



EVIDENCE AND THE WELFARE OF FARMED ANIMALS

PART 1: THE EVIDENCE BASE

June 2014

Farm Animal Welfare Committee
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www.defra.gov.uk/fawc/

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Dear Ms McDonough, Mrs Voas and Dr Glossop

I have great pleasure in sending you this draft on Evidence and Farm Animal Welfare, Part 1.

This focuses on information that is used as evidence in opinion and decision-making. Animal welfare research uses a wide variety of traditional research disciplines. These are described and examples of how they are used in animal welfare are presented; often disciplines are combined in research programmes. The range of disciplines is wide and government, industry and all others involved in decision-making on animal welfare should have an understanding of the quality and interpretation of information that they are using.

There is no one measure that can be used to determine 'best' animal welfare and this adds complexity to debates about animal welfare and decision-making. To date, three key types of welfare indicator are used: direct observation of animals, indirect measures from resources and indirect measures from records. These indicators are used as outcomes in research and as measures to assess welfare in practice. Overall, experimental studies and on farm clinical trials provide the most robust evidence and government and other research bodies should concentrate on commissioning more experimental trials to establish causality and identify factors that improve animal welfare.

Evidence regarding animal welfare is shaped by human perceptions of what animals want. Here, social science plays a key role both in helping to understand how those perceptions are constituted and in defining how both individuals and society set the levels – either through regulation or purchasing behaviour – of what is considered as acceptable welfare. Achieving acceptable standards of animal welfare depends ultimately upon the actions, engagements and motivations of those responsible for animals.

British consumers expect animals to be treated with respect; many claim that the standards of farm animal welfare in Great Britain are amongst the highest in the world. Individuals, groups, society and government make decisions about animal welfare everyday using a combination of past experience, beliefs and evidence. It is important that all available evidence is considered in evaluating the welfare of farm animals. Where there is conflicting evidence the animal should be given the benefit of the doubt.

I commend Part 1 of this report to you and others concerned about the evidence used in decision-making on the welfare of farmed animals.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Peter Jinman', is written over a light blue rectangular background.

Peter Jinman OBE, BVet Med, Dip Arb, FCI Arb, MRCVS, ARAgS

Chairman

I – Introduction

1. The Farm Animal Welfare Committee (FAWC)¹ is an expert committee of the Department for Environment, Food and Rural Affairs (Defra) in England; the Scottish Government and the Welsh Government. It was established in 2011 after a review of public bodies. The Committee publishes its advice independently; see www.defra.gov.uk/fawc.

2. FAWC's terms of reference are: i) to provide independent, authoritative, impartial and timely advice to Defra and the Devolved Administrations in Scotland and Wales on the welfare of farmed animals, including farmed animals on agricultural land, at market, in transit and at the place of killing; and on any legislative or other changes that might be considered necessary to improve standards of animal welfare; and ii) to provide independent scientific support and advice as required by Article 20 of Council Regulation (EC) No.1099/2009 on the protection of animals at the time of killing.

FAWC's philosophy of approach

3. Farm animals are kept for the production of meat, milk, wool and eggs and provision should be made for their needs. Farm animals are recognised as sentient beings within the EU Treaty of Amsterdam 1999. In addition, the Animal Welfare Act 2006 (England and Wales) and the Animal Health and Welfare Act 2006 (Scotland) include a duty of care to provide for the needs of protected animals for which humans have permanent or temporary responsibility. FAWC believes that our obligations include identifying and ensuring that certain serious harms never occur to farm animals, and minimising harms that are currently unavoidable by endeavouring to balance any harms to the animals affected against the benefits to humans. At a minimum, each individual farm animal should have a life that is worth living and a growing proportion should have a good life.²

4. There have been many attempts to define animal welfare. In FAWC's view, welfare encompasses both physical and mental health and for farmed animals good welfare is largely determined on a daily basis by the skills of the stock people, the system of husbandry and the suitability of the genotype for the environment. From time to time external factors can have a sudden impact on welfare, for example, infectious disease epidemics, adverse weather conditions, global economics and geo-political influences. These circumstances often affect animal welfare in the short term and contingencies are necessary to minimise the severity and duration of poorer welfare.

5. In considering provisions that should be made for farm animals to avoid unnecessary suffering and to promote good welfare, the Committee is guided by the Five Freedoms:

¹ The Farm Animal Welfare Committee succeeded the Farm Animal Welfare Council; both use the same acronym, FAWC.

² Farm Animal Welfare Council: Report on Farm Animal Welfare in Great Britain: Past, Present and Future (2009).

Freedom from hunger and thirst, by ready access to fresh water and a diet to maintain full health and vigour.

Freedom from discomfort, by providing an appropriate environment including shelter and a comfortable resting area.

Freedom from pain, injury and disease, by prevention or rapid diagnosis and treatment.

Freedom to express normal behaviour, by providing sufficient space, proper facilities and company of the animal's own kind.

Freedom from fear and distress, by ensuring conditions and treatment which avoid mental suffering.

6. The Five Freedoms are the cornerstone of government and industry policy and the Codes of Recommendations for the Welfare of Livestock.

7. Some pain and distress are unavoidable in livestock husbandry with current knowledge and farming practice but the goal should be to minimise their occurrence. Difficult ethical and agricultural decisions have to be made when dealing with suffering, sometimes by imposing a lesser act that may still cause short-term pain or distress but provide long-term relief for the individual or group. The long-term goal should be to eliminate the source of the problem through improved disease control, husbandry and breeding to avoid this lesser act. For example, tail docking of lambs was introduced to prevent blow fly strike, but now with appropriate timing and use of chemoprophylactic treatments, tail docking is not necessary.

8. When assessing any welfare problem, it is necessary to consider the extent of poor welfare, the intensity and duration of suffering, the number of animals involved, the alternatives available and the opportunities to promote wellbeing. Equally important is the ability to improve welfare immediately through existing sound husbandry with good stockmanship. Many day-to-day welfare challenges are manageable across all systems, although some may be intrinsic to certain production systems.

9. To offer appropriate advice about the welfare of farm animals, FAWC takes account of knowledge from scientists, veterinarians, farmers and the practical experience of those involved in agriculture. A broad-ranging approach is used in FAWC's advice, drawing on relevant views and attempting to take account of human interests with a concern to ensure that the animal's interests remain to the fore. When knowledge is inconclusive, the animal should be given the benefit of the doubt.

Aims, scope and structure of this report

10. Over the past 20 years evidence has become a particularly important issue in policy-making including in the field of farm animal welfare. In 2012, FAWC established a working group to review the evidence base for farm animal welfare. The aim of this report is to consider, evaluate and advise government on the role of

evidence in all aspects of farm animal welfare. Evidence is used to support many decisions and changes in farm animal welfare including in both government and private policy development, technology exchange, criminal law, day-to-day farm management and during formal assessment of the welfare of individuals and groups of animals e.g. in quality assurance schemes.

11. The report will be produced in more than one 'part'. It will cover how evidence is produced, why more evidence is available in some areas than others, who creates and uses evidence in GB, the wider EU and internationally and factors other than information that are used in decision-making. Whether some evidence is 'better' than other evidence is discussed and the issue of whether there is sufficient evidence is addressed. Actions that can be taken when evidence is incomplete are considered.

12. This, Part 1, defines evidence, describes the various types of information that form evidence, and how evidence is supplied. Further part(s) will discuss the use of evidence, whether it is possible to make a hierarchy of information that can be employed in decision-making and whether it is possible to evaluate the quality of evidence. Part 1 is released as a draft and will be reviewed once the other part(s) are complete.

Devolution and international issues

13. The topic of evidence in farm animal welfare is equally relevant to all devolved administrations. Where there is reference in this report to government it is addressing the Department for Environment, Food and Rural Affairs in England; the Scottish and Welsh Governments; and other responsible government departments and agencies.

14. Evidence is used in development of regulation and codes in the EU and international trade treaties (World Trade Organisation, Office Internationale des Epizooties).

Species covered

15. This study covers all the major UK farm livestock species including dairy and beef cattle, pigs, poultry, sheep, deer and fish. Evidence and lack of evidence potentially affect every farmed animal but the scale of effect is not known.

How FAWC currently uses evidence

16. FAWC is a committee of experts with a wide variety of backgrounds and expertise. The committee forms the core base that gathers information to write letters, opinions and reports. The committee accesses information by co-opting individuals, reading published material, interviewing other experts and by visiting farms, abattoirs and markets. FAWC looks for substantiated information and corroboration from several sources.

17. FAWC also values first-hand observation. The committee is aware that it is most likely to see best practice on its visits, but FAWC often hears about welfare issues that have been overcome to achieve best practice and about issues that still

challenge an industry. FAWC also hears from experts who have witnessed poor practice but as a committee rarely has the opportunity to observe poor practice first hand.

18. In recent years, FAWC has taken a more overtly scientific approach when presenting advice. Information comes from peer-reviewed journals, reports and experts. FAWC cites some of the sources of information it has used in more recent reports and opinions. The references listed are not exhaustive: a complete list of all sources used is kept by the secretariat and is available upon request.

How others use evidence

19. FAWC carried out a public consultation in February 2012, which resulted in written submissions from eight organisations and individuals. The Committee is grateful to all those who participated in the study. Organisations and individuals that gave evidence or assistance are listed in Appendix 2.

20. Responses to FAWC's public consultation showed that people use evidence as part of their decision-making process for a wide range of activities such as conducting research projects, developing welfare standards and policy, writing scientific papers and technological reports, establishing standards of good practice, and campaigning. The types of evidence consultees listed that they use when making decisions included information from original scientific research, expert opinion, books written by experts, professional advice and legislation. Respondents also listed personal belief and experience as 'evidence' that they used in decision-making. The combination of evidence and other factors that are included in decision-making will be expanded upon in Part 2 of this report.

II – Definition of evidence in farm animal welfare

21. For the purposes of this report evidence is defined as information that is used to support or refute a proposition in the context of opinion-forming or decision-making.

22. Evidence can come from research studies and empirical observation. In reality, information from such sources is proportionately rare and dominates decision-making in specific circumstances only, e.g. interpretation of a scientific study, establishing guilt beyond reasonable doubt in a court of law. Generally individuals make decisions without calling upon independent evidence. These are typically heuristic (rule of thumb) decisions based on past experience.

23. Heuristic decision-making is often influenced by belief, anecdote, tradition and hearsay. Although belief, anecdote, tradition and hearsay are rarely based on external information they strongly influence decision-making and they also influence the acceptability of new information. For example, farmers have traditionally trimmed the feet of sheep with footrot. Evidence from clinical trials indicates that trimming feet delays healing.³ Many farmers are reluctant to stop trimming feet because they have always done so (tradition) and believe (belief) it is better for the sheep.⁴

24. In 1789, the utilitarian philosopher Jeremy Bentham asked 'Can they suffer?' in relation to animals. This was the first modern challenge for animal welfare science to provide evidence for suffering, sentience and consciousness. Today, while there would appear to be clear and undisputed evidence that animals can suffer,⁵ farm animal welfare remains an area of considerable evidential complexity and confusion.

³ Kaler, J., Daniels, S. L. S., Wright, J. L. and Green, L. E. (2010) 'A randomised factorial design clinical trial to investigate the impact of parenteral long acting oxytetracycline, foot trimming and flunixin meglumine on time to recovery from lameness and foot lesions in sheep lame with footrot', *Journal Of Veterinary Internal Medicine*, **24** (2), 420 - 425

⁴ Wassink, G. J., George, T. R. N., Kaler, J. and Green, L. E. (2010) 'Footrot and interdigital dermatitis in sheep: farmer satisfaction with current management, their ideal management and sources used to adopt new strategies', *Preventive Veterinary Medicine*, **96** (1-2), 65 - 73

⁵ For example, Bateson, P. (1992) Do animals feel pain? *New Scientist*. 25th April 30-33

III – Evidence-based policy in farm animal welfare

25. There is a drive generally for robust evidence to support policy decisions at international, EU and local levels to distance policy from distinctive ideological positions or emotional responses, both of which are arguably particularly prevalent in the welfare policy domain.

26. The England Government has determined that “evidence is needed to inform, support and direct policy design, to scrutinise performance and to identify longer term issues”.⁶

27. Recent years have seen an increased emphasis being placed upon evidence-based policy in public policy-making. Derived largely from evidence-based medicine, with its emphasis on systematic, bias-free evidence and research-led methodologies, evidence-based policy might be defined as an approach that:

“helps people make well informed decisions about policies, programmes and projects by putting the best available evidence at the heart of policy development and implementation”.⁷

28. With the prominence it gives to the neutrality, objectivity, verifiability and strength of evidence, evidence-based policy (and decision-making) extends across a whole range of arenas. It has emerged largely as an alternative to opinion-based policy, widely held to have been the dominant model for policy-making within governments in the past. Opinion-based policy employs belief, ideology and selective use of evidence as supportive of what are often *a priori* positions.

29. The common understanding of evidence-based policy is that it is based on objective knowledge derived from rigorous scientific research methods employed in a wide range of academic disciplines. The definition of ‘scientific’ research used by the Department for Business, Innovation and Skills (BIS), the European Research Council (ERC) and the Research Councils UK (RCUK) consortium includes the humanities. The role of humanities scholars (e.g. historians, philosophers, and ethicists) in public policy formation is increasingly recognised by governments.

30. The primary goal of evidence-based policy is to “improve the reliability of advice concerning the efficiency and effectiveness of policy settings and possible alternatives”.⁸ The key issues here are: i) what rigorous scientific methods provide evidence; ii) from whom is such knowledge considered valid; iii) how are the demands for evidence determined (e.g. is the supply of evidence simply responsive?); iv) at what points do knowledge become evidence, and evidence become advice, and how?

31. The true extent to which evidence has genuinely replaced opinion in government’s policy-making remains to be ascertained. Some would rather

⁶ Defra’s Evidence Investment Strategy: 2010-2013 and beyond: 2011 update. 2.1.1 Green Economy programme, p.5.

⁷ Davies, P.T. (2004). *Is Evidence-Based Government Possible?*

⁸ Head, 2010, p.13

characterise this as a transitional period of evidence-influenced policy.⁹ Policy decisions involve a balance of scientific and other evidence and political considerations, which include economics, practicality, ethical and societal concerns at national, EU and international levels. Opinion (for example, public opinion) is still considered of critical importance in many issues regarding the treatment of animals. Going further, religious belief has also emerged as a crucial factor in driving differing considerations for the welfare of animals and permitting significant derogations to practices otherwise defined as illegal (e.g. concerning the non-stun slaughter of farmed animals).¹⁰

32. The demand for evidence in the field of farm animal welfare has been driven by certain considerations. As animal welfare, and particularly farm animal welfare, becomes an increasingly important area of broad societal concern, information and evidence are required to develop appropriate responses to that concern. The growth of animal welfare as a distinct area of public policy, involving governmental intervention through legislation, regulation, codes of practice, advice and incentive, creates a more specific demand for evidence as a necessary support for evidence-based policy and decision-making. In its Animal Welfare Evidence Plan, Defra identifies the critical purposes of animal welfare evidence.¹¹

33. The evidence obtained allows the UK government, and in some cases the devolved governments, to assess areas of public or ministerial concern, develop and implement policy options, negotiate with evidence in international forums, monitor welfare trends over time, provide information on the welfare implications of other policy areas and provide assurance at national and international levels that legislative requirements are being met.

34. Cultural and social values and decisions can, however, be highly varied. Research has demonstrated the considerable differences between consumers' and citizens' views of what counts as good animal welfare, and scientific assessments of welfare from physiological and/or behavioural perspectives. For some, animal welfare evidence is too scientific, drawing attention away from the importance of human-animal relations and empathy for animals. For others, the danger lies in any move away from objective scientific evidence towards anthropomorphic and subjective interpretations of animal feelings and behaviour. Effective animal welfare policy must be built upon a coherent and holistic use of evidence drawn from a wide range of fields of scientific research.

⁹ Segone, M and Pron, P. (2008) *The role of statistics in evidence-based policy-making*. Report to the UNECE Work Session on Statistical Dissemination and Communication (Geneva, 13-15), United Nations Statistical Commission and Economic Commission for the European Conference of European Statisticians. Available at: www.unicef.org/ceecis/evidence_based_policy_making.pdf. Downloaded: 21.12.2013

¹⁰ Anil, H. (2012) Religious slaughter: a current controversial animal welfare issue. *Animal Frontiers* 2 (3) pp. 64-67.

¹¹ Defra. Animal Welfare Evidence Plan 2011/2012. p 4, 2.2.

IV – Construction of scientific evidence in farm animal welfare

35. Science is the systematically organised body of knowledge on a particular subject. Scientific research is therefore research conducted in accordance with the systematic methods and principles of science. Such research may be undertaken in any intellectual discipline. BIS, ERC and the RCUK consortium all understand 'science' to include the humanities and ethical theory. Important scientific policy research in the humanities is funded by bodies such as the Arts and Humanities Research Council and the British Academy.

36. At the heart of animal welfare research is a desire to identify what animals need or want that provides them with good welfare. New information on farm animal welfare often comes from primary research. This involves direct measurement and collection of data from individual animals, herds or flocks and humans (actors) involved in the farm animal industry.

The nature of natural science research in animal welfare

37. Research approaches from the natural sciences (i.e. those that study the processes that govern the natural world and include biology, medicine and animal behaviour) have dominated animal welfare research in the past. This research tends to use experiments to further understanding. Such experiments have a hypothesis and at their simplest compare two groups, one of which is a control group used as a point of reference where nothing changes, and one group where a change is made. Groups are of a pre-calculated size to give the experiment sufficient statistical significance and power to ensure that the results will differentiate the two groups if a difference is truly present; although power is usually set at 80%: i.e. an 80% probability that if there is a true difference it will be detected. In addition, significance is set at 0.05, meaning that there is a 5% probability that the results occurred by chance. Typically with a P-value <0.05 it is considered that there is a difference between the groups. These studies rely heavily on good design and are highly controlled. In animal welfare they are used for preference testing, identification of biochemical and physiological measures, identification of causes of physical injuries and disease and testing strategies to prevent these indicators of poor welfare. In disciplines where data are plentiful, the focus is not on the power of a study, because in large studies every comparison might be significant, rather, the focus is on the variability around the mean (average) significant difference. These are the confidence intervals. A wide confidence interval around a significant mean suggests a less robust result than a narrow one.

38. It is argued that experiments are very powerful. They are often considered to provide the 'best' evidence. However, experimental conditions and the hypothesis have to be simple so that any experimental outcomes are clearly a result of the hypothesis tested and not due to other confounding issues. Limitations therefore include whether the correct experiment has been done, how well the experimental conditions reflect 'real life' and how well the hypothesis reflects the 'real issue'. For example, in testing the use of straw to reduce tail biting in pigs one might need to consider how much straw is given, how often it is given, the rest of the pig's diet and thermal comfort, stocking density and group size and pen hygiene. If variables such

as these are not considered, a fairly straightforward result is likely to get lost in the complexity of pig management.

39. When welfare issues are very complex, simple experiments might not be informative. In addition, it is sometimes not possible to perform an experiment because it is unethical, there can be no control group, or because evidence is sufficiently limited that no hypothesis can be generated to test experimentally.

40. When experiments are not useful, observational studies can be performed. Observational studies in animal welfare are designed using the same methodology as that used in medical epidemiology. In such studies, observations are made on animals or farms with a variety of management systems and welfare outcomes, and statistical analysis is used to identify associations between types of management and welfare outcomes. Such studies typically generate hypotheses that can be tested by further research.

41. As mentioned in the Introduction, there is no gold standard to measure good animal welfare. Observational studies rely on good definitions of the welfare indicator of interest (the case definition). For example, lameness, an injury or reduced growth rate are reasonably objective measures that can be defined and recorded, however, defining the criteria for identifying a sad, happy or frightened animal is currently very difficult and how these welfare indicators should be defined is itself the subject of much research.

42. Definitions of the factors that affect these welfare indicators are equally important: for example, stocking density, amount and type of feed and construction of pens are definable and measurable, but stockperson attitude or animal-to-animal interactions are more difficult to define and therefore to measure. In addition, factors that vary over time are more difficult to associate with a selected welfare indicator because of their constant change and the possibility of co-variance with other factors, e.g. season.

43. The criteria for associating factors as causal in humans were proposed by Bradford Hill¹² in 1965 and are based mainly on observational research:

- I. **Strength:** A small association does not mean that there is not a causal effect, although the larger the association, the more likely that it is causal.
- II. **Consistency:** A consistent finding, observed by different persons in different places, with different samples, strengthens the likelihood of an effect.
- III. **Specificity:** Causation is likely in a specific population at a specific site with a specific disease with no other likely explanation. The more specific an association between a factor and an effect is, the larger the probability of a causal relationship.

¹² Hill, Austin Bradford (1965). "The Environment and Disease: Association or Causation?". *Proceedings of the Royal Society of Medicine* **58** (5): 295–300. PMC 1898525. PMID 14283879

- IV. **Temporality:** The effect has to occur after the putative cause (and if there is an expected delay between the cause and expected effect, then the effect must occur after that delay).
- V. **Biological gradient:** Greater exposure should generally lead to greater effect. However, in some cases, the mere presence of the factor can trigger the effect. In other cases, an inverse proportion is observed: greater exposure leads to lower incidence.
- VI. **Plausibility:** A plausible mechanism between cause and effect is helpful (but Hill noted that understanding of the mechanism is limited by current knowledge).
- VII. **Coherence:** Coherence between epidemiological and laboratory findings increases the likelihood of an effect.
- VIII. **Experiment:** Occasionally it is possible to appeal to experimental evidence.
- IX. **Analogy:** The effect of similar factors in other studies of other diseases may be considered.

44. A statistical association does not definitively identify cause. This does not mean that observational studies are not useful or informative. On the contrary, they are usually essential to direct appropriate experimental studies. But to identify cause in animal welfare, experimental studies generally need to be undertaken. Many animal welfare research projects do not take results from observational studies forward to clinical trials. To test causality reliably, an intervention (clinical trial) study is needed that would give robust evidence for change. Such clinical trials are standard in human medicine.

The nature of animal welfare science research

45. Animal welfare science as a study of animals draws on many approaches from science research. It studies the structure and behaviour of animals in their physical world by watching, measuring, and performing experiments. From these activities, theories are developed. The types of study described above are used to measure, develop and test hypotheses to explore animal wellbeing, disease and suffering, and an animal's capacity to make choices and to cope with its environment.

46. A key focus of animal welfare science is to identify indicators of animal welfare. There are currently three types of indicator listed below with increasing confidence of association with aspects of welfare:

- Routinely collected data that inform on an animal's health and welfare. Pre-existing data, for example, data collected routinely at farms (e.g. treatment for lameness), abattoirs (e.g. recording lame cows *ante mortem*) or retailers (e.g. regular locomotion scoring of a herd) are often highlighted as being underused. Such data are prone to error and bias and before being suitable for use in research or benchmarking, standardisation and validation would be necessary.
- Resource-based indicators that observe or measure the animal's environment, for example, the quality of concrete that cows walk on.
- Animal-based indicators that directly observe or measure the animal, for example, a cow's locomotion.

47. Clear animal-based indicators of poor welfare, e.g. lameness or injury, can be used to identify resource-based indicators associated with their occurrence.

48. One branch of animal welfare science is using existing indicators to categorise individuals or herds/flocks as having good or poor welfare. It is unlikely that a single measure can address the wide range of dimensions of animal welfare. Indeed, several measures are probably necessary to obtain a comprehensive view of any particular animal's welfare. For example, for poultry it is possible to assess a range of measures including plumage cleanliness, panting, huddling, hock burn, foot pad dermatitis, cull and mortality levels and avoidance distance. There is one school of thought that an animal welfare index should be developed which scores individual or herd/flock welfare so that individuals or herds/flocks can be compared. Others do not consider it possible to code animal welfare indicators to one score. Recent evidence indicates that animals have different preferences. This suggests that providing one system will not provide good welfare and animals require variety to choose their preferred resource. For example, poultry consistently differ in their choice of environment in preference tests.¹³

49. Another branch of animal welfare research that originates in behavioural research is focused on improving animal welfare by identifying indicators of good mental welfare. Animal behaviour research has its origins in reports on observational studies in nature, with a principally anthropomorphic interpretation of the behaviours displayed. The science now incorporates rigorous methodologies across the sciences including psychology, sociology, cognitive neuroscience, physiology, immunology, anthropology, evolutionary biology and ecology. The principal aim is to understand and explain the underlying mechanisms and function of animal behaviour. There are a number of areas of animal behaviour research that have been particularly relevant to the understanding of farmed animal welfare. At a fundamental level, applied animal behaviour research contributes to the evidence of consciousness. This can help inform which animals have capacity to suffer and therefore which warrant protection from this experience. Additionally, when particular behaviours are displayed (or not), they provide an indication of that animal's emotions, affective state and needs, for example, sows in farrowing crates have limited ability to demonstrate nesting behaviour and increased restlessness and redirected nesting activity against the equipment as oral/nasal stereotypies have been observed.

50. Animal behaviour research can be used to prioritise resources and behaviours. Preference (choice) tests inform, within the constraints of the experimental design, what an animal would choose to do when offered different resources, for example whether a cow chooses to be at pasture, in a straw yard or in a cubicle. Consumer demand tests inform on animal motivation. They test how much an animal will work or "pay" to gain access to, or get away from, something, for example a particular resource, environmental experience or conspecific. These tests can compare motivations for one resource compared with another. From an animal welfare perspective the "inelastic demand", one which the animal will keep working

¹³ Browne, W, Caplen, G, Edgar, J, Wilson, L & Nicol, C 2010, 'Consistency, transitivity and inter-relationships between measures of choice in environmental preference tests with chickens'. *Behavioural Processes*, vol 83(1), pp. 72 - 78

to either get to or away from are very important in understanding the impacts of different farming systems upon animals. The evidence from such research has assisted in setting minimum standards in farming, for example, the requirement for a laying hen to have access to a nest to lay eggs and to have access to substrate for dust-bathing.

Evidence-based medicine and its role in animal welfare

51. Evidence-based medicine is ‘the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients’. It is an approach that is being adopted into other areas where evidence is used. In the context of animal welfare, this includes evidence based veterinary medicine and could, FAWC proposes, include evidence-based optimisation of animal welfare. To identify the evidence-base a systematic review of literature is completed that is focused on a well-defined research question that aims to identify, appraise, select and synthesise all high quality research evidence relevant to that question.

52. Evidence-based medicine is the approach currently recommended for identifying best treatment for human patients in the UK. In the 1980s Archie Cochrane, a doctor, stated that it was appalling that evidence from research was rarely and unsystematically used in the care of patients. Until that time, junior doctors learnt from senior doctors in a highly patriarchal system where status was as important as skill, and the senior doctor’s word was final. Cochrane¹⁴ proposed that all the available evidence should be synthesised and assessed in a transparent repeatable manner and made available so that all those involved in human health care could access the best evidence base. The result of this would be not only better uptake of new research but a change in the hierarchy and behaviour of the medical profession so that junior doctors could discuss with senior doctors different approaches to patient management. This would break the patriarchal pattern of medicine and involve patients in discussion of their own healthcare.

53. Traditionally, there is a hierarchy of evidence for assessing the efficacy of treatment that informs the systematic review (Figure 1). This hierarchy gives greatest weight to clinical trials (levels 1 and 2) above observational (non-experimental) studies (level 3) and these are followed by case series, case reports and expert opinion (level 4) and finally validation studies (level 5).

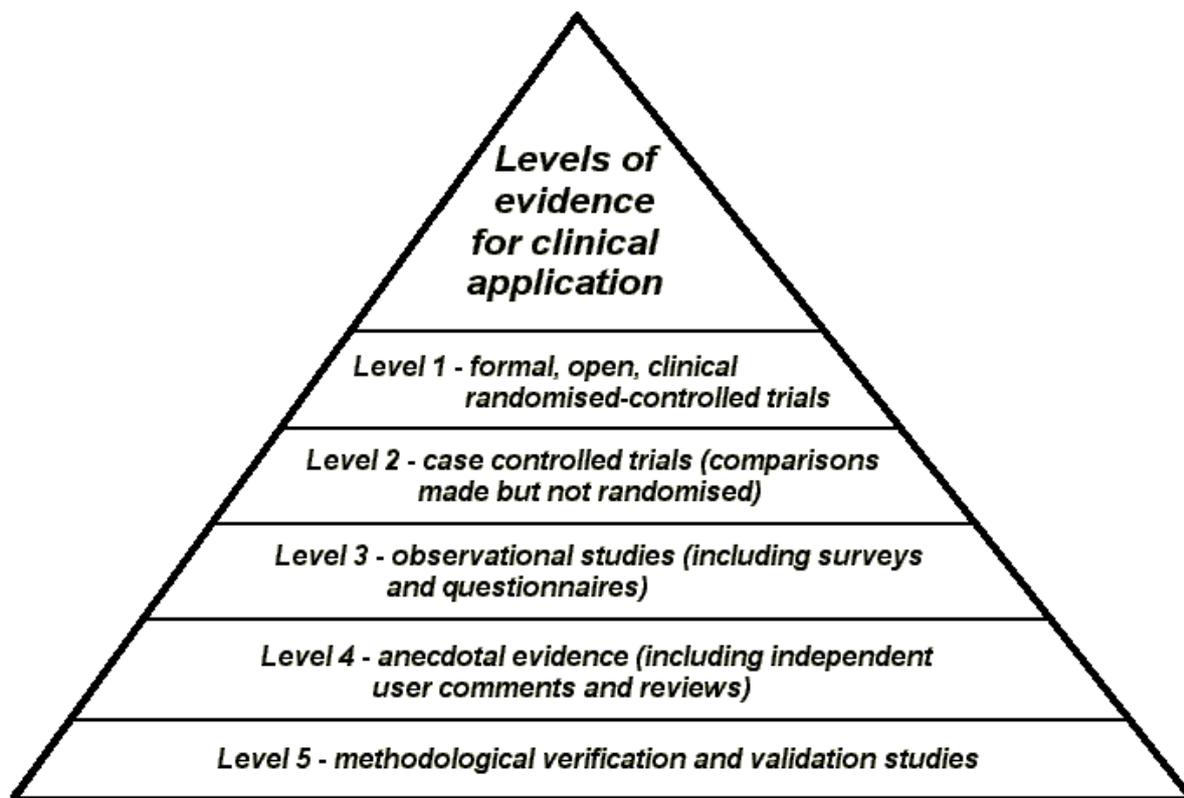
54. Clinical trials (intervention studies), for example, to test a new medicine or treatment, are much like other experiments. There are several factors that contribute to quality. These include an appropriately defined question with a quantified, easily measured difference between treatments, a random enrolment of subjects, double blind allocation to treatment, independent ethical and statistical analysis, a timeliness that ensures that participants in the trial (e.g. owners, scientists) do not already perceive that one treatment is better or sufficiently good to warrant the trial being unnecessary, and sufficient numbers of patients. Random and blinded allocation to treatment is considered essential: neither the patient nor doctor administering the treatment should know or be able to predict which treatment a patient will receive.

¹⁴ www.cochrane.org/cochrane-reviews (January 2014)

Allocation is ideally generated by a distant computer and all treatments should look identical.

55. Meta-analysis refers to methods that focus on contrasting and combining results from different studies, in the hope of identifying patterns among study results, sources of disagreement among those results, or other interesting relationships that may come to light in the context of multiple studies. In human medicine it is currently focused on independent accredited experts combining the results of several clinical trials, possibly where results are equivocal in each trial, to identify whether there is a trend through the trials. In other areas of science meta-analysis may be done on non-experimental data, i.e. at any level in the hierarchy below.

Figure 1: The hierarchy of evidence¹⁵



56. Evidence-based medicine does not consider that one doctor's experience is evidence of good or bad treatment. This does not count as evidence, because doctors have a particular client base, and individual doctors also have varying recall and varying treatments depending on what they see. Only robust clinical trials provide strong evidence when comparing treatments.

57. It has been suggested that which evidence is best depends on the question of interest and that in particular the role of fundamental research should not be ignored in human medicine or be so low in the hierarchy. In addition, for some areas of

¹⁵ Lehmann ED: The freeware AIDA interactive educational diabetes simulator - <http://www.2aida.org> - (1) A download survey for AIDA v4.0. *Medical Science Monitor* 2001; **7**: 504-515.

research a clinical trial is not possible, or not representative of a situation, and so unlikely to produce useful results.

58. In 2012, the Royal College of Veterinary Surgeons (RCVS) stated its aim to adopt evidence-based medicine as the *modus operandi* for practising vets caring for animals in the UK. Many veterinary schools have been teaching evidence-based medicine to their undergraduates for several years and so the RCVS statement is timely and most welcome. Evidence-based medicine is in its infancy in veterinary practice but if it is adopted there should be, as in human medicine, an increase in scientifically-based approaches to the treatment of sick animals and maintenance of health in flocks and herds.

59. It would be worthwhile to debate whether evidence on farm animal welfare could be ordered in a hierarchy. Such a hierarchy could identify a greater range of evidence than was previously thought available, inconsistent evidence for an animal welfare issue, research gaps, and the type of research approach that is best suited to different welfare science issues. Important debates are needed among animal welfare scientists to establish where different types of research would fall in the hierarchy. Results from experimental studies, which are possible in animals but not in humans, might be high in the hierarchy of robustness of research.

Production of veterinary medicines for improved animal welfare

60. Whilst prevention is better than cure (see FAWC's 2012 report on Farm Animal Welfare: Health and Disease), treatment of sick animals with appropriate medicines is very important for good animal welfare. The system of licensing veterinary medicines is designed to ensure that any product used as a medicine is safe and effective for the animal, the administrator and the consumer of food derived from treated animals.

61. All products used in the UK to treat sick animals must have a Marketing Authorisation (MA) granted by the Veterinary Medicines Directorate (VMD). Authorisation is only granted once robust objective evidence has been presented to the VMD and the Veterinary Products Committee of the Food Standards Agency to fulfil the following broad criteria: safety, quality, efficacy, and environmental protection.

62. Scientific evidence is required at each stage of the process of developing a new medicine. Tight controls are in place to ensure that the evidence is valid. Initially a potential new product is tested on small numbers of animals to test safety. In the UK, this is conducted under the Animal Scientific Procedures Act 1986 to regulate and minimise pain and suffering in the animals tested.

63. A new product is tested in clinical trials conducted under Good Clinical Practice (GCP) which cover the design, conduct, monitoring, recording, auditing, analysing and reporting of clinical trials used to evaluate veterinary medicinal products. Typically a number of trials are conducted on several sites with statistically significant numbers of animals to represent the population to which the medicine will ultimately be administered. Animal welfare considerations require that products be tested against a parallel product where available.

64. Commercial companies often undertake more extensive field trials with a fully licensed product to support and promote its market, although these are rarely done under GCP standards and frequently suffer from poor design, execution and data analysis.

65. Ongoing pharmacovigilance is required for all veterinary medicinal products. An adverse reaction reporting system is also available for veterinary surgeons, but this is not compulsory and for food animals is reportedly underused.

Advantages and constraints of the licensing system

66. Advantages include: a sequential system of data gathering under strictly controlled processes that is designed to provide evidence of safety, quality and efficacy whilst minimising animal testing to ensure the adequate and effective treatment of animals with minimal harmful side effects and protection of consumers.

67. Disadvantages include: the time and cost to progress new products to market. Sometimes products effective at trial are less effective on commercial farms and products have been withdrawn from market because of the costs of the re-licensing system. This might reduce animal welfare, particularly if therapeutic agents such as antimicrobials are lost and suitable effective alternatives are not available.

68. There is a need for systematic sharing of information and recognition across international borders of the validity of evidence presented for product licensing to ensure that rigorous safety testing is not unnecessarily repeated on animals, whilst generating product portfolios that will benefit animals over the widest range of health challenges.

The nature of social science research in animal welfare

69. Social science, that is the sciences of human society (including geography, sociology, anthropology, cultural studies, politics and psychology but distinct from the arts and the humanities) is the scientific study of human society and social relationships. It is concerned with understanding and explaining what humans do, why, when and where they do it and what values, attitudes, connections, attachments, opinions and motivations drive them to do, to think, and to believe as they do. At one level, social science is concerned with how such actions, thoughts and values – and the behaviours (individual, collective or institutional) that result from them – constitute part of both the natural and the social world. It is concerned with how these actions and understandings actively construct value systems – economic, scientific, ethical or political – and how those ‘systems’ then affect human society to influence human actions. Social science data are derived principally from:

- Observation and analysis of what people do (practices/action/performance)
- Recording and analysis of what people say (discourse/narrative/(re)presentation)

- Recording and analysis of what people think (ideas/attitudes/values/explanation)
- Identification and analysis of what affects or influences people beyond what is directly communicable or rationalized (affect/emotion)

70. Social science provides such data through qualitative and quantitative study, modeling, use of anecdote and testimony, textual and visual media, observation, witnessing, experimentation and participation.

71. Social science also has a critical function: to question assumptions and challenge the explanatory power of existing practices and ideas (including those associated with the natural sciences). It does this by identifying social structures and processes that underlie such practices and ideas, and by contextualising and understanding the way in which evidence (be it from social or natural science) is produced and used.

72. Social science has traditionally presented itself as exclusively interested in humans, human society and human behaviour. The emphasis that it accords to language and to communication has meant that social scientists have, in the past at least, little involvement in animal worlds or in the different scientific and policy fields of human-animal relations. However, over the last 50 years, this has changed for a number of reasons. The recent move away from purely productivity-based criteria used to develop animal health and welfare policy to embrace wider social and political debates necessitates social science input. Moreover, animal and veterinary scientists have begun to value the importance of working with social scientists to better understand and change human behaviour in the treatment of animals and the adoption of desired practices. This has led to the development of increasingly innovative cross-disciplinary methodologies and research practices. Accompanying this, a growing number of social scientists have come to recognise the role of animals as part of human society. Finally, social scientists are turning their own attention to the ways in which scientific knowledge is itself created. With this has come an understanding that social, cultural and technological concerns impact upon the creation of scientific knowledge and upon scientific practice.

73. Animal welfare is embedded in human values¹⁶ and human practices. Farm animal welfare is about how humans as individuals and as a society use animals by raising and killing them. The contribution of contemporary social science to the construction and provision of evidence in animal welfare policy thereby falls into a number of distinct concerns. First, it is society (individuals, groups, organisations, government, regulatory bodies and public opinion) that determines what are considered as unacceptable pain, distress and suffering or positive states and naturalness for farm animals. It is the role and function of social science to identify these considerations, to explain their multiple origins and diversity, to track their evolution and explore their implications for policy. Second, if welfare is what farm animals experience (either positively or negatively), then much of that experience derives from their interaction with human actions and their responses to such

¹⁶ Duncan I J H and Fraser D 1997 Understanding animal welfare. In: Appleby M C and Hughes B O (eds). Animal Welfare pp 19-31. CAB International: Wallingford, UK

actions. It is the role and function of social science to examine the nature and practices of human interaction with animals, to identify the attitudes and knowledge systems that impact upon such interactions. Finally, if society seeks to improve the welfare of farm animals, or reach acceptable levels of compliance with determined standards of welfare, then intentional human behaviour and specific goals and actions are engaged. Here social science accompanies policy and science to assess how information (whether scientific or regulatory) flows to, and is interpreted by those responsible for implementing animal welfare advice, technological innovation and regulatory requirements (whether animal keepers, food chain actors or consumers and citizens). Here too, social science is charged with evaluating compliance and the effectiveness of mechanisms to achieved desired change, with assessing the barriers and stimuli to behavioural and attitudinal change, and with identifying and understanding the social practices within which such behaviours are located and determined. In the field of farm animal welfare, the reach and relevance of social science extends throughout the food chain; from the laboratory to the farm, abattoir, supermarket shelf and kitchen table.

74. The principal domains of social science research and evidence provision in the field of farm animal welfare include:

- *Attitudinal and behavioural research* – studies of the attitudes and behaviours of farmers, consumers, veterinarians and others in the food chain towards farm animal welfare. Drawing on a wide variety of research techniques, social science has demonstrated how consumers construct their attitudes towards farm animal welfare and how this translates into purchasing behaviour. Research has explored the manner in which welfare has become a key component in retailer segmentation strategies and has helped to develop the market for products coming from improved welfare production systems. At the farm level, social science research is an essential input into the understanding of how new practices, techniques, attitudes and behaviours are adopted (or not) by animal keepers, veterinarians and others. Along with economic science, social science has developed models of behaviour that have played a major role in understanding the adoption of new technologies, products and techniques as well as compliance to new regulatory requirements. Social science evidence has been used to find ways of improving the role of veterinarians on farms and, critically the farmer-vet relationship as well as providing insightful analysis of the processes of auditing, assessment and technological innovation adoption.¹⁷
- *Policy-making and design research* – studies the processes and people involved in making animal welfare legislation, regulation and policy and the mechanisms by which farm animal welfare becomes a commodity in food chains. As farm animal welfare has become progressively governed both through legislation and through different forms of market and social regulation, social science provides essential analysis, critical input and evidence on how policies are designed and enacted. The diversification of regulatory agents associated with farm animal

¹⁷ Escobar, M P. and Buller, H. (2014) *Projecting social science into Defra's animal welfare evidence base: a review of current research and evidence gaps on the issue of farmer behaviour with respect to animal welfare*. London, Defra.

welfare - from more traditional governance to market based mechanisms (such as assurance, segmentation, branding and certification) and social regulation (consumer boycotts, popular campaigns) – has created a new demand for social science evidence on the comparative strength, value and reach of these different forms. Research into labeling methods, into the difficulties of designing enforceable rules, into the growing importance of the effective design of standard operating procedures are all fields where contemporary social science research and evidence is having an important contribution to animal welfare policy-making.

- *Implementation and evaluation* research – studies policy measures, on-farm strategies and assurance standards in meeting welfare objectives. All policies and policy instruments need to be assessed for effectiveness in achieving desired outcomes and their practical application. As welfare legislation and governance grow, so too does the sophistication of evaluative methodologies employed by social scientists. Research into the adoption and the effectiveness of instruments such as herd-health plans, assurance certification procedures, on-farm welfare strategies,¹⁸ veterinary buy-in, training events and so on have all contributed to the assessment of policy effectiveness. The emphasis within contemporary social science on practices has meant that increasingly social scientists are actively working with veterinary scientists in the on-farm assessment and evaluation of policy instruments.
- *Science practice research* – studies how veterinary science operates ‘in practice’ both within the laboratory and on the farm (Law and Mol, 2008; Armstrong, 2009; Enticott, 2012). An important contribution of social science to animal welfare policy and evidence is understanding the process of ‘science-making’. Growing interest in ‘citizen science’, in mass social data sets and in the cultural framing of scientific ‘facts’, place a greater emphasis on the active relationship between science and society. In the field of animal welfare, this is particularly important in a range of contentious policy areas such as, for example, non-stun slaughter and dangerous dogs.
- *Critical theoretical research* – accounts of how the dynamic intersection of society, technology and nature can redefine the methods, practices and understanding of farm animal welfare.¹⁹

75. The growing importance of farm animal welfare as an arena of political, market and societal intervention demands a greater understanding of the shifting influences of the market, of legislation and of farm animal welfare as a public good. With this comes much needed interrogation into its mode of governance at the local, national and international level.

¹⁸ Edwards-Jones, 2006

¹⁹ Law, 2009; Bock and Buller, 2013

The nature of ethics research in animal welfare

76. Ethics, like morality, includes an element of knowledge (i.e. people understanding or considering what is right and wrong) and an element of motivation (i.e. people in fact acting in accordance with that knowledge). It addresses specific moral dilemmas and wider contextual issues such as the formation of good character in individuals and society and the ultimate purposes of social and biological systems.

77. Ethics research is a vital component of the evidence base for farm animal welfare.²⁰ Research relevant to ethics takes place within a range of disciplines including classics, history, philosophy, politics, theology and religious studies. For example, important research has been undertaken in classics into ancient attitudes to animal welfare and its relationship with human welfare, while in theology research has been completed on the place of animals in society and diet. The types of evidence gathered include: concepts, ideas and arguments from published and unpublished texts; historical data on how humans have treated and perceived animals; philosophical assessments of similarities and differences between humans and (other) animals; theories about the place of animals in society and their relationship with humans; and artistic representations of farmed animals.

78. Increasingly, research projects in a particular field of applied ethics are interdisciplinary, bringing together humanities, natural or social sciences. Such projects are attractive to funders because of their likely impact on policy or practice in wider society. They provide significant opportunities for collaboration between governments and researchers that have not so far been fully exploited

79. The primary function of the knowledge component of ethics is to mandate, endorse, justify or proscribe an action or policy. In other words, an action or policy can be said to be required, desirable, permissible or prohibited from an ethical point of view. The type of justification employed will depend on the ethical seriousness of the issue under consideration. It may make reference to:

- **rights**, e.g. withholding water from a dairy cow is wrong because without this it cannot live the biologically healthy life to which it is entitled;
- **purpose, function or telos**, e.g. to keep laying hens free-range is desirable because they are able to carry out natural behaviours such as dustbathing and perching; to keep hens caged throughout the day is unacceptable because this prevents foraging and exploration;
- **utility and the balancing of interests**, e.g. the rearing and consumption of beef cattle is acceptable because the enjoyment and health benefits that beef production brings to humans outweigh its contribution to environmental and health problems and the suffering caused to the animals that are killed; the production of foie gras is prohibited because the pain caused to a duck or goose by force-feeding results in negligible human benefit;

²⁰ In this Report, ethics research does not refer to the ethical conduct of research in the natural or social sciences nor to social scientific surveys of the ethical views of a sample of the population.

- **coherence with other ethical beliefs**, e.g. because humans should be given access to shelter and protection from the elements because they lack natural protection, shorn sheep, which are also vulnerable to cold, should also be given shelter and protection during the winter months;
- **other ethical stances**, through testing and dynamic argument, e.g. the killing of fish by asphyxiation, although standard in capture fishery, should now cease because it is founded on the assumption that fish do not possess sentience, which recent research has shown to be false;
- **ongoing dialogue and informed debate**, e.g. controlled atmosphere gas stunning is a relatively new technology for killing broiler hens, and although electric water bath stunning has generally been viewed as ethically acceptable the balance of arguments needs to be kept under review;
- **cultural tradition and wisdom**, e.g. animals have through history been stabled in close proximity to humans, whereas modern systems of intensive mechanized rearing separate humans and animals;
- **relationality**, e.g. farmed animals, unlike animals in the wild, live in a state of intrinsic dependence on humans, which generates responsibilities that humans must fulfil.

80. Some ethical theories hold that the knowledge component of ethics is itself sufficient to motivate action. According to such theories, ethical data are qualitatively different from statistical or experimental data, and consequently, by themselves motivate action. Other theories, however, place weight on the additional need to motivate ethical action. This motivational component of ethics may make reference to:

- **emotion as well as reason**, e.g. the confinement of hens in batteries, in which they cannot stretch their wings, in order to produce cheap eggs is so cruel and unnecessary that it amounts to legalised torture;
- **implications for other ethical spheres**, e.g. animals should be slaughtered with the least possible suffering because in a humane society the normal attitude is that all suffering, including that of humans, be minimized;
- **supererogation** (going beyond the requirements of duty), e.g. although the castration of lambs is ethically justifiable in systems where lambs will reach sexual maturity, because in a society in which animals enjoy a good life it is preferable to address underlying issues such as feed type and separating ewe and ram lambs to avoid sexual activity.

81. Regardless of how precisely the relationship between ethical knowledge and motivation is construed, the overarching objective of ethics research is to improve ethical outcomes. The formation of virtuous personal character and responsible public sentiments are therefore key parts of the ethical task. The role of ethics research will sometimes be to conceptualize, express and defend in formal terms the intuitions and inclinations that many people already have.

82. The ethical discourse on the general welfare of farm animals is related to that on breeding and experimentation. Indeed, the ethical concepts and principles around farm animal welfare have, to some degree, grown out of debates around these issues, such as through the Banner principles.²¹ Although those debates have related to a far smaller number of animals, they have been prominent in public and academic discourse. They have often exhibited a moral 'flashpoint' approach to ethics, in which a large amount of intellectual energy, time and research funding is devoted to a contentious issue. A distinct ethical evidence base now needs to be developed to address farm animal welfare. This needs to be built upon the kind of framework provided by the points of ethical justification and motivation previously listed.

83. Partly because of the history of the ethical discourse just identified, farmed animals are almost always viewed as ethical objects, of which humans must take account, rather than as ethical subjects. Nevertheless, animal behaviourists are increasingly recognising that animals display traits that may be described as moral. In the popular mind, such as when animals are viewed by families at open farms, these ethical traits are often perceived in the context of the rearing of young. Although the theoretical questions involved in ascribing moral behaviour to farmed animals are considerable, ethics research into them nevertheless needs to recognise that humans and farmed animals inhabit a shared moral community in which mutual learning may take place. To treat animals merely as objects of human moral concern is a hazard in ethics research.

84. The relation of ethics to religion is complex, especially in the context of slaughter. Religious traditions have frequently promoted methods of treating and killing animals that, by the standards of the time, have been relatively compassionate. Nevertheless, in the present day tensions have developed between some religious traditions and welfare as a result of the availability of stunning technologies, which undoubtedly promote welfare. In our increasingly multi-religious society, in which animal welfare is also an increasingly high priority, there is a need for new research into the relation in animal welfare between religion and ethics and greater public understanding of the issues. Furthermore, it needs to be recognised that the purpose of ethics research is not directly to endorse or reject specific practices but to enhance the quality of ethical reflection and debate. It seems unlikely that farm animal welfare ethics research will uncover any ethical position that does not entail some degree of compromise, due not least to the moral issues surrounding the killing of animals for meat consumption.

The nature of economic research in animal welfare

85. Economics is a social science discipline concerned with human society and the use of limited resources to satisfy people's (unlimited) wants. Much of that written in the previous section on social science evidence in animal welfare policy is also relevant to economic research.

²¹ 'The Report of the Committee to Consider the Ethical Implications of Emerging Technologies in the Breeding of Farm Animals' 1995.

86. This section concentrates on the nature of economic research in general and then considers more specific types of evidence in the context of farm animal welfare. Figure 2 provides a summary of the role of economics in policy decision-making. This is equally applicable to other areas of social science. Much of this input can be considered as the provision of evidence and includes a number of different types of information.

87. The first two inputs – helping to identify and define the problem and helping to question the objective(s) of policy – largely use the same type of economic evidence. This relates to economic thinking and economic theory which, in most cases, has been built up over a period of many years and informed and tested by empirical studies. Economic principles, of which there are many, include various aspects of utilitarianism (“the greatest happiness for the greatest numbers”),²² perhaps most clearly manifested in the “economic ethic” of economic cost-benefit analysis.²³ This is the principle that the benefits and costs associated with an action can be measured, summed and the one deducted from the other to obtain a measure of net benefit (or net cost) of the action to society. For example, a cost-benefit analysis could be undertaken to determine whether a policy measure, such as banning the use of conventional cages for egg production, is likely to have a positive net benefit to society (i.e. if benefits are greater than costs).

88. Economic theories abound, including theories about how prices are determined in markets (the ‘laws’ of supply and demand), how businesses compete and how people decide how to spend their money. For example, the simple theory of demand states that the lower the price of a commodity, such as beef, the more of it will be purchased (all other things remaining the same). However, empirical evidence shows that although this is usually the case there are sometimes exceptions to this general rule – e.g., when speculators in a market purchase more of a commodity when the price rises because they have an expectation that prices will rise further – and so economic theory has needed to take such exceptions into account.

89. The various principles and theories of economics can be used to provide an economic perspective on the nature of a problem and to question policy objectives. For example, governments may decide to intervene to protect the welfare of farm animals through legislation. Governmental rationale for this may be that it is what society expects governments to do. The economic rationale would be that there are certain elements of animal welfare that display the characteristics of a ‘public good’ (a good which can be consumed/shared by all in society) and thus commercial interests will not supply the quantity of animal welfare demanded by society because commercial companies cannot feasibly charge for it. The (economic) objective of policy in this case becomes one of governments correcting a ‘market failure’ rather than improving animal welfare per se.

90. New economic theories, or changes to existing ones, are continually being proposed as empirical evidence is gathered.

²² Hutcheson. 1729.

²³ Boulding. 1969.

91. Economic research can help to consider alternative courses of action, especially in the context of the above input of economists. For example, there are a number of different ways (policy instruments) in which various ‘market failures’ – such as the insufficient provision of public goods or the existence of negative externalities (e.g. environmental pollution, animal suffering) – can be addressed, each with their merits and limitations.²⁴ Both economic theory and empirical evidence can be used to help decide which of these different policy approaches might be most effective and at what cost.

92. Policy appraisal is probably the area of economic analysis most widely recognised in terms of the provision of economic evidence. Indeed, governments and their various bodies are often required to undertake such appraisals both before policy intervention (i.e. before resources are committed) and afterwards (to gauge the success of policy). Economic evidence of this nature is often used by policy makers and others to justify, or argue, against a particular policy measure. For example, a proposed policy to improve farm animal welfare, such as a ban on a particular husbandry practice, might be argued against on the grounds of economic evidence showing its adverse impact on the competitiveness of UK production (and the consequence for trade and national income) and on farm incomes.

93. Economic evidence relies greatly on ‘real world’ observation, although evidence also comes from experiments and large-scale social surveys of individuals, families, organisations and businesses (who may report their actions, attitudes, beliefs, expectations and likely future behaviour). The complexity and scale of economic systems often means that experimental design is not feasible. For example, how could an experiment be set up to measure the effects on the global economy of the collapse of the Eurozone? One of the major difficulties for economics is that economic systems rely on the decisions and behaviour of, often, millions of people, businesses (e.g. farms) and other organisations and institutions all interacting in complex ways. For this reason, economic evidence may sometimes be based on various types of modelling which simulate the possible functioning of economic systems (e.g. particular markets), including how economic actors (e.g. consumers, businesses) are likely to behave and incorporating risk and uncertainty. The construction of these models is usually based on empirical data from observation and measurement of the real world and from economic experiments. However, given the complexity of economic systems noted above, the outputs from these models are usually not definitive and are more exploratory in nature (e.g. exploring the probability that a policy to protect farm animal welfare would have a positive net benefit to society under different sets of assumptions).

94. The types of information/evidence that might be provided by economic research/analysis/appraisal include:

- The likely resource implications and costs associated with a policy/decision and on whom in society they fall (e.g. the costs to producers associated with a ban on sow stalls and the impact on consumer prices);

²⁴ See FAWC Opinion on Policy instruments for protecting and improving farm animal welfare. 2008.

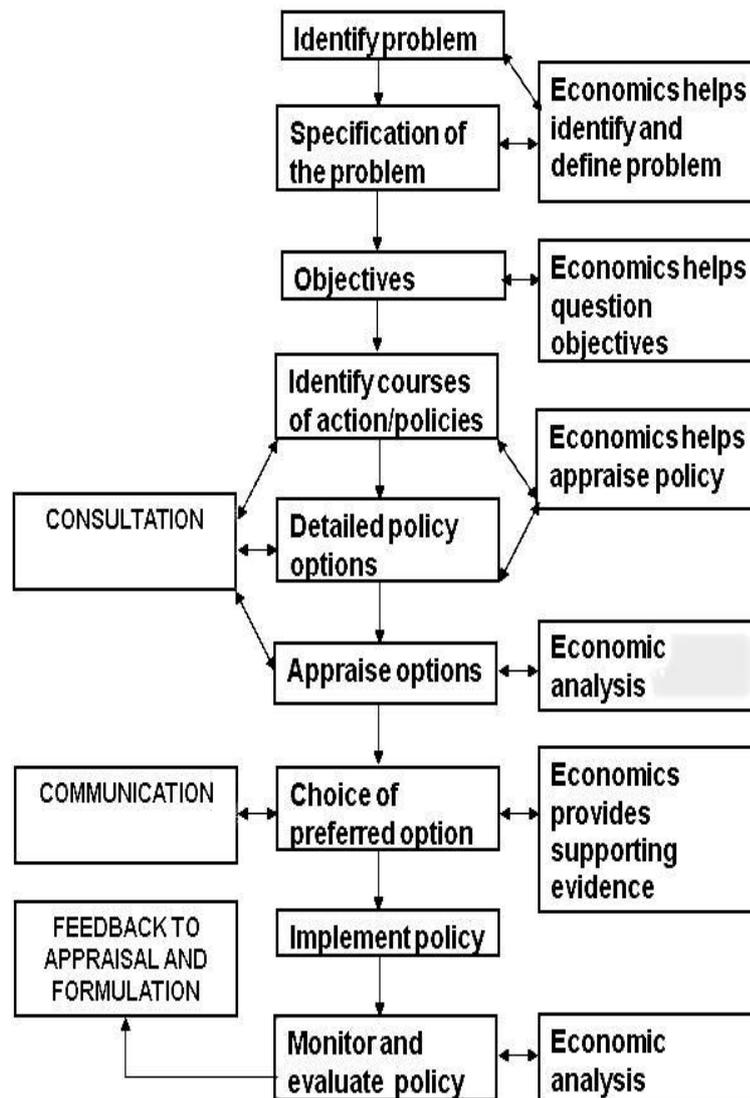
- Estimates of the value that different people or groups of people in society derive from a policy (e.g. people's willingness to pay for specified improvements to farm animals' welfare);
- The likely effect of policy on people's/consumers'/businesses' economic behaviour (e.g. how animal welfare labelling of livestock products in supermarkets might impact on consumer purchasing behaviour);
- The likely effects of policy on markets, including international trade (e.g. the effects of a ban on sow stalls in the UK on pig meat exports and imports).
- The likely macroeconomic (national economic) impact of policy (e.g. the effect of legislation concerning farm animal husbandry practices on UK gross domestic product).

95. There are numerous branches of economics that can help to provide evidence regarding particular aspects including, for example, environmental economics, institutional economics, behavioural economics, risk economics, econometrics (statistical modelling of economic systems/actors) and animal health economics. Many of these branches are cross-disciplinary (e.g. animal health economics involves economics and veterinary/animal science and epidemiology). It is important to note that economic evidence is usually context dependent and estimates or conclusions resulting from one context may not be transferable to another. For example, estimates of the likely impact of policy to improve farm animal welfare in the European Union through specified payments to livestock farmers (e.g. via the Rural Development Regulation) under current conditions would be unlikely to be valid if, for example, the Single Farm Payment was to cease, or there was an epidemic disease affecting livestock across the EU (requiring emergency slaughter, quarantine etc.) or some other substantial change affecting the economic system.

96. In conclusion, economics is useful in providing a number of quantitative measures that can be used as evidence to support policy decisions (such as measures of economic growth, price inflation) and in explaining the underlying economic forces behind such outcomes. However, providing predictions of economic behaviour and future economic outcomes is very difficult. Economics is good at helping us to understand economic behaviour, the economic forces at work and the propensities within economic systems, but fallible if expected to predict precise outcomes which are time dependent. This is because it is never possible to account fully for the myriad of factors forever changing in an uncertain world.

97. As can be seen from the disciplines indicated in Figure 2, whilst the area of study is quite different, the methodological approaches across disciplines are similar.

Figure 2: Role of economics in policy decision-making



Definition of an expert

98. As reported above, information used as evidence in scientific research is derived from observation and experimentation on animals, farms and humans. In many situations individual experts are relied on to summarise and present information from research and also from their own observation or experience, although not all experienced individuals are experts (as discussed under evidence-based medicine). This section defines and describes the role of an expert and highlights advantages and disadvantages of using experts to provide information for decision-making.

99. An expert is defined as 'someone with particular knowledge or skill because of what they have been taught or experienced'.²⁵ Expertise exists in many forms,

²⁵ Oxford English Dictionary

ranging from professional or certified expertise to 'lay' expertise gained through informed practice. Some experts have more particular knowledge or skills than others.

100. Although all of us, every day, make decisions using our past experiences (heuristic decision-making), experience *per se* does not provide expertise. There is no clear means of identifying an expert. It has been proposed that externally validated evidence of an individual's expertise is essential if, for example, an expert is going to be used in a court of law. Externally valid evidence can include specific qualifications, and someone claiming to be an expert in an area without relevant qualifications would have to explain how they had such expertise. Other such evidence includes publications with independent peer review, a recognised reputation including peer recognition and prior contribution to a field. The value of this external validation of expertise for specific professions may be affected by defined accreditation processes described by the professional body. For example, every veterinary surgeon must be a member of the RCVS to practice in the UK, which is therefore a minimum level of expertise. A veterinary expert, e.g. in pig, sheep or cattle health, would be expected to hold relevant postgraduate qualifications and to be recognised as a specialist by the RCVS.

101. Expert opinion is often used when there is insufficient independent evidence of a particular subject or when there is a need for a rapid summary or good knowledge of all available evidence. In law, an expert provides a rapid summary of the evidence available to establish or to contest the veracity of claims being made. In policy-making, experts with good knowledge are sought to assess the implications of an implementation. Within research, peer expertise is frequently used to evaluate the merits of a paper, a grant application or funded research. An expert's ability to present the available evidence is important because the decision to act on the evidence is made by someone else (judge, jury, magistrate, politician, policy-maker, editor or research council as appropriate). Finally, it is important to remember that not all potential experts are willing to serve in this capacity. The best experts might be too busy, too expensive, or uninterested in contributing their expertise in some situations.

102. Experts vary in their interpretation of evidence on a single issue. For example, in one study vets were asked their opinion on the efficacy of a medicine to treat mastitis in cattle, and in another, their opinion on the better of two treatments for footrot in sheep. In both studies vets varied considerably in their opinion on the efficacy of the treatments. Some believed one treatment to be highly effective whilst others considered it less so. Some were highly confident of their position, others very much less so.

103. As a consequence, groups of experts, often referred to as 'panels', are sometimes used to help guide the nature, direction and size of research and other projects. One methodological approach is Delphi studies, where experts work separately from each other (so that one expert does not influence another within the process) with the aim of reaching a consensus on what is important. For example, if a list of factors important in farmed salmon welfare were required, a Delphi study could be used to gain consensus on the factors and their relative importance from experts. A second use of experts is to obtain a distribution of expert opinions. Using

the mastitis sample above, a distribution of mean and variability in expert belief in the efficacy of a medicine can be obtained. This distribution is then used, together with other factors, to estimate the sample size required for a study investigating the efficacy of the medicine to convince sceptical end users of the validity of the results of such a study.

Legal aspects of evidence

104. Any legal dispute requires evidence to support or refute one or other argument to achieve resolution. There are two broad divisions of the law in England, Scotland and Wales – criminal and civil. Because cases of poor animal welfare are only considered as criminal offences, this report considers only criminal law.

Criminal law

105. Cruelty to animals is a criminal offence. Because of the implication of a criminal conviction for the individual, the law requires a high level of proof: the evidence presented must be “beyond all reasonable doubt”.

106. The Police and Criminal Evidence Act 1984 (PACE) and associated Codes of Practice provide a strict rule for the collection, processing and presentation of evidence. The principal prosecutors for animal welfare cases under the Animal Welfare Act 2006 are the local authorities. Officers are trained in the requirements of PACE with respect to evidence handling.

107. A wide range of formats of evidence is admissible including: forensic test results, (including validation of collection and testing), technical analysis (e.g. analysis of blood), witness statements and video/CCTV footage.

108. Where the offence is of an absolute nature (e.g. blood test indicating malnutrition in sheep), the evidence is restricted to proof of malnutrition (i.e. validation of the blood test) and proof or acknowledgement of responsibility for who should have fed the animal. However, there may be conflicting evidence about the reliability of the analysis and who was responsible for the animal’s care. Where conflicting evidence is presented the magistrate panel, judge and/or jury decide which parts of the evidence are most credible, i.e. some degree of subjectivity is introduced.

109. A technical expert may be called upon to explain elements of the case to the court, and the expert witness, in presenting evidence, can play an important role in determining the outcome of the trial.

The role of the expert witness in law

110. In legal cases where the welfare of an animal is in dispute, it is often necessary to have an expert witness who is presented with all the information and evidence available and interprets it based upon their knowledge of the field. The role of experts is to advise the court on technical aspects of the case. Whilst an expert witness may voice opinions that are not fully supported in literature, based on experience, it would be unusual for them to express an opinion that was contrary to

published information. Where more than one expert is used in a case, the possibility is opened that they examine the same evidence but, based on their knowledge and experience, reach different opinions and conclusions. Ultimately, the expert(s) will present an opinion based on evidence and experience but the court will determine the case.

V – Supply of evidence in farm animal welfare

111. Primary sources of evidence come from those who do original research and publish the results. Research is usually published in peer-reviewed journals. Peer review means that two, three or more peers (scientists with similar research interests) evaluate a manuscript submitted for publication and assess its novelty and quality of design, analysis and interpretation of results. If they are satisfied that the research reaches the standards for publication they will recommend publication, often after some changes from the original manuscript. This system relies on the independence of the peer reviewers to assess a piece of work impartially.

112. Ultimately, the editor of a scientific journal accepts or rejects a paper for publication. There is evidence that research that does not produce a novel positive result is less likely to be published (publication bias) than research where there is a definite result from a study. For example, if two housing systems are compared and one is considered better than another, a paper might be published, but if the systems are similar the results are less likely to be published even though they might be just as informative. Lack of publication can also lead to further research being undertaken comparing these two housing systems because the research community is unaware that this has already been tested. This may raise ethical concerns for the use of animals in research.

113. The scientific manuscript is most often a relatively short, subject-specific paper that is usually difficult for non-specialists to read because of the language and degree of assumed knowledge required. With the introduction of electronic publications, manuscripts can now be longer and supplementary material, including colour images or videos, can be included. This might make such papers more accessible. Most papers start with a summary or abstract, but because these are brief, they often do not reflect the full document and reading the full paper is necessary to understand the new results presented.

114. Each research paper contains new results. Most new results are not immediately useful to end users but advance scientific understanding; this is often referred to as basic research. Such research is essential and ultimately leads to breakthroughs in understanding that do lead to changes, for example in managing animal health and welfare. Classic examples include the structure of DNA, understanding cell division and understanding how cells take up substances. Arguably, the key area of research in animal welfare awaiting a breakthrough is a better understanding of animal sentience.

115. Some research is useful to end users immediately. This will typically be the result of clinical trials, e.g. the use of a new treatment for a sick animal or identification of an improved housing system. However, one piece of research might not be sufficient to convince the research community or those implementing the evidence from the research to adopt the new findings. Evidence from research can be strengthened by several research studies or groups reporting similar results, from similar results being reported from a similar situation or from underlying basic science.

116. Review articles are sometimes produced that summarise a large amount of research. These can be systematic and follow a transparent and described approach such as Cochrane reviews (see earlier under construction of scientific evidence), but are sometimes written opinions with no clear explanation of the articles included in the review. These latter reviews are prone to bias in content and interpretation.

117. In addition, researchers might write a précis of their research for a professional magazine or work with those in technology exchange to produce a technical summary.

118. Other sources of information used as evidence include passive and active surveillance (see FAWC 2012 Report on Farm Animal Welfare: Health and Disease) and individuals who have relevant experience. This includes farmers who observe changes in the health and welfare of their stock, and those who have observed a crime and act as witnesses in a court of law. Experts are those with experience called upon to express it for use in an evidential way. It is the expected and professional norm that these experts supply objective evidence.

The cycle of evidence

119. Much research evidence about animal welfare is generated from commissioned research and increasingly from multidisciplinary studies. It is not random but tends to follow identifiable areas of information need. As a result, information is not always evenly spread and some areas of animal welfare are better researched and better known than others. There are therefore evidence gaps, for example, more is known about social interactions amongst pigs than hens.

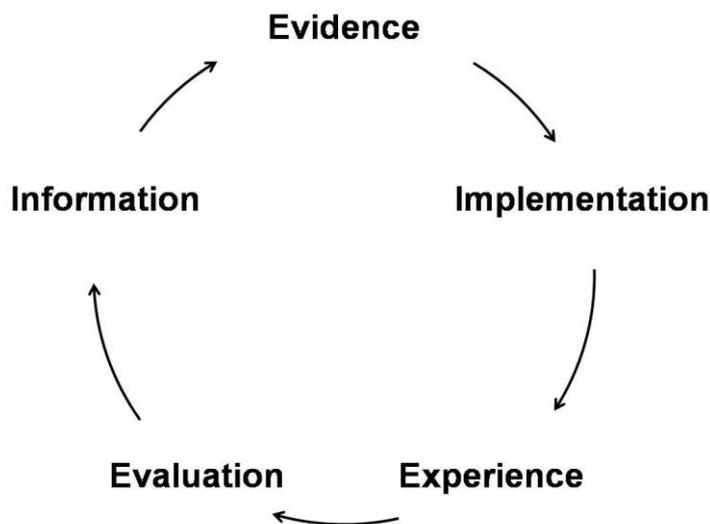
120. There are no unchanging truths when dealing with biological research, including animal welfare research. As new evidence from research becomes available understanding changes and there might be stages in the development of information when evidence is apparently contradictory, when in fact the reality is that the evidence is incomplete. For example, there is no research evidence that routine foot trimming of sheep is beneficial but some evidence that routine foot trimming is correlated with higher levels of lameness in sheep flocks, with more routine trimming events per year correlated with even higher levels of lameness. The possible conclusions from this research are i) that routine foot-trimming in sheep is not advisable, ii) that farmers routinely foot trim in response to high levels of lameness and iii) that the result is spurious, i.e. routine foot trimming has no effect on lameness levels. Which of the three interpretations is favoured will depend on an individual's interest in science and the subject. Someone who is uninterested or objective might consider all three options equally likely, whereas prior experience and prior behaviour might lead to option ii) being favoured. Further evidence is needed to understand whether routine foot trimming is detrimental, beneficial or neither.

121. From this it is apparent that current evidence is part of a cycle in which information is accrued, becomes used as evidence, is experienced and evaluated, and leads to the generation of more research and information that can be used as evidence (Figure 3).

122. Evidence and policy/decision-making also operate in a 'chicken and egg' situation. Evidence can drive policy change, for example, but policy demands may also drive research for evidence (Figure 3).

123. Information is also often accrued because of an external requirement. The result of this is that the information available is selective rather than representative. For example, there has been far more research into mastitis in dairy cows than lameness in dairy cows, possibly because mastitis obviously affects milk quality and production and so has been viewed economically as a more important disease to study when financial sources are limited.

Figure 3: The cyclical nature of evidence growing over time



124. Advances in animal welfare science, the acknowledgement of animal sentience by the EU and the development of more refined techniques both for identifying the welfare implications of husbandry techniques and recognising the nature and scale of physiological and psychological animal suffering have all played their part in greatly increasing the evidence available.

125. Social sciences have demonstrated the important role of social, political and cultural opinions, values and practices on the construction and application of evidence. Many decisions made by animal welfare sectors employ both opinion-based and evidence-based models, drawing selectively on ideological, ethical and attitudinal positions to define and interpret what is acceptable evidence and to drive policy.

126. The key issue is that there is no gold standard for animal welfare, i.e. no one absolute measure that always and only identifies that an animal has poor or good welfare. As a consequence, scientific study is a less than perfect measure of animal welfare. Results and observations are interpreted by humans and accepted by some and not others as indicating good or poor welfare. No one interpretation is correct or incorrect; implications for welfare are open to interpretation. This is not to say that welfare science research is not useful but that it is currently limited by what can be observed and measured, whatever the study design. For example, it is useful to

know what makes sheep lame if one believes that lame sheep are in pain, and physiological and behavioural studies would indicate that they are, but i) society has to believe that whether animals feel pain, and ii) that lameness is an important welfare infringement. Human attitudes to animal welfare are influenced also by culture, age, gender, demography and religion.

127. Consequently, evidence remains problematic;²⁶ either because much of it remains grounded in what are thought of as largely anthropomorphic notions of animal behaviour, or because it has rarely been exposed to the rigours of bias-free objectification. This has been argued by Dawkins,²⁷ who said

“Anyone who wants to be sure of keeping animal welfare on the political agenda in the future will need more coherent arguments and better evidence than are currently being used”.

128. For some, what has most retarded progress in farm animal welfare is not so much the lack of answers but the failure to ask the right questions for which evidence is needed²⁸ or the inability to answer the right questions. Too often in the past, this failure has been affected by assumptions about animal behaviour or underestimating animal sentience and so underestimating the deleterious effect of certain practices. Questions that seek to predict farmer behaviour in adopting welfare improvements have also sometimes ignored the broader social and professional contexts in which husbandry practice is undertaken and welfare is perceived and understood.

129. While questions about animals’ physical, behavioural and psychological responses to their living environment are becoming easier to answer, equating these to acceptable or unacceptable levels of suffering and providing evidence for this remains complex. Equally, evidence of public responses to the way farm animals are kept can also be very difficult to weigh against biological evidence. Maintaining close and integrated links between these different areas when holistic evidence is called for is a key requirement.

²⁶ Bermond, P. (1997). The myth of animal suffering.

²⁷ Dawkins. 2012. p4.

²⁸ Rollin, 1995, p.ix

VI – Conclusions and recommendations

130. The science used to investigate animal welfare uses the same methodologies that are used to investigate other research topics. All types of research are useful but some types of evidence are more appropriate than others in certain situations.

131. In addition, there is no one measure that can be used to determine an animal's welfare and there are insufficient scientifically robust techniques to measure all aspects of welfare. To date, three key types of welfare indicator have been used: direct observation of animals, indirect measures from resources and indirect measures from records. These indicators are used as outcomes in research and as measures to assess welfare in practice. Evidence regarding animal welfare is shaped by human perceptions of what animals want.

132. Social science plays a key role both in helping to understand how those perceptions are constituted and in defining how both individuals and society set the levels – either through regulation or purchasing behaviour – of what is considered as acceptable welfare. Achieving acceptable standards of animal welfare depends ultimately upon the actions, engagements and motivations of those responsible for animals. Identifying and understanding the various drivers of farmer and keeper behaviour, their attitudes towards the animals in their care and their relationship to the wider societal, economic and regulatory environment within which they work constitute the key evidence that social science brings to the field of farm animal welfare.

133. The evidence available is gathered because the need for new evidence has been identified. As a consequence, the evidence base varies by issue in animal welfare. For example, more is known about space requirements for pigs than for dairy cows. When evidence is incomplete it can appear conflicting and this may impact on the ability to make decisions. In the context of research, there will always be a desire for new information.

134. Reliance on expertise is an important part of decision-making. Identification of appropriate experts can be difficult.

135. There is a hierarchy of evidence used in human medicine that has recently been adopted for use in veterinary medicine. Clinical trials/experiments are rated as the highest quality research design.

Recommendations

1. *It is important that all available evidence should be considered in evaluating the welfare of animals. Where there is conflicting evidence the animal should be given the benefit of the doubt.*

2. *Government, industry and all others involved in decision-making on animal welfare should have an understanding of the robustness of information that they are using.*

3. *All those interested in animal welfare should consider the extent to which it is appropriate and useful to develop a hierarchy for quality of research approach, and how different types of evidence interact in different contexts.*
4. *Government and other research bodies should commission more clinical trials to establish causality and identify factors that improve animal welfare.*
5. *When expert opinion is used the expert should meet a predetermined level of independence from relevant stakeholder interests and their expertise should be externally validated, for example, through qualification and peer review.*

APPENDIX 1 – Membership of the Farm Animal Welfare Committee (Spring 2014)

Peter Jinman – Chairman
Professor Michael Appleby
Professor Richard Bennett
Professor Henry Buller
Dr Andy Butterworth
Dr Joanne Conington
Huw Davies
Mike Elliot
Professor Laura Green
Dr David Grumett
Richard Jennison
Gwyn Jones
Professor Richard Moody
Dr Philip Scott
Mark White
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FAWC Secretariat

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Appendix 2 – Acknowledgements

FAWC is grateful for the information and assistance provided by:

Animal Health Veterinary Laboratories Agency

Assured Food Standards

British Cattle Veterinary Association

Compassion in World Farming

Conservative Animal Welfare

European Food Safety Authority

National Farmers Union

National Pig Association

RSPCA

Scotland's Rural College

Sheep Veterinary Society

University of Leicester

FAWC should also like to thank its Defra veterinary advisor Dr Sophia Hepple and Brenda Rawson of the FAWC Secretariat, for their help and advice in preparing this Report.

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