Assessment of the impact of government animal welfare policy on farm animal welfare in the UK

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Abstract

The paper presents the method and findings of a Delphi expert survey to assess the impact of UK government farm animal welfare policy, farm assurance schemes and major food retailer specifications on the welfare of animals on farms. Two case-study livestock production systems are considered, dairy and cage egg production. The method identifies how well the various standards perform in terms of their effects on a number of key farm animal welfare variables, and provides estimates of the impact of the three types of standard on the welfare of animals on farms, taking account of producer compliance. The study highlights that there remains considerable scope for government policy, together with farm assurance schemes, to improve the welfare of farm animals by introducing standards that address key factors affecting animal welfare and by increasing compliance of livestock producers. There is a need for more comprehensive, regular and random surveys of on-farm welfare to monitor compliance with welfare standards (legislation and welfare codes) and the welfare of farm animals over time, and a need to collect farm data on the costs of compliance with standards.

Keywords: *animal welfare, expert (Delphi) survey, farm animal welfare standards, government policy, impact assessment*

Introduction

Within the United Kingdom (UK) government, the welfare of farm animals is primarily the concern of the Department for Environment, Food and Rural Affairs (DEFRA). DEFRA implements a range of policy measures aimed at improving the welfare of farm animals. These measures include the setting of legislative standards, the drafting of codes of practice for producers and others involved in live-stock industries, the monitoring and enforcement of welfare standards by the State Veterinary Service (SVS), the provision of information and advice on animal welfare, and support for the Farm Animal Welfare Council (FAWC, which advises government on all aspects of the welfare of farm animals).

The main legislation affecting the welfare of farm animals in the UK is the Agriculture (Miscellaneous Provisions) Act 1968 and the Welfare of Farmed Animals (England) Regulations 2000 (Statutory Instrument 2000 No 1870). Although UK legislation on the welfare of farm animals existed before there was European Union (EU) legislation, in recent years it has become more and more affected by EU Directives and Regulations. These Directives and Regulations have been based on reports from scientific committees, the Scientific Veterinary Committee, Animal Welfare Section and its successor the Scientific Committee on Animal Health and Animal Welfare. Scientists from EU countries have contributed to these reports, and research has been an important part of the basis for the reports. The 2000 Regulations implement Council Directive 98/58/EC concerning protection of animals kept for farming purposes and also maintain existing national welfare standards. The Regulations set down general requirements in Schedule 1 as to the conditions in which all farmed animals must be kept, with respect to such things as accommodation, feed and water, lighting and inspections. More detailed requirements for the management of farm animals in relation to their welfare are provided by EU Directives (and Regulations) such as Council Directives 97/2/EC and 97/182/EC for calves, 2001/88/EC and 2001/93/EC for pigs, 1999/74/EC for laying hens, 93/119/EC for animals at the time of slaughter, and 91/628/EEC and 95/29/EC for animals during transport. In the UK, there are specific pieces of legislation concerning the welfare of farm animals at markets, during transport and at slaughter, as well as on farms. These include the Welfare of Animals at Markets Order 1990 (this is currently being reviewed by FAWC and has been supplemented by a 1998 Strategy for the Protection of Animal Welfare at Livestock Markets), the Welfare of Animals (Transport) Order 1997, and the Welfare of Animals (Slaughter or Killing) Regulations 1995 and its various amendments (the latest being in 2001). Under the 2000 Regulations (England), details of additional conditions with which keepers of farmed

animals must comply are specified in species-specific Schedules (including laying hens in battery cages, other poultry, calves, cattle and pigs). The Regulations require that any person attending to livestock should be acquainted with, and have access to, the provisions of all relevant statutory welfare codes relating to the animals being attended. They also require that people who look after stock, on behalf of the keeper, receive instruction and guidance on relevant codes.

The Agriculture (Miscellaneous Provisions) Act 1968 provides for codes of recommendations to be drawn up. Before these codes (usually referred to as 'welfare codes') can be introduced they need to be approved by both Houses of Parliament. Codes are available for domestic fowls, turkeys, ducks, cattle, sheep, pigs, goats, farmed deer and rabbits. Welfare codes do not lay down statutory requirements. However, livestock farmers and employers are required by law to ensure that all those attending to their livestock are familiar with, and have access to, the relevant codes. Although the main aim of the welfare codes is to encourage farmers to adopt high standards of husbandry, they may also be used to back up legislative requirements. Where a person is charged under the Agriculture (Miscellaneous Provisions) Act 1968 with causing unnecessary pain or unnecessary distress to farm livestock, failure to comply with the provisions of a welfare code may be relied on by the prosecution to establish guilt. A number of the codes have been (and are being) revised by DEFRA to take account of the current legislation and extend beyond it (see DEFRA 2002 for up-to-date information on animal welfare legislation). For example, the most recent code for sheep at the time of writing is August 2000; for laying hens and for broilers July 2002; for cattle and for pigs March 2003. DEFRA also produces a wealth of advisory literature under the Action on Animal Health and Welfare series, which supports the legislation and expands on advice given in the welfare codes, including issues such as lameness, mastitis and heat stress.

As can be seen, DEFRA policies and activities have impacts on the welfare of farm animals on the farm, during transportation, at markets and at slaughter. The study reported here is concerned with the impacts of DEFRA policy as it relates to the welfare of animals on farms. The annual DEFRA budget for its farm animal welfare programme is around £4 million (of which around three-quarters is allocated to the SVS). In addition, a further £4 million is spent on research and development. It should be noted that DEFRA undertakes substantial work relating to disease control, which clearly has significant implications for animal welfare, but this study does not directly address the animal welfare impacts of DEFRA livestock disease-control policies.

A full report of the evaluation of DEFRA farm animal welfare policy (Bennett *et al* 2000) can be found at http://www.defra.gov.uk/esg/economics/animwelf/ WholeRep.pdf. This paper presents the methods and results of a Delphi survey of expert assessments of the impact of DEFRA policy on the welfare of animals on farms, taking into account the impacts of other influences, particularly farm assurance schemes and major food retailer specifications.

Study approach

There are two fundamental problems in attempting to assess the impact of DEFRA policy on the welfare of animals on farms. First, a method for assessing welfare that can be used on farms is needed. There is a substantial literature on welfare assessment (eg Broom 1988; Broom & Johnson 1993; Appleby & Hughes 1997; Bennett *et al* 2000). Some of the methods are usable only in controlled experimental conditions where detailed measurements of behaviour, physiology etc are possible. Where methods of welfare assessment are feasible on farm, there is certainly no single measure (Broom 1986), and the combination of measures must be carried out carefully and objectively (Fraser 1995). However, observations of injuries, behaviour problems, body condition and clinical disease can be quantitative indicators of poor welfare in individual animals. To some extent, observations can indicate that the welfare of animals is good. Data from populations of animals on mortality, morbidity, growth suppression and reproductive suppression, which can also be collated on farms, are also valuable indicators of welfare. Any one of the measures may indicate that welfare is unacceptably poor. However, unless experienced welfare scientists are present, a carefully specified weighting and scoring procedure is needed for proper evaluation of welfare. Second, even if the level of the welfare of farm animals at any one time is assessed, together with any change in animals' welfare over time, it is very difficult to gauge the influence of DEFRA policy on these. This is because there is a host of interacting factors affecting the welfare of farm animals at any one time. These factors include government policy, the economics and structure of livestock farming, the demands of consumers and food retailers, and so on.

In particular, there are many other standards with which livestock producers comply, as well as DEFRA policies. These include various farm assurance schemes and food retailer specifications. Many of these schemes address a range of quality and production issues such as food safety, hygiene and traceability, as well as animal welfare. Some specifically focus on improved animal welfare, such as the Royal Society for the Prevention of Cruelty to Animals (RSPCA)'s Freedom Food scheme. McEachern and Tregear (2000) provide a useful comparison of the animal welfare aspects of various farm assurance schemes, whilst FAWC (2001) consider the implications of farm assurance schemes for livestock welfare in the UK.

In addition to difficulties in separating out the impact of DEFRA policy, there are few data available from comprehensive surveys on the actual levels of welfare of animals on farms. Neither are there any comprehensive assessments of the extent to which different animal welfare standards impact on the welfare of animals on farms.

Figure 1 shows, in diagrammatic form, the central problem in assessing the impact of government policy on the welfare of animals on farms. 'A' shows the level of welfare at the time that a DEFRA measure or policy designed to improve welfare is implemented. 'B' shows the level of animal welfare that might be expected over time in the absence of DEFRA policy. 'C' shows the actual level of welfare over time after implementation of DEFRA policy measures. Thus, the measure of the effectiveness or benefit of DEFRA policy in terms of improvement of the welfare of animals on farms is the difference between 'C' and 'B'. The problem is that 'B' is unobservable. Both 'A' and 'C' can, in principle, be observed but this requires both a method for measuring welfare and surveillance of the welfare status of the livestock population over time, both of which were lacking at the time of this study.

Hence the approach used was to ask, using the Delphi survey approach, a group of 'experts' for their assessment of the effectiveness of DEFRA policy measures on the welfare of animals on farms. This was undertaken by using a system of scientific indicators of welfare, which, together with the Delphi survey of expert opinion on the extent to which the various standards impact on these indicators of animal welfare, enabled the contribution of DEFRA policy, and of other livestock production standards, to the welfare of animals on farms to be separately identified and assessed. The approach yields subjective estimates of the impact of DEFRA policy (and other) measures in the form of numerical scores.

Five different types of standard/recommendation were considered. These were:

(1) Legal farm animal welfare requirements

(2) DEFRA Codes of Recommendations ('welfare codes')

(3) FAWC Recommendations

(4) Farm Assurance Schemes

(5) Major food retailer specifications

FAWC recommendations are something of an anomaly here since they are not actual standards. However, they do have an important influence on standards and on DEFRA policy, and so it was felt that it would be useful to consider the impact of these recommendations on the welfare of animals on farms separately and in addition to the standards outlined above.

Measuring the impact of standards on animal welfare

Method

The measurement framework used here is based on a number of assumptions. The first assumption is that animal welfare can be disaggregated into a series of variables (i) that indicate the welfare of an animal. The second assumption is that these variables can be quantified and the estimates aggregated to provide a measure of welfare of an animal. The third assumption is that a particular standard of livestock production (j) has an impact on these variables. The fourth

Figure 1
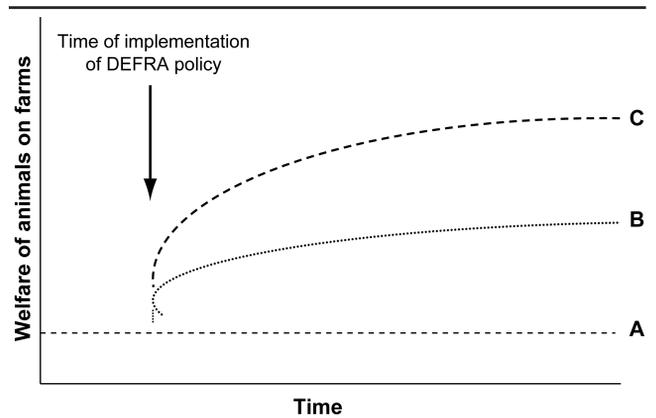
Assessment of the impact of DEFRA policy on animal welfare. A: level of welfare at the time that a DEFRA measure or policy designed to improve welfare is implemented. B: level of animal welfare that might be expected over time in the absence of DEFRA policy. C: actual level of welfare over time after implementation of DEFRA policy measures.

assumption is that the impact of different standards on each of the welfare variables can be assessed. Then, for a particular livestock production standard (j), an index of performance of the standard with regard to animal welfare (Wj) can be derived based on the defined variables (i). There are two elements to this index:

(1) Relative importance (RIi)

This is the relative importance of animal welfare variable (i) with respect to the overall welfare of the animal. There is an implicit assumption that the relative importance of each variable is not dependent upon (ie not determined by) the relative importance of any of the other welfare variables.

(2) Performance (Pij)

This is the performance of livestock production standard (j) with respect to animal welfare variable (i).

It is assumed that RIi and Pij can be estimated from rating scale scores, normalised with extreme values of 0 and 100. In the case of RIi, which is expressed as a ratio from 0 to 1, estimates are derived from the absolute importance of each animal welfare variable (Ii) as follows:

$$RIi = Ii/\Sigma(Ii)$$

The index of animal welfare for each welfare variable is then calculated as:

$$Wj = RIi \times Pij$$

The overall performance of the standard on the welfare of animals on farms, called the Performance Index (PI), is derived from the sum of the animal welfare indices for each variable such that:

$$PI = \Sigma \, Wj = \Sigma \, [RIi \times Pij]$$

PI has extreme values of 0 and 100.

In the current study, estimates of the importance of individual animal welfare variables (Pi) and the performance of each livestock production standard with respect to these variables are derived from a Delphi expert survey. This

Table 1   Animal welfare variables.

Dairy cattle	Cage egg production
Foot disorders, generally resulting in lameness.	Injury and pain caused by being pecked, turning, wing-flapping, perching etc.
Injury or pain (for example caused by accident, farm operation, human violence or other violence).	Space constraints to normal, undisturbed preening, turning, wing-flapping, perching etc.
Hunger, thirst, thermal discomfort, or udder distension.	Bone and muscle weakness resulting from inadequate exercise.
Mastitis.	Abnormal repeated behaviour, such as pacing.
Abnormal, disturbed behaviour (being chased, lying in poor conditions, stereotyping etc).	Access to litter for dust-bathing, preening and hence reduction in abnormal behaviour.
Frustration or discomfort caused by inadequate feeding or lying conditions.	Access to appropriate nest sites for egg-laying and reduction in abnormal behaviour.
Failure to grow or weight loss, which involves utilisation of functional body tissues (may be indicated by poor body condition).	Injurious pecking (indicating poor welfare in the pecker).
Ability to perform normal, undisturbed behaviour.	Feather loss (caused by feather pecking, treading and abrasion).
Other clinical disease.	Access to perches for resting and sleeping.
Failure to reproduce given adequate opportunity.	Clinical disease.
	Fear (caused by humans or other birds).

approach requires that the welfare variables encompass the major determinants of animal welfare and are specified in such a way that experts are able to provide quantitative estimates of the extent to which different standards affect these variables.

First, a series of animal welfare variables was defined for each species in relation to the production system being considered (see Broom 1999, 2001). These variables were then distributed among a group of veterinary and animal scientists for comments and were revised accordingly. The welfare variables were then presented to respondents in the Delphi survey and further revised according to their responses and comments. Animal welfare variables defined for two case-study animal production systems — dairy production and cage egg production — are presented here. Table 1 shows the welfare variables used for the two production systems.

Use of the Delphi survey method

The Delphi survey technique involves a panel of recruited experts who are asked to provide initial estimates and who are subsequently provided with an opportunity to revise their estimate in the light of the responses provided by the panel as a whole. The objective is to reduce variance associated with parameter estimates and thus improve reliability. The Delphi technique has been used since the early 1950s and applied to many different areas of investigation (Linstone & Turoff 1975).

In the current study, estimates of I_i (the importance of each of the welfare variables) and P_{ij} (the performance of a standard with respect to each welfare variable) were derived using bipolar rating scales. The rating scores were then normalised to have a minimum value of 0 and a maximum value of 100. In the case of I_i, respondents were presented with the following question:

> "The aim of this question is to assess the importance of a number of factors to the overall welfare of animals on

farms in the UK. Veterinary scientists, who have particular expertise in farm animal welfare, have defined these parameters. The question is sub-divided into three sections, each of which corresponds to a particular animal species. In each case, please indicate the importance of each factor to overall on-farm animal welfare of the livestock population (taking account of its extent, severity, duration and frequency where appropriate)."

Estimates were provided on a line scale with extremes of 'very unimportant' to 'very important'.

In the case of P_{ij}, respondents were presented with the following question, and asked to provide scores for each of the five livestock production standards outlined above:

> "The aim of this section is to consider how well different farm animal welfare standards address the various animal welfare factors for dairy cows/caged hens on farms. The question is sub-divided into five sections, each of which corresponds to different standards for the welfare of dairy cows/caged hens. In each case, please indicate the performance of the standard (from very low to very high) with respect to each animal welfare factor (taking account of its extent, severity, duration and frequency where appropriate)."

Estimates were provided on a line scale with extremes of 'very low' to 'very high'.

A total of 130 experts on animal welfare from universities, government, research institutes, veterinary practices and other bodies were invited to take part in the survey and were all sent a first-round questionnaire. Reminders were sent to non-responders after three weeks. Of the experts sampled, 78 (60%) returned a completed questionnaire. Researchers' contact details were provided on the questionnaire if respondents had any queries. A number of enquiries were made to clarify particular points concerning the questionnaire and the survey. Responses to the first round of the Delphi survey were analysed and mean results sent out as part of the second round. Respondents were asked to complete the questionnaire again in the light of the results of the first

round. A total of 73 (94%) of the respondents to the first round returned a completed questionnaire in the second round. Table 2 shows a breakdown of the backgrounds of each of the Delphi survey expert participants in both the first and second rounds of the survey. It can be seen that around 46% of respondents were veterinarians, 36% other animal welfare experts and 18% industry representatives. The veterinarians selected included those registered with the Animal Welfare Science, Ethics and Law Veterinary Association and those particularly concerned with animal welfare within government (for example, those undertaking welfare inspections); other animal welfare experts were selected from universities, organisations such as the RSPCA and the Universities Federation for Animal Welfare (UFAW) and FAWC; industry representatives included welfare experts from two major food retailers, the main livestock farm assurance schemes and livestock organisations such as the Meat and Livestock Commission (MLC). The 'welfare' veterinarians were a relatively large group of respondents because they were thought to be a particularly relevant (and relatively large) community to consult on farm animal welfare matters, whilst other groupings, such as members of FAWC, had relatively few representatives. Consideration of responses according to type of respondent is presented later in the paper.

Survey results

Dairy cattle

Welfare variables

Table 3 shows the final Delphi survey results relating to the importance of different variables to dairy cattle welfare. The mean scores are out of 100 (standard deviations are shown in parentheses), where 0 means that the variable is very unimportant and 100 means that the variable is very important in determining cattle welfare. It can be seen that the standard deviations of all of the mean scores are reduced in the second round of the Delphi survey compared to the first, showing that the Delphi survey technique was achieving its purpose of reducing the variance of estimates. Clearly, both lameness and mastitis are seen as particularly important influences on cattle welfare, although all of the variables, except 'failure to reproduce', scored substantially higher than 50 (ie of some importance, where 50 would be interpreted as neither important nor unimportant). The relative importance score for each variable is derived from the score of the variable divided by the sum of scores for all of the variables. The relative importance score is used to derive the indices of performance outlined below.

Performance of livestock production standards in terms of welfare variables

Table 4 shows how, for dairy cattle, Delphi participants rated the performance of the different livestock production standards in terms of the welfare variables. Again, these are mean scores out of 100 (with standard deviations in parentheses), where 0 denotes a very low performance and 100 a very high performance. FAWC recommendations are rated

Table 2   Number of participants in the Delphi survey.

Type	Round of Delphi survey	
	Round 1	Round 2
Independent veterinarian	16	15
DEFRA veterinarian	20	19
Animal scientist	13	12
Member of FAWC	11	11
Animal welfare organisation	4	4
Farm assurance scheme	6	5
Retailer	2	2
Food industry	6	5
Total	78	73

highest in terms of performance, and this is true for each of the welfare variables, followed by farm assurance schemes. The performance of legal requirements is generally rated as being the lowest.

Indices of performance of standards

Table 5 shows the indices of performance of the different livestock production standards for dairy cattle. The performance of each of the standards in terms of each welfare variable (foot disorders, mastitis etc) is weighted according to the relative importance of those welfare variables, as derived from the Delphi survey results (shown in Table 4). Thus, for each welfare variable, the performance score of each standard in relation to that variable is multiplied by the relative importance score of the welfare variable to give an index value. The index values for each of the welfare variables are then summed for each livestock production standard to give an overall index of performance for the standard. The index thus takes account of the extent to which the different standards address the more important aspects of the welfare of animals.

It can be seen from Table 5 that FAWC recommendations have the highest overall performance associated with them compared with the other standards, in terms of the extent to which they address the important aspects of the welfare of dairy cattle on farms. These are followed by farm assurance schemes, DEFRA codes, the requirements of food retailers and, lastly, legal requirements.

Caged hens

Welfare variables

Table 6 shows the Delphi survey results relating to the importance of different welfare variables to caged hen welfare. Again, the mean scores are out of 100 (standard deviations are in parentheses), where 0 means that the variable is very unimportant and 100 means that the variable is very important in determining hen welfare. Also, once again, the standard deviations of all of the mean scores are reduced in the second round of the Delphi survey compared to the first, showing that the technique helped to reduce the variance of responses. Injury/pain caused by being pecked followed by injurious pecking and bone/muscle weakness are seen as

Table 3   Mean importance of animal welfare parameters to overall on-farm welfare of dairy cattle across two rounds of Delphi survey. * Standard deviations are given in parentheses.

Animal welfare parameter	Mean importance score	
	Round 1*	Round 2*
Foot disorders, generally resulting in lameness	79.1 (9.2)	81.9 (5.3)
Mastitis	72.6 (12.6)	74.2 (8.2)
Injury or pain (for example caused by accident, farm operation, human violence or other violence)	74.2 (14.1)	71.6 (9.3)
Hunger, thirst, thermal discomfort, or udder distension	70.9 (16.3)	70.1 (12.2)
Abnormal, disturbed behaviour (being chased, lying in poor conditions, stereotyping etc)	70.8 (15.4)	69.2 (10.3)
Frustration or discomfort caused by inadequate feeding or lying conditions	67.4 (14.5)	68.9 (0.5)
Ability to perform normal, undisturbed behaviour	68.3 (15.7)	67.2 (10.4)
Failure to grow or weight loss, which involves utilisation of functional body tissues (may be indicated by poor body condition)	64.1 (16.5)	67.2 (12.3)
Other clinical disease	66.2 (14.7)	64.8 (11.9)
Failure to reproduce given adequate opportunity	51.4 (10.3)	49.7 (9.2)

Table 4   Mean performance of livestock production standards/recommendations for dairy cattle. * Standard deviations are given in parentheses.

Animal welfare parameter	Animal welfare standard/recommendations				
	Legal*	DEFRA codes*	FAWC*	Farm assurance schemes*	Major food retailers*
Foot disorders, generally resulting in lameness	43.0 (6.3)	49.0 (5.6)	62.9 (6.8)	52.4 (6.5)	43.9 (5.5)
Mastitis	42.6 (5.9)	47.5 (5.8)	59.2 (6.2)	55.8 (6.2)	53.1 (4.9)
Other clinical disease	41.4 (6.4)	45.4 (4.6)	55.6 (5.4)	51.9 (6.5)	47.8 (5.3)
Failure to reproduce given adequate opportunity	30.4 (4.1)	35.7 (4.2)	46.5 (5.2)	41.7 (4.9)	34.5 (4.2)
Ability to perform normal, undisturbed behaviour	37.5 (4.3)	45.2 (5.2)	56.6 (6.4)	49.8 (5.2)	42.1 (4.9)
Abnormal, disturbed behaviour (being chased, lying in poor conditions, stereotyping etc)	37.0 (4.5)	47.1 (5.4)	57.6 (5.7)	48.8 (5.6)	41.9 (5.3)
Failure to grow or weight loss, which involves utilisation of functional body tissues (may be indicated by poor body condition)	37.5 (4.3)	45.5 (5.3)	55.4 (6.9)	49.1 (5.6)	43.8 (6.2)
Injury or pain (for example caused by accident, farm operation, human violence or other violence)	50.5 (5.6)	53.4 (4.9)	61.9 (7.4)	53.3 (5.4)	45.1 (5.9)
Frustration or discomfort caused by inadequate feeding or lying conditions	40.8 (5.1)	45.5 (6.1)	61.0 (7.2)	49.6 (5.3)	45.3 (6.3)
Hunger, thirst, thermal discomfort, or udder distension	47.5 (5.7)	47.8 (5.6)	62.0 (7.5)	52.0 (5.9)	49.5 (5.6)

particularly important influences on caged hen welfare, although all of the variables scored substantially higher than 50 (ie of some importance, where, again, 50 would be interpreted as neither important nor unimportant).

Performance of standards in terms of welfare variables

Table 7 shows how, for caged hens, Delphi participants rated the performance of the different livestock production standards in terms of the welfare variables. Again, these are mean scores out of 100 (standard deviations are in parentheses), where 0 denotes a very low performance and 100 a very high performance. FAWC recommendations are rated highest in terms of performance — substantially higher than

the standards for all of the welfare variables — followed by farm assurance schemes, requirements of food retailers, DEFRA codes and then legal requirements.

Indices of performance of standards

Table 8 shows the indices of performance of the different livestock production standards for caged hens, derived as described above for dairy cows. It can be seen that, as in the case of dairy cattle, FAWC recommendations have the highest overall performance associated with them (57.1) compared with the standards, in terms of the extent to which they address the important aspects of the welfare of caged hens on farms. These are followed by farm assurance

Table 5   Index of performance of livestock production standards/recommendations for dairy cattle.

Animal welfare variable	Livestock production standard/recommendations				
	Legal	DEFRA codes	FAWC	Farm assurance schemes	Major food retailers
Foot disorders, generally resulting in lameness	5.1	5.9	7.5	6.3	5.3
Mastitis	4.6	5.1	6.4	6.0	5.8
Other clinical disease	4.3	4.7	5.8	5.4	5.0
Failure to reproduce given adequate opportunity	3.1	3.7	4.8	4.3	3.5
Ability to perform normal, undisturbed behaviour	3.8	4.6	5.7	5.0	4.3
Abnormal, disturbed behaviour (being chased, lying in poor conditions, stereotyping etc)	3.7	4.7	5.8	4.9	4.2
Failure to grow or weight loss, which involves utilisation of functional body tissues (may be indicated by poor body condition)	3.7	4.5	5.4	4.8	4.3
Injury or pain (for example caused by accident, farm operation, human violence or other violence)	5.0	5.2	6.1	5.2	4.4
Frustration or discomfort caused by inadequate feeding or lying conditions	3.9	4.3	5.8	4.7	4.3
Hunger, thirst, thermal discomfort, or udder distension	3.4	3.5	4.5	3.8	3.6
Overall performance	40.7	46.2	57.8	50.5	44.6

Table 6   Mean importance of animal welfare parameters to overall on-farm welfare of caged hens across two rounds of Delphi survey. * Standard deviations are given in parentheses.

Animal welfare parameter	Mean importance	
	Round 1*	Round 2*
Injury and pain caused by being pecked, turning, wing-flapping, perching etc	78.3 (10.3)	76.2 (8.4)
Injurious pecking (indicating poor welfare in the pecker)	75.2 (13.2)	73.6 (10.3)
Bone and muscle weakness resulting from inadequate exercise	70.4 (14.2)	73.0 (10.4)
Space constraints to normal, undisturbed preening, turning, wing-flapping, perching etc	68.9 (16.2)	70.6 (12.9)
Clinical disease	68.9 (15.3)	69.9 (11.6)
Access to litter for dust-bathing, preening and hence reduction in abnormal behaviour	65.4 (15.7)	67.6 (10.6)
Access to appropriate nest sites for egg-laying and reduction in abnormal behaviour	66.3 (14.9)	67.6 (10.1)
Feather loss (caused by feather pecking, treading and abrasion)	65.3 (13.7)	66.7 (11.4)
Fear (caused by humans or other birds)	66.3 (11.6)	66.6 (10.2)
Abnormal repeated behaviour, such as pacing	62.6 (14.7)	64.9 (11.7)
Access to perches for resting and sleeping	65.7 (16.1)	63.8 (9.5)

schemes, the requirements of food retailers, DEFRA codes and, lastly, legal requirements.

Measure of compliance with standards and the impact on animal welfare on farms

The assessments of the impact of different standards on dairy cow and caged hen welfare do not, by themselves, provide information on the actual impact of these standards on the welfare of animals on farms. Information on the extent to which these standards are complied with on farms is needed. Thus, the numbers and proportions of the different farm species affected by the different standards (ie on livestock holdings that comply with those standards) need to be estimated. By combining these estimates with the

Delphi survey indices of the overall performance of each standard, a measure of the impact on the welfare of animals on farms can be derived. This is a relatively crude measure that combines the extent of compliance with standards and the performance of standards in addressing key animal welfare determinants. It relies greatly on the availability of information concerning the extent of compliance with different welfare standards on farms.

Table 9 shows the derivation of this measure of the impact of standards on the welfare of animals on farms for the two case-study farm systems. The performance index multiplied by the compliance ratio (the proportion of farm livestock of that species/production system that is actually produced to the standards concerned) gives an impact measure of the

Table 7   Mean performance of livestock production standards/recommendations for caged hens. * Standard deviations are given in parentheses.

Animal welfare parameter	Animal welfare standard/recommendations				
	Legal*	DEFRA codes*	FAWC*	Farm assurance schemes*	Major food retailers*
Injury and pain caused by being pecked, turning, wing-flapping, perching etc	46.8 (5.6)	47.5 (5.8)	61.3 (7.2)	51.5 (6.2)	48.9 (5.5)
Space constraints to normal, undisturbed preening, turning, wing-flapping, perching etc	42.1 (5.1)	44.3 (5.4)	59.0 (6.4)	50.6 (6.0)	49.3 (5.7)
Bone and muscle weakness resulting from inadequate exercise	36.6 (4.7)	38.9 (5.5)	55.3 (6.1)	46.1 (6.3)	45.2 (6.5)
Abnormal repeated behaviour, such as pacing	34.9 (6.4)	39.9 (6.5)	53.3 (7.2)	43.5 (6.3)	40.0 (5.8)
Access to litter for dust-bathing, preening and hence reduction in abnormal behaviour	34.4 (5.7)	39.6 (5.1)	56.5 (6.4)	48.3 (6.1)	43.9 (5.8)
Access to appropriate nest sites for egg-laying and reduction in abnormal behaviour	36.3 (6.1)	40.4 (5.4)	58.3 (7.3)	49.3 (6.5)	44.2 (6.6)
Injurious pecking (indicating poor welfare in the pecker)	38.5 (7.3)	44.4 (6.5)	57.7 (6.8)	48.4 (6.7)	47.4 (5.3)
Feather loss (caused by feather pecking, treading and abrasion)	35.7 (5.4)	40.5 (6.0)	56.6 (7.3)	48.1 (5.8)	46.1 (6.2)
Access to perches for resting and sleeping	34.2 (5.9)	38.6 (5.8)	57.4 (6.3)	47.1 (5.3)	45.5 (5.9)
Clinical disease	44.3 (6.5)	46.5 (4.9)	56.3 (7.1)	52.6 (5.7)	50.9 (6.2)
Fear (caused by humans or other birds)	36.6 (5.2)	38.4 (5.0)	55.8 (6.3)	44.2 (6.4)	42.1 (7.2)

extent to which each type of standard has a positive impact on animal welfare. An impact measure score of 100 would denote that compliance with the standard is addressing all of the welfare needs of the farm livestock concerned. Impact measures for FAWC recommendations and for DEFRA Codes of Recommendations are not included in Table 9, because no information was available on compliance with these standards at the time of the study. The compliance ratios were constructed from information supplied by the SVS (based on data from their on-farm welfare inspections of hundreds of farms each year), the relevant farm assurance schemes (the National Dairy Farm Assured Scheme, the British Egg Industry Council Lion Mark Scheme and the RSPCA Freedom Food scheme) and commercial data on the proportions of dairy cows and caged hens affected by the major food retailers' livestock production specifications.

The impact measures appear to show that compliance with legal requirements has the greatest impact on the welfare of dairy cattle on farms. This is mainly because relatively large numbers of dairy cattle are on holdings that comply with these standards. The dairy farm assurance scheme does not have as much impact (despite having a higher performance index), largely because, as a relatively new scheme at the time of the study, it covers a much smaller proportion of the national dairy herd. The impact measure for the requirements of major food retailers is relatively low because these requirements affect a smaller proportion of dairy cattle (and the performance index is not high).

In the case of caged hens, legal requirements have a relatively low impact measure because of a relatively low compliance ratio combined with a relatively low performance index. The farm assurance scheme has the highest impact

measure and food retailer requirements have the lowest impact measure (largely attributable to a relatively low compliance ratio).

Discussion

The aim of the Delphi survey was to provide a quantitative measure of the impact of DEFRA policy, as well as other influences, on levels of on-farm animal welfare in the UK. The framework developed provides a basis for comparison of the level of welfare associated with different farm animal welfare standards across species and over time (if the exercise is repeated periodically). Furthermore, it permits quantification not only of relative levels of welfare in aggregate, but also of individual elements of welfare, indicating the areas in which standards are performing particularly well or badly.

Clearly, there are a number of limitations to the study. First, the study has used the Delphi technique to assess the impact of standards on welfare, according to the opinions of a panel of 'experts'. This method of assessment relies on the subjective judgements of people (although these judgments are informed by objective information) and is no substitute for objective assessment of the welfare of animals on farms. However, in the absence of data to provide such an objective assessment, the approach presented here has considerable merit in helping to evaluate the contribution of different standards to improving animal welfare on farms. Of course, the participants of a Delphi survey are important. There is always the possibility that very different results might ensue depending on the panel of experts participating. This potential problem was minimised in this study by (a) carefully selecting individuals who have a particular expertise concerning farm animal welfare, (b) selecting a large sample of such experts, and (c) testing within the sample to see if

Table 8 Index of performance of livestock production standards/recommendations for caged hens.

Animal welfare variable	Livestock production standard/recommendations				
	Legal	DEFRA codes	FAWC	Farm assurance schemes	Major food retailers
Injury and pain caused by being pecked, turning, wing-flapping, perching etc	4.7	4.8	6.1	5.2	4.9
Space constraints to normal, undisturbed preening, turning, wing-flapping, perching etc	4.1	4.3	5.7	4.9	4.8
Bone and muscle weakness resulting from inadequate exercise	3.5	3.7	5.3	4.4	4.3
Abnormal repeated behaviour, such as pacing	3.2	3.7	4.9	4.0	3.7
Access to litter for dust-bathing, preening and hence reduction in abnormal behaviour	3.2	3.6	5.2	4.4	4.0
Access to appropriate nest sites for egg-laying and reduction in abnormal behaviour	3.2	3.6	5.2	4.4	3.9
Injurious pecking (indicating poor welfare in the pecker)	3.4	3.9	5.1	4.3	4.2
Feather loss (caused by feather pecking, treading and abrasion)	3.1	3.6	5.0	4.2	4.0
Access to perches for resting and sleeping	3.0	3.4	5.0	4.1	4.0
Clinical disease	3.8	4.0	4.8	4.5	4.3
Fear (caused by humans or other birds)	3.1	3.2	4.7	3.7	3.5
Overall performance	38.3	41.8	57.1	48.2	45.8

Table 9 Measures of the impact of standards on the welfare of dairy cattle and laying hens.

Species	Standard		
	Legal	Farm assurance schemes	Food retailer
Dairy cattle			
Performance index	40.7	50.5	44.6
Compliance ratio*	0.951	0.501	0.420
Impact measure	38.7	25.3	18.7
Caged hens			
Performance index	38.3	48.2	45.8
Compliance ratio*	0.645	0.720	0.462
Impact measure	24.7	34.7	21.2

* The compliance ratio is the proportion of UK livestock directly affected by the standard. Effectively it denotes the 'sphere of influence' of the standard.

different groups give very different responses (eg veterinary and non-veterinary respondents gave very similar results). The response rate (60%) and sample size (78) of the Delphi survey was also relatively good in comparison with other studies (eg Whay *et al* 2003 achieved a response rate of 22%, with 35 experts participating).

The welfare variables identified for each livestock production system may not take account of all factors affecting welfare. However, the variables chosen were thought to reasonably encompass the main factors affecting the welfare of the livestock concerned and are compatible with the 'Five Freedoms' as put forward by FAWC (FAWC 1992). Also, Delphi survey respondents had the opportunity both to revise the welfare variables and to weight them according to their own knowledge and beliefs (see Whay *et al* 2003 for a system of suggested welfare indicators for welfare assessment of farm animals also derived from a Delphi survey of

experts). Concerning relationships between variables, it is clear that some variables may be related to one another in some way. This is virtually inevitable given the interaction of factors that contribute to the welfare status of an animal. In some cases, there may have been a degree of 'double counting' for some variables. For example, in the case of the caged hen welfare variables, there may be some overlap between variables such as 'injury and pain caused by being pecked, turning, wing flapping, perching etc' and 'feather loss (caused by feather pecking, treading and abrasion)'. Such relationships do not invalidate the method or the results but they might have resulted in a slightly greater weight being given to a particular indicator of welfare.

Comprehensive and detailed data on compliance with various standards are somewhat lacking. Farm assurance schemes have information on producers who fail to comply with their standards (ie the number of suspensions), although the

rigour with which standards are monitored and enforced is not always entirely clear and certainly varies from one scheme to another. SVS data on non-compliance with legal requirements and with the DEFRA Codes of Recommendations relate to a relatively large sample of farms but have lacked the detail necessary for any comprehensive assessment of the extent to which standards are complied with. However, the SVS system of recording has been changed and developed to provide more comprehensive data relating to the welfare of animals on inspected farms, which would be available for future studies. Information on the animal welfare requirements of major food retailers is often confidential to contractual arrangements. Also, because of the general lack of detailed data on failures to comply with the different standards, producers recorded as failing to comply with standards have been assumed, in this study, to fail to comply with all components of the standards whereas, in reality, many may have failed on just one component. Thus the compliance ratios used for the analysis are relatively crude figures but based on the best information available.

Government policy, and other influences on welfare, may have both direct and indirect impacts. For example, the farm assurance scheme representatives noted that their standards were influenced both by the DEFRA welfare codes and by FAWC recommendations. This makes it difficult to attribute changes in farm animal welfare exclusively to DEFRA policy (or to other influences). In principle, the expert survey method can take account of the influence of these interactions, since the experts can incorporate such considerations into their scorings.

The survey did not take account directly of the impact of knowledge gained from animal welfare research. In recent years, laws, government codes, farm assurance schemes and retailer codes have come to rely more and more on scientific evidence relating to animal welfare and animal health (Broom 2002). These scientific reports and reviews by individual scientists are used by bodies such as FAWC in producing their reports. This situation may explain why the experts questioned rated FAWC recommendations highest in terms of performance. The rating may have been high because FAWC recommendations were perceived as being the nearest to the scientific facts among the choices available in the survey. DEFRA-funded research has made a contribution to the pool of international scientific knowledge about farm animal welfare. Hence, DEFRA policy has a significant impact on farm animal welfare by this route, as well as by purveying information and enforcing legislation.

Clearly these limitations prevent a full quantitative assessment of the impact of government policy, or other standards, on the welfare of animals on farms. However, in the absence of methods and data for objective scientific assessment of the welfare of animals on farms and for separating out the influence of government policy from other factors, the method reported here is useful because it helps to identify specific areas where policy or standards are performing relatively poorly or well in terms of improving welfare. The method provides a framework within which the influence of standards on welfare can be considered and helps to identify areas for improvement and areas where more information or research is required.

It is worth noting again that all of the animal welfare mean performance and impact scores derived from this study are substantially less than 100 (where 100 denotes that a standard or policy completely addresses the welfare concerns associated with a particular aspect of livestock production). In many cases, the scores are less than 50, showing that there is substantial scope for standards to further improve the welfare of farm animals. The findings also show the value and potential scope of farm assurance schemes in improving the welfare of animals on farms, given that they incorporate both government standards and other recommendations and requirements (they are able to stipulate more stringent standards much more quickly than government legislation). Their success depends on schemes striking the right balance between the stringency of their welfare standards and the number of farm animals affected by those standards as a consequence of farmer membership.

Animal welfare implications

The study presented here describes a method for assessing the impact of different standards on animal welfare by harnessing expert judgements using the Delphi survey technique. Assessments of the impact of DEFRA policy, farm assurance schemes and retailer specifications have identified how well these standards perform in terms of their effects on key farm animal welfare variables for dairy and cage egg production. The study highlights that there remains considerable scope for these standards to improve the welfare of farm animals.

A number of policy recommendations can be made as a result of the research reported here. First, there is a clear need for more comprehensive, regular, random surveys of on-farm welfare to monitor compliance with welfare standards (legislation and welfare codes) and the welfare of farm animals over time. Records from such surveys should show which particular aspects of welfare standards producers are failing to comply with and the number of animals affected. In fact, the SVS now has a revised recording system for its welfare inspections, partly prompted and informed by this study, which goes some way towards achieving this. Second, there is a need to collect farm data on the costs of compliance with standards. These costs can then be weighed against the benefits of the welfare improvements resulting from the implementation of higher standards through legislation etc. Finally, the importance of farm assurance schemes in implementing government policy regarding animal welfare and other standards needs to be recognised. Other studies (eg Bennett *et al* 2003 in their study of DEFRA policy on the control of food-borne pathogens in live farm animals) have also found that farm assurance schemes are an important vehicle for achieving compliance with government-recommended production standards. Incorporation of welfare codes and

other recommendations into farm assurance schemes can result in greater producer compliance with higher levels of welfare standards than achieved by legislation or welfare codes alone. Recognition of this means that government might seek various ways of directly influencing farm assurance schemes. For example, a number of farm assurance schemes already incorporate some FAWC recommendations ahead of, or in addition to, updated welfare codes.

Acknowledgements

References

Appleby MC and Hughes BO 1997 *Animal Welfare*. CAB International: Wallingford, UK

Bennett R, Harper G, Henson S, French N and Moore A 2003 Economic evaluation of DEFRA policy on food-borne pathogens in live animals. Report to the Department for Environment, Food and Rural Affairs. Department of Agricultural and Food Economics, University of Reading, UK

Bennett R, Henson S, Harper G, Blaney R and Preibisch K 2000 *Economic Evaluation of Farm Animal Welfare Policy: Baseline Study and Framework Development. Report to the Ministry of Agriculture, Fisheries and Food*. Department of Agricultural and Food Economics, The University of Reading, UK

Broom DM 1986 Indicators of poor welfare. *British Veterinary Journal 142*: 524-526

Broom DM 1988 The scientific assessment of animal welfare. *Applied Animal Behaviour Science 20*: 5-19

Broom DM 1999 The welfare of dairy cattle. In: Aagaard K (ed) *Proceedings of the 25th International Dairy Congress, Aarhus 1998. III Future Milk Farming* pp 32-39. Danish National Committee of IDF: Aarhus, Denmark

Broom DM 2001 Assessing the welfare of hens and broilers. *Proceedings of the Australian Poultry Science Symposium 13*: 61-70

Broom DM 2002 Does present legislation help animal welfare? *Landbauforschung Völkenrode 227*: 63-69

Broom DM and Johnson KG 1993 *Stress and Animal Welfare* p 211. Kluwer: Dordrecht, The Netherlands

DEFRA (Department for Environment, Food and Rural Affairs) 2002 Animal health and welfare. Available at: www.defra.gov.uk/animalh/welfare

FAWC (Farm Animal Welfare Council) 1992 FAWC updates the Five Freedoms. *Veterinary Record 131*: 357

FAWC (Farm Animal Welfare Council) 2001 *Interim Report on the Animal Welfare Implications of Farm Animal Assurance Schemes*. Department for Environment, Food and Rural Affairs: London, UK

Fraser D 1995 Science, values and animal welfare: exploring the 'inextricable connection'. *Animal Welfare 4*: 103-117

Linstone H and Turoff M 1975 *The Delphi Method: Technologies and Applications*. Addison-Wesley: Reading, MA, USA

McEachern M and Tregear A 2000 Farm animal welfare in the UK: a comparison of assurance schemes. *Farm Management 10*: 685-708

Whay HR, Main DCJ, Green LE and Webster AJF 2003 Animal-based measures for the assessment of welfare state of dairy cattle, pigs and laying hens: consensus of expert opinion. *Animal Welfare 12*: 205-217