. Because the view of poultry veterinarians was comparable with that of poultry farmers and the group of

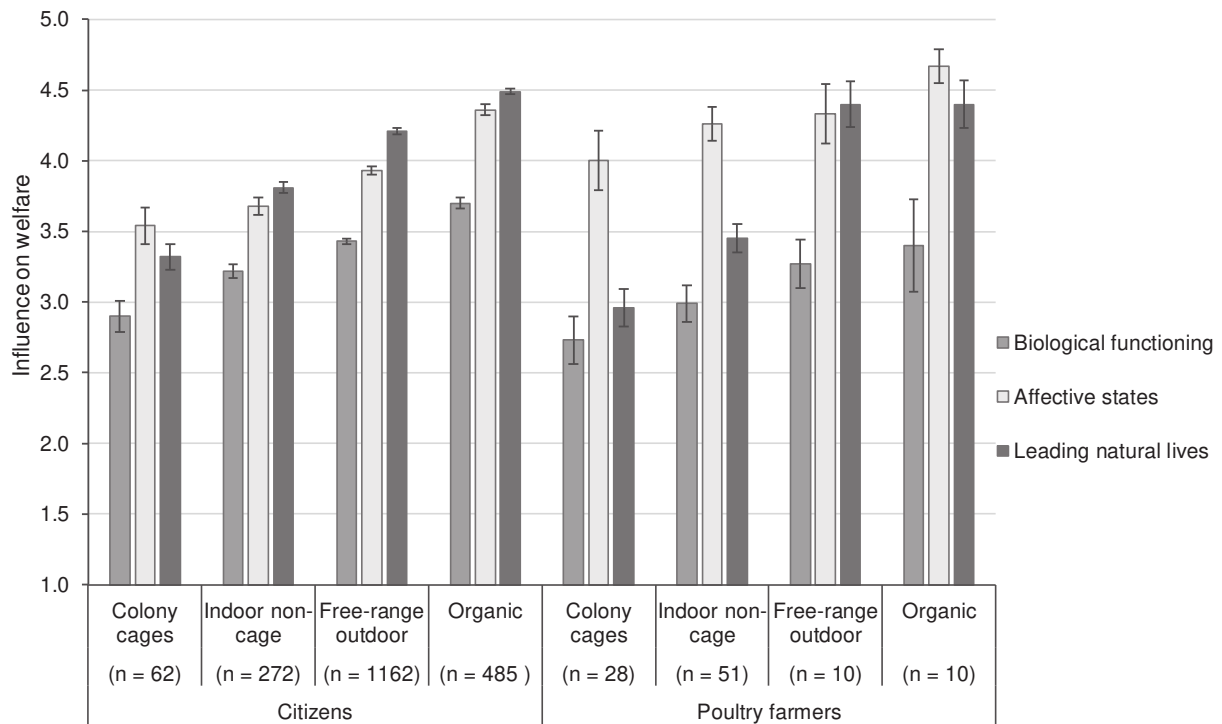


Figure 7.2 Mean score (\pm SE) per concept of animal welfare given by citizens and poultry farmers for each preferred hen husbandry system on a five-point Likert scale ranging from 1 = absolutely no influence on welfare to 5 = absolutely influences welfare

^{a, b, c, d} Mean scores of a welfare concept per stakeholder group with different superscripts indicate a significant difference ($p < 0.05$) between preferred best system

veterinarians is relatively small, we did not include it in Figure 7.2. It is interesting to note that citizens and farmers who prefer the same system score the three concepts in a comparable pattern. Both citizens and farmers who prefer an outdoor husbandry system gave higher scores to the three concepts of welfare than those who prefer an indoor system. The concept *leading natural lives* is given a significant ($p < 0.05$) higher score by those who prefer outdoor systems. It suggests that people – citizens or farmers – who consider the concept *leading natural lives* to be the dominant concept of animal welfare view outdoor systems as those in which aspects of the concept *leading natural lives* are best met, because chickens have more space to move around and to perform natural behaviour, and thus enjoy better welfare. It is also interesting to note that farmers who prefer indoor systems, gave a higher value to aspects of the concept

affective states than citizens who prefer indoor systems. This may be explained by the fact that farmers believe that these aspects of hen welfare can be better safeguarded in indoor husbandry systems, while citizens may be not aware of a potential difference in the *affective states* of hens kept in either indoor or outdoor systems.

RISK PERCEPTIONS

Food safety and public health have become important issues for all stakeholder groups (Chapter 4; Bergstra et al., 2017b; Verbeke et al., 2000). Citizens have positive attitudes towards outdoor poultry husbandry systems (Chapter 2; Chapter 3; Van Asselt et al., 2015) and they perceive products from outdoor systems as healthy and safe (Aertsens et al., 2009; Eurobarometer, 2007; Harper et al., 2002). However, outdoor systems have been associated with increased public health and food safety risks for certain hazards, such as avian influenza, contamination of eggs with dioxin, and contamination of meat with *Campylobacter* (e.g. EFSA, 2011, 2012; EFSA Panel on Animal Health and Welfare et al., 2017; Gonzales et al., 2013; Kijlstra et al., 2009; Schoeters et al., 2006). Therefore, we studied the perceptions of three stakeholder groups regarding these three risks associated with different poultry husbandry systems (Chapter 4).

The professional groups evaluated the risks of these hazards as being higher in outdoor systems than in indoor systems, in accordance with the above-mentioned literature. In contrast, citizens evaluated the public health risks of *Campylobacter* contamination of broiler meat, increased dioxin levels in eggs, and avian influenza introduction in laying hens as being higher when chickens are kept in indoor systems than in outdoor systems and they perceived these risks as lowest for the organic systems. The risk perceptions of citizens are not in accordance with the risk assessment of these hazards in the literature. However, citizens' risk perceptions seem to be associated with their perceptions of hen welfare (Chapter 3) and broiler welfare (Van Asselt et al., 2017). On the one hand they perceive chicken welfare in outdoor systems as good, and the risks in outdoor systems as low. On the other hand, citizens perceive chicken welfare in indoor systems as less good and risks associated with indoor systems as higher than in outdoor systems.

Professionals – especially farmers – seem to overestimate risks related to the outdoor husbandry systems, and they may have an optimistic bias with respect to the public health risks presented by indoor systems (Chapter 4). As was found in citizens, the risk perceptions of farmers and veterinarians were linked to their perceptions of chicken welfare: in the systems where they gave a high value to chicken welfare, they accorded the risks a low value and in systems accorded a low value for chicken welfare, they gave the risks a high value. It can therefore not be ruled out that risk perceptions are influenced by views on animal welfare or poultry husbandry in general. The reason why risk perceptions are related to perceptions of animal welfare may be influenced by intuitive feelings, in risk literature also referred to as *affect*.

The role of affect

When people evaluate or judge complex situations, or when they lack knowledge, they make a more intuitive judgment (Slovic et al., 2007; Van den Heuvel et al., 2008). Such intuitive judgments are influenced by *affect*, which is a positive (like) or negative (dislike) evaluative feeling (Finucane et al., 2000a; Slovic et al., 2007). In the questionnaire the respondents were not provided with information about how the husbandry systems perform on issues such as chicken welfare, and public health and food safety risks. In citizens and the two professional groups, *affect* may have influenced perceptions of the best husbandry systems, chicken welfare and risk.

Citizens

An example of *affect* in citizens is their positive association of animal welfare, i.e. a natural way of keeping chickens, with product attributes such as healthy food, safe food and food quality (Aertsens et al., 2009; Eurobarometer, 2007; Harper et al., 2001; Harper et al., 2002; Vanhonacker et al., 2009a). Our results suggest that citizens perceive chicken welfare in natural systems, such as systems with outdoor access, as positive, because hens have more space to move around, more possibilities to perform natural behaviour, and as a result suffer less stress, have fewer diseases and thus enjoy better welfare (Chapter 3 and Chapter 6). Therefore, they may view the husbandry systems with outdoor access as the preferred husbandry systems. These positive feelings about outdoor systems may be the reason why citizens perceive the public health risks related to these systems as low.

Over time, citizens have developed negative feelings towards indoor husbandry systems which may have been triggered by media coverage of animal disease outbreaks (Te Velde et al., 2002) and consequent mass culling of poultry. Another reason that may underlie the negative feelings regarding indoor systems could be related to chicken numbers. In general, indoor systems are perceived as being intensive systems with large numbers of chickens. The farm visit showed that citizens view the large number of chickens as negative (Chapter 6). Food scandals, such as the dioxin or fipronil egg contamination, and increased attention for animal welfare problems in intensive and indoor production systems may have prompted these negative views. As a result, citizens developed negative feelings – also referred to as stigma (Chapter 4) – towards intensive indoor husbandry systems. Consequently, citizens seem to perceive various issues of poultry husbandry, such as chicken welfare, and public health risks, as negative in intensive indoor husbandry systems.

Poultry farmers and poultry veterinarians

Although the professional groups may be more knowledgeable about poultry husbandry than citizens, *affect* may also have influenced professionals in their views on poultry husbandry. In contrast to citizens, professionals, especially conventional farmers, may have negative feelings towards outdoor systems (Gocsik et al., 2016; Stadig et al., 2016). Several reasons may cause these negative feelings. First, in outdoor systems, chickens have more opportunities to lead natural lives than in indoor systems, but outdoor systems perform less well as regards aspects such as pain, anxiety or stress and injuries (*affective states*), as well as disease incidences, mortality rates, and production rates (Lay Jr et al., 2011; Shimmura et al., 2011; Shimmura et al., 2010). Farmers believe that aspects of the welfare concept *leading natural lives* do not influence hen welfare as much as pain, anxiety or stress and injuries (*affective states*) (Chapter 3, Bracke et al., 2005; Fraser et al., 1997; Te Velde et al., 2002; Vanhonacker et al., 2008). Second, farmers may worry about the higher risks of the introduction of infectious diseases, such as avian influenza (Gocsik et al., 2015) and the financial impact of an influenza outbreak. Third, farmers' views may be influenced by their current farming system, which is predominantly an indoor system, and they might not be able to convert to an outdoor system (Gocsik et al., 2015). These negative attitudes towards outdoor systems may influence the views of the professionals on the preferred husbandry systems and the welfare and risk evaluation of outdoor systems.

CASES REPRESENTING THE DILEMMA

The main objective of this thesis was to study the dilemma of choosing a husbandry system that improves chicken welfare or reduces public health and food safety risks. Chapter 5 we studied the judgments made by citizens and poultry farmers in a conflict between chicken welfare and the risks of three public health hazards: *Campylobacter*, avian influenza and dioxin in eggs. It is of interest to study how the three stakeholder groups weigh up the interests of humans against those of chickens when presented with a case. The three cases were presented, illustrating the choice of a system with improved chicken welfare or a system with reduced public health or food safety risks (Chapter 5). The results of Chapters 2, 3, and 4 showed that the uninformed citizens perceived the risks of three public health hazards *Campylobacter*, avian influenza and dioxin in eggs in indoor systems higher than in outdoor systems, and were not aware of the dilemma (Chapter 4). To study the judgments of the conflict between chicken welfare and public health risks we provided the respondents with information about the husbandry systems, such as facts influencing chicken welfare, infection or contamination rates of the hazards, and the probability and severity of health risks for humans.

The *Campylobacter* case concerned a broiler farmer who switched from a conventional husbandry system to a conventional-plus system that is considered better for broiler welfare, but may increase the risk of *Campylobacter* contamination in meat. The influenza case concerned a laying hen farmer who changed from a free-range system with outdoor access to an indoor non-cage system that is considered less welfare-friendly than the old system. However, this new indoor non-cage system is associated with a lower risk of avian influenza infection in hens and thus lower public health risks than the outdoor system. The last case concerned dioxin contamination of eggs and described a laying hen farmer who keeps his chickens in an indoor non-cage system and wants to switch to an organic husbandry system. Compared to the indoor non-cage system, the organic system with outdoor access may be considered more welfare-friendly, but the dioxin level in eggs may be higher, implying higher public health risks.

When provided with the case descriptions for one of the aforementioned hazards, a considerable group of citizens still made a judgment in favour of the welfare of

chickens at the expense of public health. Of the citizens, 42% made a judgment in favour of chicken welfare for the *Campylobacter* case, 24% for the avian influenza case, and 50% for the dioxin case. Compared to the citizens, a small group of farmers judged the cases in favour of chicken welfare: 30% for the *Campylobacter* case, 8% for the avian influenza case, and 17% for the dioxin case. The judgments of citizens and poultry farmers seem in line with citizens' preferences for outdoor systems and farmers' preferences for indoor systems (Chapter 2, Van Asselt et al., 2015), and their perceptions of chicken welfare in the various husbandry systems (Chapter 3, Van Asselt et al., 2017).

Of the three cases, citizens most often agreed with a judgment in favour of chicken welfare for the dioxin case, and farmers for the *Campylobacter* case. The *Campylobacter* case concerns a choice between a conventional and a conventional plus system for broilers, which are both indoor systems. The farmers' judgment is in line with their preference for conventional plus systems (Van Asselt et al., 2015), which they also perceive as the system with the highest broiler welfare (Van Asselt et al., 2017). Another reason for this relatively high level of agreement of farmers with the *Campylobacter* case, might be the by farmers expressed high self-protection ability against bacteria on chicken meat (Chapter 4).

Half of the citizens judged in favour of hen welfare in the dioxin case by choosing the organic husbandry system, which is associated with higher risks of contamination of eggs with dioxin than the other two cases (Chapter 5). The change from an indoor non-cage system to an organic system that offers outdoor access to chickens made substantially bigger improvements to chicken welfare in the dioxin case than in the other two cases. This bigger improvement in chicken welfare and citizens' high valuation of chicken welfare in the organic system (Chapter 3) may explain why more citizens judged in favour of welfare and at the expense of public health in the dioxin case than in the other two cases.

Citizens did not judge the avian influenza case in line with their preference for outdoor systems and welfare evaluation of the various systems. More citizens (32%) disagreed with the influenza case, i.e. with keeping hens in a free-range system with outdoor access, than agreed (24%). Also, a low percentage of the farmers (8%) favoured hen welfare over risks for public health in the influenza case. In contrast to

the other two hazards, avian influenza is a risk for both human and chicken health, and an avian influenza outbreak negatively affects chicken welfare. Respondents may also have considered these negative consequences for chicken and human health while judging the case. In consequence, they may have balanced the improved chicken welfare in the free-range system with outdoor access against both the risks for public health and chicken health and welfare. It suggests that only a minority of the citizens and farmers perceived the welfare concept *leading natural lives* important enough to override the risk of an avian influenza infection in chickens and humans.

It was concluded that when faced with a dilemma, citizens judge in favour of chicken welfare more often than poultry farmers, even when informed about public health risks (Chapter 5). This is interesting, because it was also shown that citizens are more concerned about public health and food safety risks nowadays than in the past (Bergstra et al., 2017a; Hansen et al., 2003; Harper et al., 2001; Verbeke et al., 2000). Citizens might have ignored the higher public health and food safety risk of the hazards presented, but there may be other explanations. First of all, as was shown in Chapter 6, citizens may trust farmers to meet the requirements laid down in legislation and have confidence in inspections by farmers and authorities to prevent the public health risk. Second, people may feel that they are able to handle the risks, for example as was expressed by a high self-protection ability for *pathogens on chicken meat* (Chapter 4). Third, a group of people might refrain from consuming chicken products when a hazard occurs, as has previously happened in response to food safety incidents, and thus do not consider the case presented to be a dilemma. Another explanation might be that a small group of people, more citizens than farmers, have strong moral convictions about how to treat chickens, and these convictions regarding chickens may weigh more heavily than convictions related to public health.

MORAL CONVICTIONS

A person's opinion in relation to animal husbandry in general, and to specific aspects such as animal welfare and public health and food safety risks in particular, is influenced by moral convictions regarding humans and animals. In a society, people share moral values (Beauchamp et al., 2009; Cohen et al., 2009), but convictions related to these values might be weighed up differently by different stakeholder

groups such as farmers, veterinarians and citizens, depending on the case presented (Cohen, 2010; Cohen et al., 2016). These moral convictions are based on *prima facie* principles – further referred to as fundamental moral values – from deontological and utilitarian perspectives, such as respect for *autonomy*, *justice* or *fairness*, and *wellbeing* (Beauchamp et al., 2009; Mepham, 2000). To study dilemmas in society and the moral convictions involved, multi-criteria frameworks have been developed (Beauchamp et al., 2009; Cohen et al., 2009; Jensen et al., 2011; Mepham, 2000; Michalopoulos et al., 2008). In Chapter 5, we presented a framework to study the conflict between chicken welfare and public health risks, and the role of moral convictions and arguments related to fundamental moral values for stakeholders. Our framework included moral convictions for various moral values relevant for the dilemma: *value of chickens*, *naturalness*, *fairness* and *wellbeing*. In Chapter 5 we explained how we selected these relevant moral convictions for our framework.

Moral conviction of citizens and poultry farmers

The valuation given by citizens and farmers to moral convictions related to the moral values *value of chickens*, *naturalness*, *fairness*, and *wellbeing* are shown in Figure 7.3. Farmers and citizens agreed to a certain extent (scores above 3) with all moral convictions presented, except that farmers did not agree with *chickens should reach their natural lifespan* (Figure 7.3). We will now discuss for each moral value the related moral convictions that differ considerably between citizens and poultry farmers.

Value of chickens

Convictions related to the value of animals and how their value is related to human value, i.e. the *hierarchical position* of humans with respect to animals, have been shown to influence the way people treat animals (Bergstra et al., 2015; Cohen et al., 2009; Cohen et al., 2012). People may value chickens only for their functional value for humans, but they may also respect the *intrinsic value of chickens*, which means that they value chickens independently of their usefulness for humans. Belief in the intrinsic properties of chickens to experience *sentience*, such as the capacity to feel pain, and emotions such as pleasure and boredom, may be a reason to attribute intrinsic value to chickens (Heeger et al., 2001; Knight et al., 2008; Knight et al., 2004; Warren, 1997). Our results confirm that citizens and poultry farmers agreed on

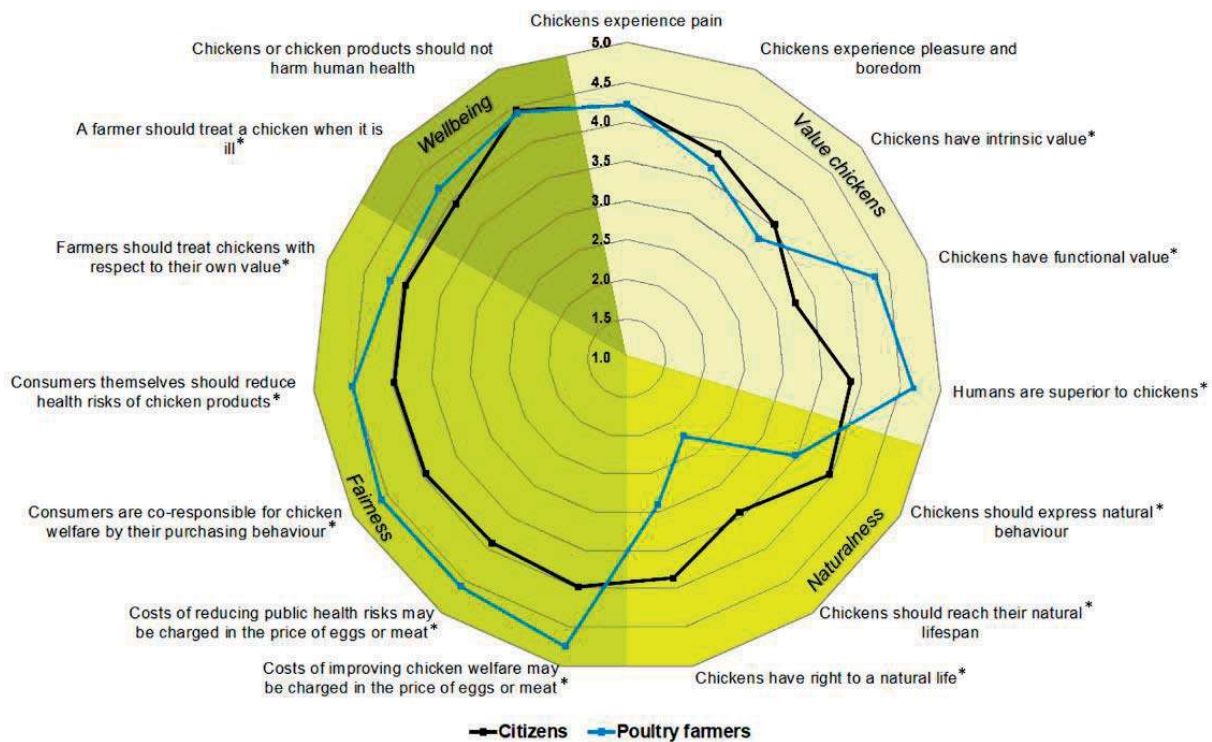


Figure 7.3 Mean scores for statements regarding moral convictions given by citizens (n=2259) and poultry farmers (n=100) related to the moral values *value of chickens*, *naturalness*, *fairness*, and *wellbeing* (1 = strongly disagree to 5 = strongly agree). Adapted from Table 5.3 (Chapter 5)
* Statements differ significantly ($p < 0.05$) between citizens and poultry farmers

the convictions regarding sentience and both groups acknowledged to some extent the intrinsic value of chickens. Nevertheless, this shared view on sentience does not mean that they also share convictions related to the *functional value of chickens* and the hierarchical position of humans with respect to chickens, i.e. *humans are superior to chickens* (Figure 7.3). A considerable group of citizens (32%) consider animals in general – including chickens – to be creatures that are as important as humans because they are part of the ecosystem (Cohen et al., 2012), while in farmers this group is smaller (15%) (Cohen et al., 2010). Consequently, citizens may consider chickens to be not only an instrument with a functional value for humans, but also a backyard or companion animal with associated values, such as relational value. For poultry farmers, however, chickens are primarily an economic instrument and most poultry farmers perceive chickens predominantly as production animals with a functional value and consequently perceive their own position to be superior to chickens.

Naturalness

What constitutes *naturalness* is not entirely clear (Bergstra et al., 2015; Miele, 2011; Ventura et al., 2014) and we will therefore elaborate further on the concept of *naturalness*. For some people, *naturalness* may mean respect for the self-regulation of living beings (Verhoog et al., 2007), which is also referred to as respect for the *telos* of animals – an animal living its life according to its nature – (Rollin, 1981). To study *naturalness*, we included for the value *naturalness* the convictions *natural behaviour*, *natural lifespan* and *natural life*. The value *naturalness*, as included in our study, is an important concept of animal welfare. It is interesting to note that all convictions regarding the moral value *naturalness* were valued differently by citizens and poultry farmers. The most prominent difference related to the conviction *chickens should reach their natural lifespan*; farmers disagreed with this conviction (score of 2.23), while citizens agreed (score of 3.42). A short lifespan may be a relevant biological and moral welfare issue (Broom, 2007; Bruijnis et al., 2015; Bruijnis et al., 2013; Gremmen et al., 2018; Woelders et al., 2007), which seems to be recognised by citizens, but not by farmers. In current poultry production, day-old male layer chicks are killed and broiler chickens are slaughtered at around 6 weeks of age. By disagreeing with the conviction regarding lifespan, farmers seem to have defended their current production practices. Studies have shown the public resistance to the killing of healthy young animals or production animals that are not productive enough (Bruijnis et al., 2015; Bruijnis et al., 2013; Gremmen et al., 2018; Woelders et al., 2007). Our results confirm that *chickens should reach their natural lifespan* is a conviction present in society. The discussion on lifespan may continue in the future, necessitating adaptations in poultry production practices.

Fairness

For this study relevant convictions related to the moral value *fairness* are a fair distribution of costs to improve animal welfare and to reduce public health risks, a fair distribution of responsibility for chicken welfare and prevention of public health risks among farmers and consumers and a fair treatment of chickens. Farmers strongly believed that consumers are co-responsible for chicken welfare, and for the prevention of risks related to consuming chicken products, for example by taking measurements while preparing chicken products. Moreover, farmers viewed that citizens have to pay for improvement of chicken welfare and prevention of public health and food safety

risks. Citizens find themselves co-responsible for lowering public health risks and improvement of chicken welfare and are willing to pay for that (Bennett et al., 2002; Clark et al., 2017; Lagerkvist et al., 2011). However, citizens' convictions regarding *fairness* were not as strong as those of the farmers. The reason for that may be that citizens view that certain minimal levels of chicken welfare and risk prevention are part of the farmers' *licence to produce*, and they expect farmers or authorities to guarantee those levels (Chapter 6) without increasing the cost for consumers. Nevertheless, a group of consumers is willing to pay for welfare plus products, for example from animals that have outdoor access (Mulder et al., 2017).

Wellbeing

The convictions related to the moral value *wellbeing* in this study focused on the *not harm* principle. Convictions related to the *promote welfare* principle were also studied by means of the moral values *value of chickens* and *naturalness*, because these are important values for the interpretation of animal welfare (Bergstra et al., 2015; Cohen et al., 2009; Fraser, 1999; Fraser et al., 1997). The *not harm* principle implies that poultry farmers are responsible for taking care of their chickens and preventing public health risks, as laid down in legislation. In this study, citizens and poultry farmers had comparable convictions related to the value *wellbeing* as expressed by the convictions *a farmer should treat a chicken when it is ill* and *chicken or chicken products should not harm human health*. These convictions are minimal requirements to protect humans and chickens, and farmers must respect these in order to have a licence to produce.

Moral convictions related to chicken welfare, husbandry systems and dilemma

Moral convictions regarding humans and animals influence views on how to treat animals and, consequently, views on animal welfare and animal husbandry (Bergstra et al., 2015; Cohen et al., 2012; Fraser et al., 1997). In our study, we asked about moral convictions independent from the cases representing the dilemma and we asked about relevant moral arguments in the context of the cases. These moral arguments were based on the moral convictions formulated for the moral values *value of chickens*, *naturalness*, *fairness* and *wellbeing* (Figure 7.3 and Chapter 5). In Chapter 5, we confirmed that judgments of the dilemma whether to improve chicken welfare or reduce public health risks were associated with people's moral arguments as well as with their moral convictions related to these moral values.

The group of people, who judged the cases presented in favour of a husbandry system that benefits chicken welfare included more citizens than poultry farmers and the people in this group especially scored the moral arguments and convictions related to *naturalness*, *sentience chicken*, *intrinsic value chicken*, and *wellbeing chicken* higher than those who judged the cases in favour of public health (Chapter 5). In contrast, those who judged the cases in favour of public health scored the moral arguments and convictions related to *humans are superior to chickens*, *functional value of chicken* and *not harm humans* higher than those who judged the cases in favour of chicken welfare. These convictions are all related to ethical views on how to treat chickens. People who view themselves as superior to chickens may perceive chickens as production animals and value them predominantly for their functional value. They view animal welfare predominantly in terms of *affective states* and *biological functioning*, and perceive natural behaviour as being less important for chicken welfare. This implies that, for them, naturalness – as in offering outdoor access, space and opportunities to express natural behaviour – is not important. They may also focus on the negative consequences of outdoor husbandry systems for the *biological functioning* and *affective states* of the animals, such as contact with infectious agents and predators, and bad weather conditions. As a consequence, they may value chicken welfare in indoor systems higher than in outdoor systems. In contrast, people who see humans and chickens as equally important may attribute intrinsic value to chickens and consider it necessary for the animals to be able to live a natural life. They thus find it necessary to offer outdoor access, which provides chickens with more space and opportunities to express natural behaviour. These people perceive chicken welfare in outdoor systems as better than in indoor systems and thus prefer husbandry systems which offer outdoor access to chickens.

EXPLANATION OF DIFFERENCES BETWEEN STAKEHOLDERS' MORAL CONVICTIONS AND JUDGMENTS

In society, most people share fundamental moral values related to humans and animals, such as *autonomy*, *wellbeing* and *justice* (Beauchamp et al., 2009; Mepham, 2000). These fundamental moral values are deeply felt beliefs about how to treat humans and animals, but people hold these values independently of topic or case. In a practical case, the fundamental moral values related to humans and animals are

adapted to the case, become moral convictions and are balanced against each other. The balancing of moral convictions is influenced by several factors, which may explain the differences between the stakeholders: *context* – whether or not connected to poultry husbandry –, knowledge and experiences, intuitions and *affect*, and socio-demographic characteristics.

Cohen et al. (2009) argue that the *context* of a person influences his or her balancing of moral convictions. Being a non-farming citizen or a person involved in poultry husbandry, such as poultry farmers, or poultry veterinarians, i.e. the *context* of a person, may influence his or her moral convictions related to humans and animals, and the judgment of a practical case. In their poultry husbandry *context*, professionals such as poultry farmers and poultry veterinarians have to cope with a diversity of issues related to humans, animals and the environment, such as the production of healthy and safe food, farmers' welfare, income, animal welfare, environmental aspects, food security, and fair trade (Driessen, 2012). Convictions regarding these issues will influence their convictions regarding the welfare of chickens and public health risks for humans.

Moreover, the *context* of a person will influence his or her knowledge and experiences related to poultry husbandry and the importance of relevant moral facts. The personal context of professionals influences how they exert their practical knowledge and experience. The importance of relevant moral facts, such as legislation and economic viability of the farm, is influenced by the farmers' poultry husbandry context. For example, as farmers are financially dependent on keeping chickens, they will – in contrast to citizens – always take into account their farming and economic situation, and consequently give a high value to the conviction regarding the functional value of chicken (Chapter 5).

With regard to a certain conviction or case, a person forms an intuitive view and selects and values the importance of various fundamental moral values and relevant moral facts, and these depend on the person's *context*. When this person forms a conviction regarding a certain topic, he or she will balance fundamental moral values against relevant facts and his or her intuitions. Another example is the influence of the professionals' negative or positive feelings – *affect* – about outdoor husbandry systems on their intuitions (Chapter 4). These negative or positive feelings may influence their

convictions regarding *naturalness* and outdoor husbandry systems and thus influence their judgment of the dilemma presented.

When we looked specifically at poultry veterinarians, an interesting and consistent finding in Chapters 2 to 4 was that veterinarians shared the views of poultry farmers on several aspects. Most professionals preferred indoor systems, viewed chicken welfare in indoor systems as better than in outdoor systems, and perceived the public health risks in outdoor systems as higher than in indoor systems. These results may give the impression that veterinarians mainly take the farmers' interests into consideration. Society, however, expects veterinarians to consider the interests of public health and animals independently from the farmers' interests. Veterinarians should not only focus on the concerns and interests of farmers, but should maintain their independence from farmers in order to deal with moral dilemmas (Meijboom, 2018) in a way that it is socially justifiable. There is currently an interesting debate among veterinarians. A group of veterinarians, the Caring Vets (www.caringvets.nl), started the discussion with other veterinarians about how to treat animals, especially animals in intensive farming systems.

When citizens who are not involved in poultry husbandry are asked about their convictions, they consider the convictions more independently from the context of poultry husbandry than professional groups do. They mainly consider moral values regarding the *value of chickens*, *wellbeing of chickens*, *naturalness* and *not harm human*. Citizens have negative intuitive feelings – *affect* – about indoor husbandry systems (Chapter 4), because of media coverage of animal welfare issues and disease outbreaks in livestock husbandry (Te Velde et al., 2002). These negative feelings will influence their intuitions (Chapter 4) and thus their moral convictions regarding poultry husbandry. Moreover, citizens will have limited knowledge about relevant moral facts related to poultry husbandry, chicken welfare (Chapter 3) and public health risks related to poultry husbandry (Chapter 4). Citizens' convictions and judgment will be based on 1) their possibly limited knowledge; 2) negative intuitive feelings regarding indoor systems and positive intuitive feelings regarding outdoor systems; and 3) moral values predominately related to chickens and their wellbeing. Citizens in their role as consumers, however, may have different convictions and might make different judgments from those they make as citizens (Harper et al., 2001; Mulder et al., 2017), because consumers will consider other issues such as availability,

price, and knowledge regarding labelling of products (Harvey et al., 2013; Vermeir et al., 2006).

Socio-demographic characteristics, and in particular gender, could explain different perception, moral convictions and judgments related to human and animals (e.g. Chapter 2; Chapter 3; Chapter 4; Cohen et al., 2012; Finucane et al., 2000; Kendall et al., 2006; Knight et al., 2004; Slovic, 1999; Vanhonacker et al., 2009a; Vanhonacker et al., 2007). In general and in our study, poultry farmers and poultry veterinarians are predominantly male while the citizens were representative for the Dutch population. Females are more concerned about animal welfare than males are, while males view issues more from an economic point of view than female. (Cohen et al., 2012; Kendall et al., 2006). These gender differences may partly explain the differences between the professionals and citizens regarding convictions and judgments related to animals. For example, in Chapter 3 was shown that compared to the sample mean, citizens in *High concerned* group were more often female. This *high concern* group had the same level of knowledge regarding chicken behaviour as poultry farmers had, but they had different views on chicken welfare (Chapter 3).

FARM VISIT

Society has expressed concerns about poultry husbandry, chicken welfare and public health risks. Our study provided insight into stakeholders' perception of poultry husbandry systems, chicken welfare, public health risks, convictions related to humans and animals, and judgments of a dilemma. Citizens' concerns and perceptions may be based on their – possibly limited – knowledge and experiences related to poultry farming. A farm visit provides the opportunity to study citizens' perceptions and judgments in a real-life situation and provides citizens' information and experiences with farming (Boogaard et al., 2006; Eurobarometer, 2005).

A recently developed innovative laying hen farm that tries to take societal concerns into account, was selected for a farm visit. This farm with a large covered free-range area considers concerns regarding public health hazards such as avian influenza and dioxin in eggs, as well as concerns regarding hen welfare and *naturalness*. Our question was whether this innovative system really addresses citizens' concerns, and

to what extent the farm visit influences citizens' opinions. Therefore, two groups of citizens were taken on a farm visit to a laying hen farm with a large covered free-range area.

This farm's barn accommodates two rows of multi-tiered aviaries and of either side of the aviary area there is a free-range area, which is covered with transparent roof plates. The free-range area is enriched with diverse materials, such as bales with Lucerne, bamboo and hiding places (See Chapter 6 for further details). Citizens' views during the farm visit to the laying hen farm with a large covered free-range area for laying hens were predominantly positive. They viewed hen health, hen welfare, public health and *naturalness* as satisfactory or even good. This suggests that this type of husbandry system, which addresses public concerns about hen welfare and public health by providing a large covered free-range area, as well as enrichment such as litter with straw, bales of chopped straw, hiding places, and grain, is a husbandry system that can count on societal support.

However, the participants in the farm visit also expressed concerns. These concerns were predominantly related to the welfare concept *leading natural lives*. The farm visit provided insight how citizen view *naturalness* in relation to keeping hens. The participants viewed *naturalness* predominantly as a *natural environment and space to move around and perform natural behaviour*. To a minor extent *naturalness* was associated with less use of medicine, such as antibiotics. According to Rozin et al. (2004a) two different perspectives on *naturalness* can be distinguished: an instrumental and a moral perspective. Based on our results we may consider the instrumental perspective to be one of not using any chemicals or medicine and this perspective is related to public health (Chapter 6; Rozin et al., 2004b; Verhoog et al., 2007). The moral perspective on *naturalness* seem to be related to animals living their lives according to their nature (Rollin, 1981; Rozin et al., 2004a). The participants of the farm visit viewed *naturalness* as a *natural environment and space to move around and perform natural behaviour* (Chapter 6), which seems a more practical approach of the moral perspective on *naturalness*. Citizens showed a strong preference for *naturalness* in relation to chicken husbandry systems, chicken welfare, public health and the judgment of a conflict between chicken welfare and public health (Chapter 2, 3, 4, and 5), which is in line with a general trend of people having strong preferences for *naturalness*, such as for natural food (Román et al., 2017). It suggests that for

citizens *naturalness* ensures good animal husbandry, good animal welfare and low public health risks.

Although the farm with a large covered free-range area provides more space per laying hen than conventional systems, space per hen and the large number of hens, especially in the aviary area, is still a subject of concern. Suggestions for improving the farm and addressing concerns are: providing a more natural environment by offering more daylight, a more natural bedding material, trees, plants or grass, and places for hens to hide or shelter (Chapter 6). With regard to the concerns related to the large number of hens, especially in the aviary area, some remarks and suggestion could be made. The hens can choose between the free-range or the aviary area, but most hens choose to be in the aviary area. Farmers could encourage hens to go to the free-range area by making the range more attractive, for example by supplying more enrichment and hiding places. These suggestions may also be incorporated into the existing indoor and outdoor husbandry systems.

Scientific knowledge indicate that outdoor systems are potentially riskier for certain hazard than are indoor systems. Citizens, however, perceive *naturalness* and outdoor access important for poultry husbandry and prefer systems that offer outdoor access to chickens (Chapter 2 to 5). The farm visit, which provided citizens with knowledge and experiences, showed that a new system that offers hens space to move around and perform natural behaviour in covered free-range area, could be an acceptable husbandry system. A farm visit is valuable because it may reduce certain concerns. However, also new concerns may come to the fore (Hötzel et al., 2017; Ryan et al., 2015; Ventura et al., 2016), such as concerns regarding the large number of chickens and the lack of natural materials (Chapter 6).

POULTRY HUSBANDRY IN THE FUTURE

The general public has expressed concerns about current intensive poultry production. To achieve successful innovations in poultry husbandry, adaptations should be based on scientific facts related to multiple issues – such as animal welfare, public health, environmental and impact – and should address concerns and convictions from citizens and professionals. Citizens do not share the professionals' views on the

preferred husbandry system, welfare evaluations of chickens, or public health risks in various husbandry systems (Chapter 2 to 4). The sector often chooses to educate the general public by providing facts, with the aim of bringing public opinions and convictions in line with those of the professionals (Benard et al., 2013; Ventura et al., 2016). However, this kind of information provision by professionals to the general public in order to resolve public concerns is questionable (Benard et al., 2013; Hansen et al., 2003; Hötzel, 2016; Hötzel et al., 2017; Sturgis et al., 2010; Weary et al., 2017). Recent research regarding the effects of providing citizen with information on their perceptions of livestock husbandry showed that perceptions of citizens changed; for some management practices they became more positive, but for other management practices they became more negative than before (Chapter 6; Hötzel et al., 2017; Ryan et al., 2015; Ventura et al., 2016).

Uninformed views gathered by means of the online questionnaire provided insight into perceptions and judgments in representative sample of the Dutch population. Based on these, a farm visit with citizens was done to get in-depth insight into the perceptions of better-informed citizens on specific aspects and on a specific husbandry system. Research regarding public perceptions may bring new concerns to the fore, because moral values and convictions regarding human and animals are changing, as are farm management practices.

In future research it would be valuable to take citizens to several farms with different husbandry systems – e.g. the four systems that were subject of research in Chapters 2 to 5 – and to study their opinions on several aspects before, during and after the visit. It would be interesting to know whether opinions change or not, to which issues these opinions change and how long these changes in opinions last. Such farm visits also provide farmers with the opportunity to get acquainted with citizens' concerns, which may help to bridge the gap between the poultry sector and the general public.

Although citizens, and professionals working in poultry husbandry have different moral convictions and judge dilemmas differently, we like to emphasize that they do share a number of fundamental moral values regarding humans and animals. When there is a conflict between opinions of citizens and professionals, these shared fundamental moral values might be a starting point for a dialogue between the two

groups. Ideally such dialogue among stakeholder groups leads to a broad agreement, which may form a common base for future poultry husbandry in society.

CONCLUSIONS

Based on this thesis the following main conclusions can be drawn:

- Citizens view outdoor husbandry systems as the preferred poultry husbandry system, while professionals – poultry farmers and poultry veterinarians – prefer indoor systems. All groups regard food safety and hen health as the most important issues for poultry husbandry and all share the same view of the importance of chicken welfare.
- Citizens and professionals evaluate hen welfare differently. Citizens predominantly consider that the concept *leading natural lives* – i.e. space to move around and perform natural behaviour – influences chicken welfare. Citizens seem to view the concept *leading natural lives* to be safeguarded best in outdoor systems. In contrast, farmers and veterinarians predominantly consider that *affective states* – i.e. pain, anxiety, stress and injuries – influences chicken welfare and may view this as being safeguarded best in indoor systems.
- Citizens and professionals who prefer outdoor systems view the welfare concept *leading natural lives* as the dominant concept of animal welfare.
- Professionals perceive the public health risks of *Campylobacter*, avian influenza and dioxin related to keeping chickens in outdoor systems as higher than in indoor systems. In contrast, citizens perceive the indoor systems as riskier than the outdoor systems.
- Farmers value moral convictions regarding *functional value of chickens, humans are superior to chickens* and *fairness* – i.e. a fair distribution of cost and responsibility regarding welfare improvement and risk prevention of public health hazards – higher than citizens, while citizens value convictions regarding *naturalness* higher than farmers do.
- Citizens judge the dilemma of improving chicken welfare or reducing public health risks predominantly in favour of chicken welfare – in terms of *leading natural lives* – while poultry farmers judge predominantly in favour of public health.
- Citizens and poultry farmers who judge the dilemma in favour of chicken welfare scored moral convictions related to *naturalness, sentience chicken*, and *intrinsic value of chickens* in particular higher than those who judged the dilemma in favour

of public health. In contrast, those who judged the dilemma in favour of public health scored the moral convictions related to *humans are superior to chickens* and *functional value of chickens* higher than those who judged the cases in favour of chicken welfare.

- The differences between citizens and professionals regarding moral convictions and judgments of the conflict between chicken welfare and public health risks could be explained by differences in weighing up of moral values, *context* – whether or not connected to poultry husbandry –, knowledge and experiences, intuitions and *affect*, and socio-demographic characteristics.
- Perceptions of husbandry systems in general, chicken welfare, public health risks and judgments of dilemmas by citizens and professionals are influenced by intuitive feelings, also referred to as *affect*.
- In the context of poultry husbandry citizens have a strong preference for *naturalness*.
- Citizens' concerns related to public health, and chicken welfare, as well as concerns related to *naturalness* can be addressed in a laying hen farm with a large covered free-range area.

REFERENCES

- Aertsens, J., Verbeke, W., Mondelaers, K., & van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: A review. *British Food Journal*, *111*(10), 1140-1167. doi:10.1108/00070700910992961
- Beauchamp, T. L., & Childress, J. F. (2009). *Principles of biomedical ethics* (6th ed.). New York / Oxford: Oxford University Press.
- Benard, M., & de Cock Buning, T. (2013). Exploring the Potential of Dutch Pig Farmers and Urban-Citizens to Learn Through Frame Reflection. *Journal of Agricultural and Environmental Ethics*, *26*(5), 1015-1036. doi:10.1007/s10806-013-9438-y
- Bennett, R. M., Anderson, J., & Blaney, R. J. P. (2002). Moral intensity and willingness to pay concerning farm animal welfare issues and the implications for agricultural policy. *Journal of Agricultural and Environmental Ethics*, *15*(2), 187-202.
- Bergstra, T. J., Gremmen, B., & Stassen, E. N. (2015). Moral Values and Attitudes Toward Dutch Sow Husbandry. *Journal of Agricultural and Environmental Ethics*, *28*(2), 375-401. doi:10.1007/s10806-015-9539-x
- Bergstra, T. J., Hogeveen, H., Erno Kuiper, W., Oude Lansink, A. G. J. M., & Stassen, E. N. (2017a). Attitudes of Dutch Citizens toward Sow Husbandry with Regard to Animals, Humans, and the Environment. *Anthrozoös*, *30*(2), 195-211. doi:10.1080/08927936.2017.1310985
- Bergstra, T. J., Hogeveen, H., & Stassen, E. N. (2017b). Attitudes of different stakeholders toward pig husbandry: a study to determine conflicting and matching attitudes toward animals, humans and the environment. *Agriculture and Human Values*, *34*(2), 393-405. doi:10.1007/s10460-016-9721-4
- Bestman, M., & Wagenaar, J. P. (2014). Health and welfare in Dutch organic laying hens. *Animals*, *4*(2), 374-390. doi:10.3390/ani4020374
- Blok, V., & Lemmens, P. (2015). The Emerging Concept of Responsible Innovation. Three Reasons Why It Is Questionable and Calls for a Radical Transformation of the Concept of Innovation. In B.-J. Koops, I. Oosterlaken, H. Romijn, T. Swierstra, & J. van den Hoven (Eds.), *Responsible Innovation 2: Concepts, Approaches, and Applications* (pp. 19-35). Cham: Springer International Publishing.
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2006). Elements of societal perception of farm animal welfare: A quantitative study in The Netherlands. *Livestock Science*, *104*(1-2), 13-22. doi:10.1016/j.livsci.2006.02.010
- Boogaard, B. K., Oosting, S. J., & Bock, B. B. (2008). Defining sustainability as a socio-cultural concept: Citizen panels visiting dairy farms in the Netherlands. *Livestock Science*, *117*(1), 24-33.
- Boogaard, B. K., Bock, B. B., Oosting, S. J., Wiskerke, J. S. C., & van der Zijpp, A. J. (2011a). Social Acceptance of Dairy Farming: The Ambivalence Between the Two Faces of Modernity. *Journal of Agricultural and Environmental Ethics*, *24*(3), 259-282.
- Boogaard, B. K., Oosting, S. J., Bock, B. B., & Wiskerke, J. S. C. (2011b). The sociocultural sustainability of livestock farming: An inquiry into social perceptions of dairy farming. *Animal*, *5*(9), 1458-1466. doi:10.1017/S1751731111000371
- Bracke, M. B. M., de Greef, K. H., & Hopster, H. (2005). Qualitative stakeholder analysis for the development of sustainable monitoring systems for farm animal welfare. *Journal of Agricultural and Environmental Ethics*, *18*(1), 27-56. doi:10.1007/s10806-004-3085-2
- Broom, D. M. (1991). Animal welfare: concepts and measurement. *Journal of Animal Science*, *69*(10), 4167-4175.
- Broom, D. M. (2007). Quality of life means welfare: how is it related to other concepts and assessed? *Animal Welfare*, *16*, 45-53.
- Bruijnis, M. R. N., Blok, V., Stassen, E. N., & Gremmen, H. G. J. (2015). Moral "Lock-In" in Responsible Innovation: The Ethical and Social Aspects of Killing Day-Old Chicks and

- Its Alternatives. *Journal of Agricultural and Environmental Ethics*, 28(5), 939-960. doi:10.1007/s10806-015-9566-7
- Bruijnis, M. R. N., Meijboom, F. L. B., & Stassen, E. N. (2013). Longevity as an Animal Welfare Issue Applied to the Case of Foot Disorders in Dairy Cattle. *Journal of Agricultural and Environmental Ethics*, 26(1), 191-205.
- CBS Statistics Netherlands, (2018). Landbouw; biologisch en/of in omschakeling; gewassen, dieren, nationaal. Retrieved 04-04-2018
<http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=81517NED&D1=176,244,272,315,338,342,367-378&D2=a&D3=a&HDR=G1&STB=T,G2&VW=T>
- Clark, B., Stewart, G. B., Panzone, L. A., Kyriazakis, I., & Frewer, L. J. (2017). Citizens, consumers and farm animal welfare: A meta-analysis of willingness-to-pay studies. *Food Policy*, 68(Supplement C), 112-127. doi:<https://doi.org/10.1016/j.foodpol.2017.01.006>
- Cohen, N. E. (2010). General discussion Thesis: *Considering animals. Moral convictions concerning animals and judgement on the culling of healthy animals in animal disease epidemics*. Wageningen, the Netherlands: Wageningen University.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2009). Fundamental Moral Attitudes to Animals and Their Role in Judgment: An Empirical Model to Describe Fundamental Moral Attitudes to Animals and Their Role in Judgment on the Culling of Healthy Animals During an Animal Disease Epidemic. *Journal of Agricultural and Environmental Ethics*, 22(4), 341-359. doi:10.1007/s10806-009-9157-6
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2010). Moral convictions about animals and the culling of healthy animals in animal disease epidemics. An empirical survey among farmers and veterinarians. In PhD-thesis: *Considering animals. Moral convictions concerning animals and judgement on the culling of healthy animals in animal disease epidemics*. Wageningen, the Netherlands: Wageningen University.
- Cohen, N. E., Brom, F. W. A., & Stassen, E. N. (2012). Moral Convictions and Culling Animals: A Survey in the Netherlands. *Anthrozoös*, 25(3), 353-367. doi:10.2752/175303712x13403555186334
- Cohen, N. E., & Stassen, E. N. (2016). Public moral convictions about animals in the Netherlands: culling healthy animals as a moral problem. In F. L. B. Meijboom & E. N. Stassen (Eds.), *The end of animal life: a start for ethical debate*. Wageningen: Wageningen Academic publishers.
- Driessen, C. (2012). Farmers Engaged in Deliberative Practices; An Ethnographic Exploration of the Mosaic of Concerns in Livestock Agriculture. *Journal of Agricultural and Environmental Ethics*, 25(2), 163-179. doi:10.1007/s10806-010-9293-z
- EFSA. (2011). Scientific Opinion on Campylobacter in broiler meat production: control options and performance objectives and/or targets at different stages of the food chain. *EFSA Journal*, 9(4), 2105. doi:10.2903/j.efsa.2011.2105
- EFSA. (2012). Update of the monitoring of levels of dioxins and PCBs in food and feed. *EFSA Journal*, 10(7), 82. doi:10.2903/j.efsa.2012.2832
- EFSA Panel on Animal Health and Welfare, More, S., Bicot, D., Bøtner, A., Butterworth, A., Calistri, P., . . . Stegeman, J. A. (2017). Avian influenza. *EFSA Journal*, 15(10), 4991. doi:10.2903/j.efsa.2017.4991
- Eurobarometer. (2005). *Attitudes of consumers towards the welfare of farmed animals* (229). Retrieved from Brussels, Belgium:
http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_229_en.pdf
- Eurobarometer. (2007). *Attitudes of consumers towards the welfare of farmed animals* (270). Retrieved from
http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_270_en.pdf
- Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000a). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13(1), 1-17.

- Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000b). Gender, race, and perceived risk: The 'white male' effect. *Health, Risk and Society*, 2(2), 170-172.
- Fraser, D. (1995). Science, Values and Animal Welfare: Exploring the 'Inextricable Connection'. *Animal Welfare*, 4(2), 103-117.
- Fraser, D. (1999). Animal ethics and animal welfare science: Bridging the two cultures. *Applied Animal Behaviour Science*, 65(3), 171-189.
- Fraser, D. (2003). Assessing animal welfare at the farm and group level: the interplay of science and values. *Animal Welfare*, 12(4), 433-443.
- Fraser, D. (2009). Assessing animal welfare: Different philosophies, different scientific approaches. *Zoo Biology*, 28(6), 507-518.
- Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare*, 6(3), 187-205.
- Freire, R., & Cowling, A. (2013). The welfare of laying hens in conventional cages and alternative systems: First steps towards a quantitative comparison. *Animal Welfare*, 22(1), 57-65. doi:10.7120/09627286.22.1.057
- Gocsik, É., van der Lans, I. A., Lansink, A. G. J. M. O., & Saatkamp, H. W. (2016). Elicitation of preferences of Dutch broiler and pig farmers to support decision making on animal welfare. *NJAS - Wageningen Journal of Life Sciences*, 76, 75-86. doi:10.1016/j.njas.2015.11.006
- Gocsik, É., Van Der Lans, I. A., Oude Lansink, A. G. J. M., & Saatkamp, H. W. (2015). Willingness of Dutch broiler and pig farmers to convert to production systems with improved welfare. *Animal Welfare*, 24(2), 211-222. doi:10.7120/09627286.24.2.211
- Gonzales, J. L., Stegeman, J. A., Koch, G., de Wit, S. J., & Elbers, A. R. W. (2013). Rate of introduction of a low pathogenic avian influenza virus infection in different poultry production sectors in the Netherlands. *Influenza and other Respiratory Viruses*, 7(1), 6-10. doi:10.1111/j.1750-2659.2012.00348.x
- Gremmen, B., Bruijnij, M. R. N., Blok, V., & Stassen, E. N. (2018). A Public Survey on Handling Male Chicks in the Dutch Egg Sector. *Journal of Agricultural and Environmental Ethics*. doi:10.1007/s10806-018-9712-0
- Hansen, J. W., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, 41(2), 111-121. doi:10.1016/S0195-6663(03)00079-5
- Harper, G. C., & Henson, S. (2001). *Consumer concerns about animal welfare and the impact on food choice* (Final report). Retrieved from http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf
- Harper, G. C., & Makatouni, A. (2002). Consumer perception of organic food production and farm animal welfare. *British Food Journal*, 104(3-5), 287-299. doi:10.1108/00070700210425723
- Harvey, D., & Hubbard, C. (2013). Reconsidering the political economy of farm animal welfare: An anatomy of market failure. *Food Policy*, 38(1), 105-114. doi:10.1016/j.foodpol.2012.11.006
- Heeger, R., & Brom, F. W. A. (2001). Intrinsic Value and Direct Duties: From Animal Ethics towards Environmental Ethics? *Journal of Agricultural and Environmental Ethics*, 14(2), 241-252. doi:10.1023/a:1011319921159
- Hötzel, M. J. (2016). Letter to the editor: Engaging (but not “educating”) the public in technology developments may contribute to a socially sustainable dairy industry *Journal of Dairy Science*, 99(9), 6853-6854. doi:10.3168/jds.2016-11393
- Hötzel, M. J., Cardoso, C. S., Roslindo, A., & von Keyserlingk, M. A. G. (2017). Citizens' views on the practices of zero-grazing and cow-calf separation in the dairy industry: Does providing information increase acceptability? *Journal of Dairy Science*, 100(5), 4150-4160. doi:10.3168/jds.2016-11933
- Jensen, K. K., Forsberg, E., Gamborg, C., Millar, K., & Sandøe, P. (2011). Facilitating Ethical Reflection Among Scientists Using the Ethical Matrix. *Science and Engineering Ethics*, 17(3), 425-445. doi:10.1007/s11948-010-9218-2

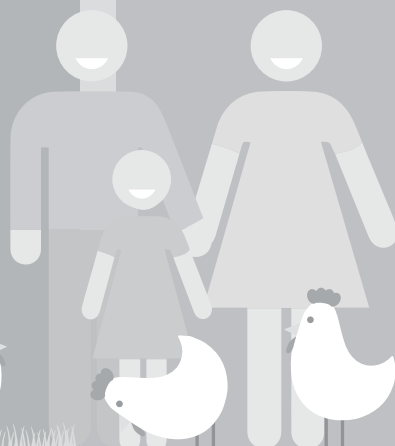
- Kendall, H. A., Lobao, L. M., & Sharp, J. S. (2006). Public concern with animal well-being: Place, social structural location, and individual experience. *Rural Sociology*, 71(3), 399-428. doi:10.1526/003601106778070617
- Kijlstra, A., Meerburg, B. G., & Bos, A. P. (2009). Food Safety in Free-Range and Organic Livestock Systems: Risk Management and Responsibility. *Journal of Food Protection*, 72(12), 2629-2637.
- Knierim, U. (2006). Animal welfare aspects of outdoor runs for laying hens: A review. *NJAS - Wageningen Journal of Life Sciences*, 54(2), 133-145.
- Knight, S., Vrij, A., Cherryman, J., & Nunkoosing, K. (2004). Attitudes towards animal use and belief in animal mind. *Anthrozoös*, 17(1), 43-62.
- Knight, S., & Barnett, L. (2008). Justifying attitudes toward animal use: A qualitative study of people's views and beliefs. *Anthrozoös*, 21(1), 31-42.
- Lagerkvist, C. J., & Hess, S. (2011). A meta-analysis of consumer willingness to pay for farm animal welfare. *European Review of Agricultural Economics*, 38(1), 55-78. doi:10.1093/erae/jbq043
- Lassen, J., Sandøe, P., & Forkman, B. (2006). Happy pigs are dirty! - conflicting perspectives on animal welfare. *Livestock Science*, 103(3), 221-230. doi:10.1016/j.livsci.2006.05.008
- Lay Jr, D. C., Fulton, R. M., Hester, P. Y., Karcher, D. M., Kjaer, J. B., Mench, J. A., . . . Porter, R. E. (2011). Hen welfare in different housing systems. *Poultry Science*, 90(1), 278-294. doi:10.3382/ps.2010-00962
- Meijboom, F. L. B. (2018). More Than Just a Vet? Professional Integrity as an Answer to the Ethical Challenges Facing Veterinarians in Animal Food Production. *Food Ethics*, 1(3), 209-220. doi:10.1007/s41055-017-0019-z
- Mepham, B. (2000). A framework for the ethical analysis of novel foods: The ethical matrix. *Journal of Agricultural and Environmental Ethics*, 12(2), 165-176.
- Michalopoulos, T., Korthals, M., & Hogeveen, H. (2008). Trading "ethical preferences" in the market: Outline of a politically liberal framework for the ethical characterization of foods. *Journal of Agricultural and Environmental Ethics*, 21(1), 3-27.
- Miele, M. (2011). The taste of happiness: Free-range chicken. *Environment and Planning A*, 43(9), 2076-2090. doi:10.1068/a43257
- Mulder, M., & Zomer, S. (2017). Dutch Consumers' Willingness to Pay for Broiler Welfare. *Journal of Applied Animal Welfare Science*, 20(2), 137-154. doi:10.1080/10888705.2017.1281134
- Rollin, B. E. (1981). *Animal rights and human morality*: Prometheus Books.
- Román, S., Sánchez-Siles, L. M., & Siegrist, M. (2017). The importance of food naturalness for consumers: Results of a systematic review. *Trends in Food Science and Technology*, 67, 44-57. doi:10.1016/j.tifs.2017.06.010
- Rozin, P., Spranca, M., Krieger, Z., Neuhaus, R., Surillo, D., Swerdlin, A., & Wood, K. (2004a). Preference for natural: instrumental and ideational/moral motivations, and the contrast between foods and medicines. *Appetite*, 43(2), 147-154. doi:10.1016/j.appet.2004.03.005
- Rozin, P., Spranca, M., Krieger, Z., Neuhaus, R., Surillo, D., Swerdlin, A., & Wood, K. (2004b). Preference for natural: instrumental and ideational/moral motivations, and the contrast between foods and medicines. *Appetite*, 43(2), 147-154. doi:https://doi.org/10.1016/j.appet.2004.03.005
- Schoeters, G., & Hoogenboom, R. (2006). Contamination of free-range chicken eggs with dioxins and dioxin-like polychlorinated biphenyls. *Molecular Nutrition & Food Research*, 50(10), 908-914. doi:10.1002/mnfr.200500201
- Shimmura, T., Bracke, M. B. M., De Mol, R. M., Hirahara, S., Uetake, K., & Tanaka, T. (2011). Overall welfare assessment of laying hens: Comparing science-based, environment-based and animal-based assessments. *Animal Science Journal*, 82(1), 150-160. doi:10.1111/j.1740-0929.2010.00834.x

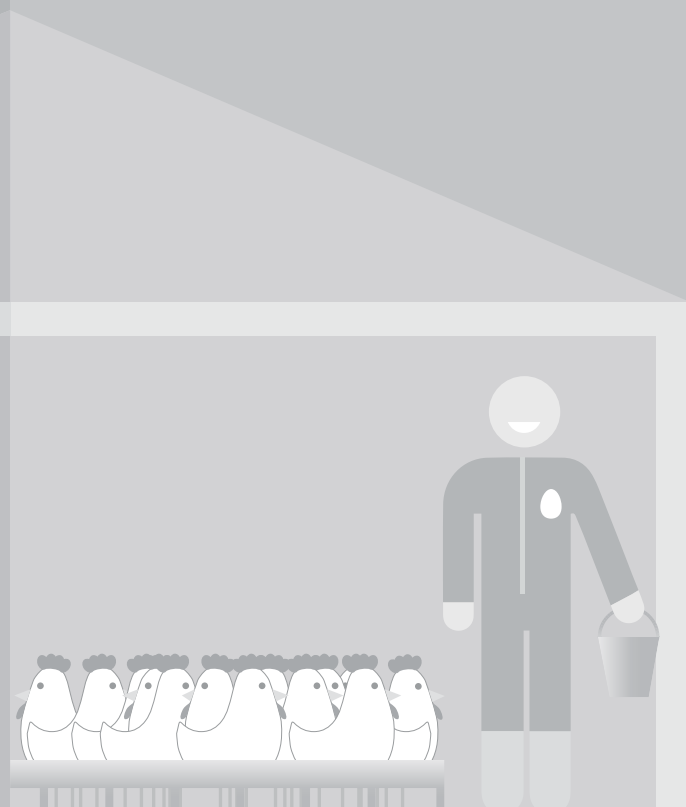
- Shimmura, T., Hirahara, S., Azuma, T., Suzuki, T., Eguchi, Y., Uetake, K., & Tanaka, T. (2010). Multi-factorial investigation of various housing systems for laying hens. *British Poultry Science*, 51(1), 31-42. doi:10.1080/0007166090342116
- Slovic, P. (1999). Trust, emotion, sex, politics, and science: Surveying the risk- assessment battlefield. *Risk Analysis*, 19(4), 689-701. doi:10.1023/A:1007041821623
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177(3), 1333-1352. doi:10.1016/j.ejor.2005.04.006
- Stadig, L. M., Ampe, B. A., Van Gansbeke, S., Van Den Bogaert, T., D'Haenens, E., Heerkens, J. L. T., & Tuytens, F. A. M. (2016). Survey of egg farmers regarding the ban on conventional cages in the EU and their opinion of alternative layer housing systems in Flanders, Belgium. *Poultry Science*, 95(3), 715-725. doi:10.3382/ps/pev334
- Sturgis, P., Brunton-Smith, I., & Fife-Schaw, C. (2010). Public attitudes to genomic science: An experiment in information provision. *Public Understanding of Science*, 19(2), 166-180. doi:10.1177/0963662508093371
- Tannenbaum, J. (1991). Ethics and animal welfare: The inextricable connection. *Journal of the American Veterinary Medical Association*, 198(8), 1360.
- Te Velde, H., Aarts, N., & Van Woerkum, C. (2002). Dealing with ambivalence: Farmers' and consumers' perceptions of animal welfare in livestock breeding. *Journal of Agricultural and Environmental Ethics*, 15(2), 203-219. doi:10.1023/A:1015012403331
- Thompson, P. B., Appleby, M., Busch, L., Kalof, L., Miele, M., Norwood, B. F., & Pajor, E. (2011). Values and public acceptability dimensions of sustainable egg production. *Poultry Science*, 90(9), 2097-2109. doi:10.3382/ps.2010-0138
- Tuytens, F. A. M., Vanhonacker, F., Van Poucke, E., & Verbeke, W. (2010). Quantitative verification of the correspondence between the Welfare Quality® operational definition of farm animal welfare and the opinion of Flemish farmers, citizens and vegetarians. *Livestock Science*, 131(1), 108-114. doi:10.1016/j.livsci.2010.03.008
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians. In D. E. Dumitras, I. M. Jitea, & S. Aerts (Eds.), *Know your food. Food ethics and innovation*. (pp. 138-143). Wageningen: Wageningen Academic Publishers Books.
- Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2017, 5-8 september). *Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians*. Paper presented at the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level, Ede, the Netherlands.
- Van den Heuvel, T., Renes, R. J., Gremmen, B., Van Woerkum, C., & Van Trijp, H. (2008). Consumers' images regarding genomics as a tomato breeding technology: "Maybe it can provide a more tasty tomato". *Euphytica*, 159(1-2), 207-216. doi:10.1007/s10681-007-9474-7
- Van der Burg, W. V. W., T. . (1998). *Reflective equilibrium: Essays in Honour of Robert Heeger*. Dordrecht, Boston, London: Kluwer Academic Publishers.
- Van Wijk-Jansen, E., Ronteltap, A., & Jager, L. (2009). *Het gezonde van biologisch voedsel: de beleving van consumenten* (908615381X). Retrieved from
- Vanhonacker, F., Tuytens, F. A. M., & Verbeke, W. (2016). Belgian citizens' and broiler producers' perceptions of broiler chicken welfare in Belgium versus Brazil. *Poultry Science*, 95(7), 1555-1563. doi:10.3382/ps/pew059
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuytens, F. A. M. (2007). Segmentation based on consumers' perceived importance and attitude toward farm animal welfare. *International Journal of Sociology of Food and Agriculture*, 15(3), 91-107.
- Vanhonacker, F., & Verbeke, W. (2009a). Buying higher welfare poultry products? Profiling flemish consumers who do and do not. *Poultry Science*, 88(12), 2702-2711.

- Vanhonacker, F., Verbeke, W., Van Poucke, E., Buijs, S., & Tuyttens, F. A. M. (2009b). Societal concern related to stocking density, pen size and group size in farm animal production. *Livestock Science*, *123*(1), 16-22. doi:10.1016/j.livsci.2008.09.023
- Vanhonacker, F., Verbeke, W., Van Poucke, E., & Tuyttens, F. A. M. (2008). Do citizens and farmers interpret the concept of farm animal welfare differently? *Livestock Science*, *116*(1-3), 126-136. doi:10.1016/j.livsci.2007.09.017
- Ventura, B. A., von Keyserlingk, M. A. G., & Weary, D. M. (2014). Animal Welfare Concerns and Values of Stakeholders Within the Dairy Industry. *Journal of Agricultural and Environmental Ethics*, *28*(1), 109-126. doi:10.1007/s10806-014-9523-x
- Ventura, B. A., von Keyserlingk, M. A. G., Wittman, H., & Weary, D. M. (2016). What Difference Does a Visit Make? Changes in Animal Welfare Perceptions after Interested Citizens Tour a Dairy Farm. *PLoS ONE*, *11*(5), e0154733. doi:10.1371/journal.pone.0154733
- Verbeke, W. A. J., & Viaene, J. (2000). Ethical Challenges for Livestock Production: Meeting Consumer Concerns about Meat Safety and Animal Welfare. *Journal of Agricultural and Environmental Ethics*, *12*(2), 141-151. doi:10.1023/a:1009538613588
- Verhoog, H., Lammerts Van Bueren, E. T., Matze, M., & Baars, T. (2007). The value of 'naturalness' in organic agriculture. *NJAS - Wageningen Journal of Life Sciences*, *54*(4), 333-345. doi:10.1016/S1573-5214(07)80007-8
- Vermeir, I., & Verbeke, W. (2006). Sustainable food consumption: Exploring the consumer "attitude - Behavioral intention" gap. *Journal of Agricultural and Environmental Ethics*, *19*(2), 169-194.
- Von Schomberg, R. (2013). A vision of responsible innovation. In R. Owen, M. Heintz, & J. Bessant (Eds.), *Responsible innovation: Managing the responsible emergence of science and innovation in society*. London: John Wiley & Sons. doi:10.1002/9781118551424.ch3
- Warren, M. A. (1997). *Moral status: Obligations to persons and other living things*: Oxford University Press, USA.
- Weary, D. M., Ventura, B. A., & Von Keyserlingk, M. A. G. (2016). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal*, *10*(2), 309-317. doi:10.1017/S1751731115001160
- Weary, D. M., & Von Keyserlingk, M. A. G. (2017). Public concerns about dairy-cow welfare: How should the industry respond? *Animal Production Science*, *57*(7), 1201-1209. doi:10.1071/AN16680
- Woelders, H., Brom, F. W. A., & Hopster, H. (2007). *Alternatieven voor doding eendagskuikens—Technologische perspectieven en ethische consequenties*. Rapport 4444. Lelystad. Retrieved from: <https://library.wur.nl/WebQuery/wurpubs/fulltext/45674>



Appendices





Summary

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SUMMARY

Since the 1950s poultry husbandry has changed from keeping chickens in backyard flocks to keeping large numbers of chickens in confined systems on specialised farms in order to ensure ample food. In those systems chickens were mainly valued for their productivity. Over time, moral convictions regarding animals have changed, which has led to societal concerns about the welfare of animals kept in these intensive husbandry systems. As a result, alternative poultry husbandry systems have been introduced, which no longer focus primarily on production output, but also on chicken welfare. Alternative systems, especially those systems offering outdoor access to chickens, are potentially better for chicken welfare, because chickens have more space and opportunities to express natural behaviour. However, keeping chickens in these alternative systems is also associated with higher public health and food safety risks for certain hazards, such as *Campylobacter* contamination of broiler meat, avian influenza introduction in laying hen flocks, and increased dioxin levels in eggs. It implies that the demand for poultry husbandry systems that are potentially beneficial for chicken welfare may conflict with the demand for systems with low public health risks and producing safe chicken products.

For successful innovation of poultry husbandry systems that can count on societal support, interaction is needed between society and the poultry sector. Therefore, insight is needed into the views of key stakeholder groups – citizens, poultry farmers and poultry veterinarians – concerning poultry husbandry. The main objective of this thesis was to study stakeholders' views on the conflict between chicken welfare and public health and food safety risks and relevant moral arguments and convictions. Therefore, the subsequent chapters of this thesis presented the perceptions of three stakeholder groups regarding hen husbandry systems, hen welfare, public health and food safety risks, moral convictions, and opinions on the dilemma of improving chicken welfare or reducing public health risks. Moreover, citizens views during a farm visit to an innovative husbandry system that addresses concerns regarding hen welfare and public health risks were presented.

The first part of the thesis is based on an online questionnaire, which was filled out by representatives of the three stakeholder groups: citizens (n = 2259), poultry farmers (n = 100) and poultry veterinarians (n = 41). The questionnaire was based on a

literature review, public debates on hen husbandry, and input from a consulting group. It included questions on the preferred hen husbandry system and the importance of husbandry issues, knowledge of poultry husbandry, perceptions of chicken welfare, risk perceptions of public health hazards, three cases representing the dilemma of improving chicken welfare or reducing public health risks, moral convictions and arguments relevant to the dilemma, and socio-demographic characteristics.

Chapter 2 presented the perceptions of citizens, poultry farmers and poultry veterinarians of the preferred system for laying hen husbandry and the importance of 10 issues of hen husbandry. Participants were asked which system was the best systems for hen husbandry in their opinion. They could choose from the most commonly used hen husbandry systems in the Netherlands – *colony cages, non-cage indoor system, free-range or an organic system with outdoor access* –. Most citizens perceived an outdoor system, either a free-range system (51%) or an organic system (22%) as the preferred system. In contrast, the majority of poultry farmers and poultry veterinarians perceived an indoor system, either indoor non-cage system (51% and 50% respectively) or colony cages (28% and 44% respectively), as the preferred husbandry system. With regard to the importance of the 10 issues of hen husbandry, all stakeholder groups regarded ‘food safety’ and ‘hen health’ as the most important issues for poultry husbandry. The three groups perceived ‘hen welfare’ as equally important. Compared to farmers and veterinarians, citizens perceived the issues ‘natural needs of hens’ and ‘environmentally friendly’ as more important, and the issues ‘hen health’, ‘farmer income’ and ‘hens lay many eggs’ as less important. Citizens who preferred an outdoor husbandry system, perceive the issues ‘hen health’, ‘hen welfare’, ‘natural needs of hens’ and ‘environmentally friendly’ as more important, and ‘cheap eggs’, ‘farmer income’ and ‘hens lay many eggs’ as less important than citizens who prefer indoor systems.

Chapter 3 presented the stakeholders’ perceptions of laying hen welfare in four husbandry systems – *colony cages, non-cage indoor system, free-range and an organic system with outdoor access* – and their perceptions of chicken welfare aspects. Citizens perceived hen welfare in an organic husbandry system as being the highest of the four husbandry systems, while farmers and veterinarians perceived hen welfare in an indoor non-cage system as the highest. Differences between the welfare scores given by citizens and those given by the two professional groups could be explained by

different perceptions of hen welfare aspects, knowledge regarding hen behaviour and socio-demographic characteristics. Compared to the professionals, citizens perceived the influence on welfare of aspects related to natural behaviour as higher and of the influence of the aspects pain, and anxiety or stress as lower. This seemed to clarify citizens' high welfare scores for the outdoor systems and the professionals' high welfare scores for the indoor systems. Based on their scores for hen welfare aspects, four different clusters of citizens could be distinguished: a *Low concern*, *Moderate concern*, *High concern* and *Diverse* cluster. Compared to the other clusters, citizens in the *High concern* cluster were more often female, between 25 and 44 years, more highly educated, they more often had pets, consumed meat less frequently, and more often donate to animal welfare or nature organisations. The *High concern* cluster gave lower scores for the welfare of hens kept in the colony cage system and higher scores for the welfare of hens in the organic system than the other three clusters. It was concluded that professionals and citizens evaluate hen welfare differently. Citizens predominantly consider that the concept *leading natural lives* influences chicken welfare, while farmers and veterinarians predominantly consider that *affective states* – i.e. pain, anxiety, stress and injuries – influences chicken welfare.

Risk perceptions of public health and food safety hazards in various poultry husbandry systems may affect the acceptability of those systems. Therefore, in Chapter 4 we studied stakeholders' perceptions of *Campylobacter* contamination of broiler meat, avian influenza introduction in laying hens, and altered dioxin levels in eggs for the most commonly used broiler and laying hen husbandry systems, and factors explaining these risk perceptions. Compared to the two professional groups, citizens perceived the risks of the three hazards to be higher in the indoor systems and lower in the outdoor systems. Citizens reported higher concerns regarding various factors of risk perception – i.e. *unknownness*, *trust*, *severity*, *voluntariness*, *type of hazard* and *personal control* – than the two professional groups did. Poultry farmers and veterinarians might have an optimistic bias regarding the public health risks related to poultry farms and with that seem to deny risks for public health. The socio-demographic characteristics of the citizens were associated with risk perceptions. Female respondents compared to male respondents and respondents who consumed meat once a week or less compared to those who ate meat more often perceived the risks of the three hazards in indoor systems to be higher. Respondents who grew up on a farm more often gave lower scores for the risks of indoor systems and higher scores

for those of outdoor systems than respondents who did not grow up on a farm. It was concluded that professionals perceive the public health risks of *Campylobacter*, avian influenza and dioxin related to keeping chickens in outdoor systems as higher than in indoor systems, while citizens perceive the indoor systems as riskier than the outdoor systems. We suggest that risk perceptions of all stakeholder groups are influenced by intuitive feelings – *affect* – and underlying values.

Welfare-friendly outdoor poultry husbandry systems are associated with potentially higher public health risks for certain hazards, such as *Campylobacter*, avian influenza and dioxin. This gives rise to a dilemma: whether to improve chicken welfare or reduce these public health risks. In Chapter 5 we studied the views of citizens and poultry farmers in judging this dilemma, as well as relevant moral arguments and moral convictions, in a practical context. Citizens and poultry farmers judged three practical cases that illustrate a conflict between chicken welfare and public health risks for *Campylobacter*, avian influenza and dioxin. Furthermore, participants scored the importance of moral arguments and to what extent they agreed with moral convictions related to humans and chickens. Citizens judged the dilemma of improving chicken welfare or reducing public health risks predominantly in favour of chicken welfare, in terms of leading natural lives, while poultry farmers judged it predominantly in favour of public health. Different valuations of moral arguments and convictions, predominantly those regarding the *value of chickens* and *naturalness*, could explain the various judgments. Farmers valued moral convictions regarding *functional value of chickens*, *humans are superior to chickens* and *fairness* – i.e. a fair distribution of cost and responsibility regarding welfare improvement and risk prevention of public health hazards – higher than citizens, while citizens valued convictions regarding *naturalness* higher than farmers did. Regarding all stakeholders, the group of people who judged the dilemma in favour of chicken welfare scored moral convictions related to *naturalness*, *sentience chicken*, and *intrinsic value of chickens*, in particular, higher than those who judged the cases in favour of public health. In contrast, those who judged the cases in favour of public health scored the moral convictions related to *humans are superior to chickens* and *functional value of chickens* higher than those who judged the cases in favour of chicken welfare. We argued that the stakeholders' judgments depend on their *context*, i.e. whether or not they are involved in poultry farming.

Concerns of the general public regarding animal welfare and public health in relation to livestock husbandry seem predominantly related to *naturalness*. What citizens consider to be natural and how they view an innovative hen husbandry system that takes account of concerns about *naturalness*, hen welfare and public health, is not clear. Therefore, during a farm visit, views of citizens on an innovative laying hen husbandry system with an indoor aviary system and a large covered free-range area, as well as related aspects, such as hen welfare, hen health and public health risks, were studied. Two groups of nine participants filled out a questionnaire, partly before and partly while seeing the hens in the husbandry system. Results showed that participants were predominantly positive regarding the systems in general, and regarding hen health, hen welfare and public health risks, and the large covered free-range area. However, participants expressed concerns about the space chickens have to move around and perform natural behaviour, and these concerns were predominantly related to the aviary section. This confirms that citizens focus on the welfare concept *leading natural lives*. The participants' views on *naturalness* could be described as "*a natural environment with space to move around and express natural behaviour*". Suggestions for improving hen husbandry systems in accordance with citizens' concerns for the aviary section are: lower stocking densities, a less industrial design, more daylight and the use of straw as bedding material. Based on the views of the participants, we suggest that husbandry systems in general could implement some enrichment for hens, such as bales of Lucerne, hiding places, and green plants or trees. It was concluded that citizens' concerns related to public health, chicken welfare and *naturalness* could be addressed in a free-range system with a large covered free-range area.

Chapter 7 discussed and synthesised the results of the preceding chapters. We explained the different views of citizens and professionals – poultry farmers and poultry veterinarians – regarding perceptions, moral convictions and judgments. Finally, the implications of this study for future poultry husbandry were discussed. We concluded that differences in views are influenced by:

- differences in perceptions of chicken welfare
- differences perceptions of public health risks of various chicken husbandry systems
- differences in moral convictions related to chicken welfare and husbandry systems

- differences in weighing up of moral values
- *context*, i.e. whether or not someone is involved in poultry farming
- *affect* and intuition
- knowledge and experiences related to poultry farming
- socio-demographic characteristics

SAMENVATTING

De vraag naar voldoende voedsel heeft ertoe geleid dat de pluimveehouderij na 1950 is veranderd van het houden van kleine koppels kippen op het erf naar het binnenhouden van grote aantallen kippen op gespecialiseerde pluimveebedrijven. De kippen op deze intensieve bedrijven werden vooral gewaardeerd voor hun productiviteit. Na verloop van tijd zijn de morele overtuigingen met betrekking tot dieren veranderd en dat leidde tot maatschappelijke zorgen over het welzijn van dieren in deze intensive houderijsystemen. Mede daarom werden alternatieve pluimveehouderijsystemen geïntroduceerd, waarin de focus niet alleen ligt op hoge productie, maar ook op het welzijn van de kippen. Alternatieve houderijsystemen, zoals systemen die kippen een vrije uitloop naar buiten bieden, zijn potentieel beter voor het welzijn van de kippen, omdat de kippen meer ruimte en mogelijkheden hebben om natuurlijk gedrag uit te oefenen. Echter, deze alternatieve houderijsystemen worden ook geassocieerd met hogere volksgezondheids- en voedselveiligheidsrisico's voor bepaalde gezondheidsgevaren, zoals *Campylobacter* contaminatie van kippenvlees, introductie van aviaire influenza in leghennen, en verhoogde dioxinegehalten in eieren. De vraag naar pluimveehouderijsystemen die potentieel beter zijn voor het welzijn van kippen kan dus conflicteren met de vraag naar houderijsystemen die veilige kipproducten produceren en lage volksgezondheidsrisico's opleveren.

Voor succesvolle innovaties in de pluimveehouderij die op maatschappelijke steun kunnen rekenen is input nodig vanuit de maatschappij. Inzicht in de percepties van de belangrijkste stakeholdergroepen – burgers, pluimveehouders en -dierenartsen – over de pluimveehouderij geeft kennis die bij kan dragen aan succesvolle innovaties. Het doel van deze thesis was het bestuderen van de percepties van stakeholdergroepen van het conflict tussen het welzijn van kippen en volksgezondheids- en voedselveiligheidsrisico's, en relevante morele overtuigingen en argumenten. Daarom presenteren de opeenvolgende hoofdstukken van deze thesis de percepties van drie stakeholdergroepen ten aanzien van houderijsystemen voor leghennen, het welzijn van leghennen, volksgezondheids- en voedselveiligheidsrisico's, morele overtuigingen en oordelen over het dilemma of het welzijn van kippen moet worden verbeterd of volksgezondheidsrisico's moeten worden verlaagd. Daarnaast zijn de percepties van burgers tijdens een bezoek aan een innovatief houderijsysteem dat tegemoetkomt aan

zorgen ten aanzien van het welzijn van leghennen en volksgezondheidsrisico's gepresenteerd.

Het eerste deel van deze thesis is gebaseerd op een online vragenlijst die is ingevuld door vertegenwoordigers van de drie stakeholdergroepen: burgers (n = 2259), pluimveehouders (n = 100) en pluimveedierenartsen (n = 41). De vragenlijst was gebaseerd op literatuuronderzoek, het publieke debat over de pluimveehouderij, en input van een klankbordgroep. De vragenlijst bevatte vragen over welk houderijsysteem men het beste vond, het belang van verschillende issues, kennis van de pluimveehouderij, percepties van het welzijn van kippen, risicopercepties van volksgezondheidsgevaaren, drie casussen over het dilemma of het welzijn van kippen moet worden verbeterd of volksgezondheidsrisico's moeten worden verlaagd, morele overtuigingen en argumenten relevant voor het dilemma, en socio-demografische kenmerken.

Hoofdstuk 2 presenteert de percepties van burgers, pluimveehouders en -dierenartsen ten aanzien van het beste houderijsysteem voor leghennen en het belang van 10 issues die spelen in de pluimveehouderij. Aan de deelnemers was gevraagd welk houderijsysteem voor leghennen zij het beste vonden. Ze konden kiezen uit de meest voorkomende houderijsystemen voor leghennen in Nederland – *koloniehuisvesting*, *scharrel*, *scharrel met vrije uitloop en een biologisch systeem*. De meeste burgers vonden een systeem met vrije uitloop, ofwel scharrel met vrije uitloop (51%) of een biologisch systeem (22%) het beste systeem. In tegenstelling tot de burgers vond het grootste deel van de pluimveehouders en pluimveedierenartsen een systeem zonder uitloop naar buiten, ofwel scharrel (51% en respectievelijk 50%) of koloniehuisvesting (28% en respectievelijk 44%) het beste systeem. Alle stakeholdergroepen vonden de issues 'voedselveiligheid' en 'gezondheid van leghennen' de belangrijkste issues van de 10 issues, en zij vonden het 'welzijn van hennen' even belangrijk. Vergeleken met pluimveehouders en pluimveedierenartsen vonden burgers de issues 'natuurlijke behoeften van leghennen' en 'milieuvriendelijk' belangrijker, en 'gezondheid van hennen', 'inkomen van de veehouder' en 'hennen leggen veel eieren' minder belangrijk. Burgers die een systeem met vrije uitloop het beste vonden, beoordeelden de issues 'gezondheid van hennen', 'welzijn van hennen', 'natuurlijke behoefte van hennen' en 'milieuvriendelijk' als belangrijker, en 'goedkope eieren', 'inkomen van de

pluimveehouder' en 'hennen leggen veel eieren' als minder belangrijk dan burgers die een systeem zonder vrije uitloop het beste vonden.

Hoofdstuk 3 geeft de percepties van stakeholders weer ten aanzien van het welzijn van leghennen gehouden in vier verschillende houderijsystemen – *koloniehuisvesting*, *scharrel*, *scharrel met vrije uitloop* en *een biologisch systeem*. Burgers vonden het welzijn van leghennen in het biologische systeem het beste, terwijl pluimveehouders en -dierenartsen het welzijn in het scharrelstelsel zonder uitloop het beste vonden. De verschillen tussen de scores van burgers en de twee groepen professionals konden verklaard worden door verschillende percepties van welzijnsaspecten, kennis van het gedrag van kippen en socio-demografische kenmerken. Vergeleken met de professionals beoordeelden burgers de invloed op het welzijn van de hennen van aspecten gerelateerd aan natuurlijk gedrag hoger, en de invloed van de aspecten pijn, en angst en stress lager. Dit lijkt de hogere welzijnsscores van burgers voor de systemen met vrije uitloop en die van de professionals voor de systemen zonder uitloop te verklaren. Op basis van de scores voor de welzijnsaspecten konden vier clusters van burgers onderscheiden worden: een *laag bezorgd*, *matig bezorgd*, *hoog bezorgd* en een *divers cluster*. De burgers in het *hoog bezorgde* cluster waren vergeleken met de andere clusters vaker vrouw, tussen 25 en 44 jaar, hoger opgeleid, hadden vaker een huisdier, eten minder vaak vlees en doneren vaker aan een dierenwelzijns- of natuurorganisatie. Het *hoog bezorgde* cluster gaf vergeleken met de andere drie clusters lagere scores voor het welzijn van hennen in koloniehuisvesting en hogere scores voor het welzijn van hennen in het biologische systeem. De conclusie was dat burgers en professionals welzijn verschillend beoordelen. Burgers vinden dat het welzijn van leghennen vooral wordt beïnvloed door het welzijnsconcept *een natuurlijk leven leiden*, terwijl pluimveehouders en -dierenartsen vinden dat vooral het concept *affectieve staat* (mate van positieve en negatieve ervaringen) – bestaande uit de aspecten *pijn*, *angst*, *stress* en *verwondingen* – het welzijn van hennen beïnvloed.

Risicopercepties van volksgezondheid- en voedselveiligheidsgevaren in verschillende pluimveehouderijsystemen kan de acceptatie van die systemen beïnvloeden. Daarom werden in Hoofdstuk 4 de stakeholderpercepties van het risico op *Campylobacter* contaminatie van kippenvlees, introductie van aviaire influenza (vogelgriep) in leghennen en verhoogde dioxinegehalten in eieren van leghennen in de meest voorkomende houderijsystemen voor vleeskuikens en leghennen onderzocht.

Daarnaast onderzochten we factoren die risicopercepties zouden kunnen verklaren. Burgers vonden de drie risico's in de systemen zonder uitloop hoger en in de systemen met uitloop lager dan de twee professionele groepen. Burgers uitten meer zorgen dan de twee professionele groepen over verschillende factoren van risicoperceptie – *onbekendheid, vertrouwen, ernst, vrijwilligheid, type gevaar, en persoonlijke controle* –. Pluimveehouders en pluimveedierenartsen lijken een te optimistisch beeld van de volksgezondheidsrisico's van pluimveebedrijven te hebben, en daarmee lijken ze de risico's voor volksgezondheid enigszins ontkennen. De socio-demografische kenmerken van de burgers waren geassocieerd met risicopercepties van de verschillende houderijsystemen. Vrouwelijk respondenten en respondenten die maximaal eenmaal per week vlees eten vonden het risico van de drie gevaren in de systemen zonder uitloop hoger dan manlijke respondenten en respectievelijk diegene die vaker dan één keer per week vlees eten. Respondenten die op een boerderij zijn opgegroeid scoorden het risico in systemen zonder vrije uitloop lager en van systemen met vrije uitloop hoger dan diegene die niet op een boerderij zijn opgegroeid. De risicopercepties van de respondenten van alle stakeholdergroepen leken te worden beïnvloed door intuïtieve gevoelens en onderliggende waarden.

Welzijnsvriendelijke pluimveehouderijsystemen met vrije uitloop leveren mogelijk hogere risico's op voor bepaalde volksgezondheidsgevaren zoals *Campylobacter*, aviaire influenza en dioxine. Het leidt tot een dilemma of men het welzijn van kippen moet verhogen of deze risico's voor de volksgezondheid moet verlagen. In hoofdstuk 5 hebben we de afweging van dit dilemma door burgers en pluimveehouders, en relevante morele argumenten en morele overtuigingen in een praktische context onderzocht. Burgers en pluimveehouders beoordeelden drie praktijkcasussen waarin een conflict tussen het welzijn van kippen en een volksgezondheidsrisico voor *Campylobacter*, aviaire influenza en respectievelijk dioxine werd gepresenteerd. Daarnaast scoorden de participanten de belangrijkheid van morele argumenten voor de afweging, en in welke mate ze het eens of oneens ware met morele overtuigingen ten aanzien van mens en kip. Burgers beoordeelden het dilemma vooral in het belang van het welzijn kippen, terwijl pluimveehouders het dilemma vooral in het belang van het verlagen van volksgezondheidsrisico's beoordeelden. Verschillende waarderingen van morele argumenten en morele overtuigingen, met name die ten aanzien van de *waarde van kippen* en *natuurlijkheid*, konden de verschillende oordelen van het dilemma verklaren. Pluimveehouders waardeerden morele overtuigingen ten aanzien

de *functionele waarde van kippen*, *mensen staan boven kippen*, en *eerlijkheid* – ofwel een eerlijke verdeling van kosten en verantwoordelijkheid voor het verbeteren van dierenwelzijn en verlagen volksgezondheidsrisico's – hoger dan burgers deden, terwijl burgers de overtuigingen ten aanzien van *natuurlijkheid* hoger waardeerden dan pluimveehouders. De groep mensen, burgers en pluimveehouders, die het dilemma oordeelden in het voordeel van het welzijn van kippen, scoorden de morele overtuigingen ten aanzien van *natuurlijkheid*, *sentience* van kippen – d.w.z. capaciteit van kippen om positief en negatief gevoel te ervaren – en *intrinsieke waarde* van kippen hoger dan de groep die het dilemma in voordeel van het verlagen van volksgezondheidsrisico's beoordeelden.

Zorgen in de maatschappij over dierenwelzijn en volksgezondheid lijken vooral *natuurlijkheid* te betreffen. Het is onduidelijk wat burgers als natuurlijk zien en wat hun percepties zijn van een innovatief huisvestingssysteem voor leghennen dat tegemoetkomt aan zorgen over *natuurlijkheid*, welzijn van leghennen en volksgezondheid. Daarom onderzochten we tijdens een bedrijfsbezoek de meningen van burgers over een innovatief houderijsysteem met een grote overdekte uitloop voor leghennen en gerelateerde aspecten zoals het welzijn en de gezondheid van leghennen en volksgezondheidsrisico's. Twee groepen van negen burgers vulden deels voor en deels na het zien van de hennen in het houderijsysteem een vragenlijst in. De deelnemende burgers waren overwegend positief over het houderijsysteem, de grote overdekte uitloop, de gezondheid en het welzijn van de hennen, en over de volksgezondheidsrisico's. Echter, de deelnemers hadden ook zorgen over de ruimte die de hennen hadden om te bewegen en natuurlijk gedrag uit te oefenen. Deze zorgen betroffen vooral het deel van de stal met de uit meerdere etages bestaande volière. Het bevestigt dat burgers focussen op het welzijnsconcept *natuurlijk leven*. De deelnemers zagen *natuurlijkheid* als “*een natuurlijke omgeving met ruimte om te bewegen en natuurlijk gedrag uit te oefenen*”. Suggesties om het systeem te verbeteren zodat het beter rekening houdt met de percepties van burgers zijn: een lagere bezettingsgraad in met name in het deel van de stal met de volière, een minder industrieel design, meer daglicht, en meer stro op de grond. Verder zou in houderijsystemen in het algemeen meer verrijking aan de hennen kunnen worden aangeboden, zoals balen met luzerne stro, verstopplekken, en groene planten of bomen. De conclusie was dat een houderijsysteem met een grote overdekte uitloop tegemoet kan komen aan de zorgen van burgers over volksgezondheid, het welzijn van leghennen en *natuurlijkheid*.

Hoofdstuk 7 bediscussieert integraal de resultaten uit de voorgaande hoofdstukken. De verschillen tussen burgers en de professionals – pluimveehouders en pluimveedierenartsen – ten aanzien van percepties, overtuigingen, en oordelen konden door verschillende factoren worden verklaard. Tenslotte werden de implicaties van deze thesis voor de toekomst van de pluimveehouderij bediscussieert. De verschillen tussen de opvattingen van burgers, pluimveehouders en pluimveedierenartsen over de pluimveehouderij konden worden verklaard door:

- verschillen in de percepties van welzijn van kippen
- verschillen in de percepties van volksgezondheidsrisico's van verschillende houderijsystemen
- verschillen in morele overtuigingen ten aanzien van kippen, welzijn en houderijsystemen
- verschillen in het wegen van morele waarden en overtuigingen
- de *context* – d.w.z of iemand wel of niet betrokken is bij de pluimveehouderij
- gevoel en intuïtie
- kennis van en ervaring met de pluimveehouderij
- socio-demografische kenmerken

DANKWOORD

Promoveren was soms eenzaam. Hele dagen aan één ding werken; het toverwoord was focus. Natuurlijk kon ik het niet alleen en er waren veel mensen die mij hielpen met de inhoud van mijn onderzoek, brainstormen, reflecteren, en me feedback gaven.

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ABOUT THE AUTHOR

Mariska van Asselt was born on the 5th of March 1974 in Hengelo, Overijssel, the Netherlands. She grew up in Borne and completed secondary school in Hengelo in 1992. Her main interests were playing water polo, animals – in particular rabbits – and she spent her summer holidays with her parents and sister in Italy. These interests influenced her career. In 1992 she started to study Veterinary Science at the Faculty of Veterinary Medicine in Utrecht. Till 1996 she combined her study with playing water polo in the highest division in the Netherlands. During her study her interests changed from companion animals in Farm animals. In her last year of her study she did an internship Food hygiene of products of animal origin in Perugia. In September 2001 she graduated as a veterinarian with a specialisation in farm animals and started to work at the Department of Farm Animal Health at the Utrecht University as a junior lecturer and veterinarian in the ambulatory clinic. Later she joined the clinical pathophysiology group at this department and wrote her first scientific contribution. In September 2006 she started as a lecturer in animal health at the CAH Dronten – now the Aeres University of Applied Sciences. Later she applied successfully for a PhD position at the Aeres University of Applied Sciences and a collaboration was started with the Adaptation Physiology Group of Wageningen University & Research. She wrote a research proposal that was awarded with doctoral grant for teachers by the Netherlands Organisation for Scientific Research (NWO) in December 2012. The aim of the PhD-project was to study the trade-off between chicken welfare and public health risks in poultry husbandry.

LIST OF PUBLICATIONS

Peer reviewed scientific papers

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians. In D. E. Dumitras, I. M. Jitea, & S. Aerts (Eds.), *Know your food: Food ethics and innovation* (pp. 138-143). Wageningen: Wageningen Academic Publishers. doi: 10.3920/978-90-8686-813-1_20

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2016). Role of moral values in the trade-off between animal welfare and food safety risks in broiler husbandry In A. S. Olsson, S. M. Araújo, & M. F. Vieira (Eds.), *Food futures: ethics, science and culture* (pp. 273-278). Wageningen: Wageningen Academic Publishers Books. doi: 10.3920/978-90-8686-834-6_41

Van Asselt, M., Poortvliet, P. M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2018). Risk perceptions of public health and food safety hazards in poultry husbandry by citizens, poultry farmers and poultry veterinarians. *Poultry Science*, 97(2), 607-619. doi: 10.3382/ps/pex325

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2019). The trade-off between chicken welfare and public health risks in poultry husbandry: significance of moral convictions. Accepted for publication in *Journal of Agricultural and Environmental Ethics*.

Contributions to scientific conferences

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2015). Best broiler husbandry system and perceived importance of production aspects by Dutch citizens, poultry farmers and veterinarians *Oral presentation at 12th EurSafe Conference. Know your food: Food ethics and innovation*. Cluj-Napoca, Roemenia.

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2016). Role of moral values in the trade-off between animal welfare and food safety risks in broiler husbandry *Oral presentation at the 13th EurSafe Conference. Food futures: ethics, science and culture*. Porto, Portugal.

Van Asselt, M., Ekkel, E. D., Kemp, B., & Stassen, E. N. (2017). *Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians*. Poster presented at the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level, Ede, the Netherlands.

Van Asselt, M., & Stassen, E. N. (2017). Arguments in a dilemma between laying hen welfare and food safety *Oral presentation at the WIAS Science Day 2017*. Wageningen.

Other

Van Asselt, M. (2013). *Een blij kuiken of een veilig kuiken? Een dilemma tussen welzijn en voedselveiligheid*. Presentation at the Hygieia najaarsymposium. De kip van de toekomst o.d.z. vleesmachines of dieren met gevoel? Utrecht, The Netherlands, 30 October 2013

Van Asselt, M. (2014). Blijde kip of veilige eieren; Een dilemma? Presentation at *Barneveld-taire Barbecue, Stichting Wereld Eidag, De ontdekkingsstocht rond het ei*. Barneveld, the Netherlands, 10 September 2014

Van Asselt, M. (2014). Blijde kip of veilige kip? Een dilemma tussen dierenwelzijn en volksgezondheid. Presentations at *Inspiratiesessie Kenniscentrum Agrofood en ondernemen*. Dronten, the Netherlands, 1 April 2014

Van Asselt, M. (2014) *Dilemma: Blijde of veilige kip*. Interviewer: I. Lesscher. *Nieuwe Oogst*. Vol 19, , 5 april 2014.

Van Asselt, M. (2014). Uitgangswaarden burger en sector liggen dicht bijeen. *Pluimveehouderij*, p 29.

Van Asselt, M. (2015). Opvattingen over de pluimveehouderij *Ontbijtsessie Poultry Expertise Centre (PEC)*. Barneveld, the Netherlands, 10 November 2015.

Van Asselt, M. (2017). Editorial. *EurSafe Newsletter. Special Issue on Vonne Lund price winners*, 19, June 2017. pp 1-2.

Van Asselt, M. (2018). Risicopercepties nodig voor maatschappelijk debat over pluimveesector. Retrieved from <https://www.poultryexpertisecentre.com/columns/risicopercepties-nodig>



WIAS EDUCATION CERTIFICATE

Research Skills Training (6 ECTS¹)

- Writing PhD research proposal – **Awarded with NWO Doctoral Grant for Teachers**, 2012
- Writing WIAS PhD research proposal, 2013

In-Depth Studies (8 ECTS)

- Animal and Nature Ethics, Ethics Institute Utrecht University, 2011-2012

Statutory Courses (3 ECTS)

- Use of laboratory animal, Utrecht University, 2003

Professional Skills Support Courses (4 ECTS)

- Techniques for Writing and Presenting Scientific Papers, WSG, 2014
- Efficient Writing Strategies, WGS 2014
- Course Scientific Writing, WGS, 2014
- Course Last Stretch of the PhD Programme, WGS, 2017

Scientific Exposure (12 ECTS)

International conferences (4.4 ECTS)

- 2nd Minding Animals Conference, Utrecht, the Netherlands, July 4-7, 2012
- 12th EurSafe conference, Cluj-Napoca, Romania, May 28-30, 2015
- Vethics conference, May 19, 2016
- 13th EurSafe conference, Porto, September 28-30, 2016
- 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level. Ede, 5-8 Sept 2017

Seminars and workshops (0.9 ECTS)

- WIAS Science Day, Wageningen, the Netherlands, 2013/02/28
- Symposium CVI, Campylobacter bij pluimvee, Lelystad, 24/06/2013
- Symposium Hygieia "De kip van de toekomst", Utrecht, 30/10/2013
- WIAS Science Day, Wageningen, the Netherlands, 2014/02/13
- WIAS Science Day, Wageningen, the Netherlands, 2017/02/06

¹ one ECTS credit equals a study load of approximately 28 hours

Presentations (7.0 ECTS))

- Blij kuiken of veilig kuiken? Een dilemma tussen welzijn en voedselveiligheid. Symposium Hygieia, 30/10/2013. Oral presentation.
- Blijde kip en veilige eieren; een dilemma? Barneveld-taire Barbecue, 2014/09/10. Oral presentation.
- Opvattingen over de pluimveehouderij. PEC Ontbijtsessie 2015/11/10. Oral presentation.
- Best broiler husbandry system and importance of production aspects by Dutch citizens, poultry farmers and veterinarians. EurSafe, 2015/05/28, oral presentation.
- Role of moral values in the trade-off between animal welfare and food safety risks in broiler husbandry. EurSafe 2016/09/26, oral presentation.
- Arguments in a dilemma between laying hen welfare and food safety. WIAS Science Day, 2017/02/06. Oral presentation.
- Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians. WAFL 2017/09/05. Poster presentation - *3rd prize best poster award*

Supervision of thesis students (7 ECTS)

- De preventie van Campylobacter bij vleeskijzens op biologische vleeskuikenhouderijen in Nederland (BSc.)
- The attitude of Polish dairy farmers towards animal welfare and their willingness to change to more cow comfort in their dairy barns (MSc.)
- Intention to change behaviour. The intention of field service advisors in the Dutch dairy sector to change their behaviour (MSc.)
- Rethinking and optimizing servitization in the laying hen feed business (MSc.)

Preparing course material (4 ECTS)

- Development of an ethics course at Aeres University of Applied Sciences Dronten, 2012

Lecturing (10 ECTS)

- Lecturing animal ethics at Aeres University of Applied Sciences Dronten, 2012-2017

Management Skills Training (4 ECTS)

Organisation of seminars and courses

- Organisation consulting group workshop (2 times), 2012-2016
- Organisation farm visit (2018)

Membership of boards and committees

- Editor EursafeNews, Newsletter of the European Society of Agriculture and Food Ethics (2016 - today)

Colophon

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