The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK

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Experimental welfare assessment and on-farm application

SA Edwards

School of Agriculture, Food and Rural Development, University of Newcastle, King George VI Building, Newcastle upon Tyne NE1 7RU, UK; email: sandra.edwards@ncl.ac.uk

Abstract

The assessment of animal welfare is a complex subject which gives rise to divergent views and debate. It is generally accepted that scientific welfare assessment must involve multidisciplinary approaches, and that to interpret results unambiguously, a high level of control over the experimental conditions is required. Such considerations would appear to militate against attempts to measure welfare in a practical farm situation, where systems are relatively uncontrolled and contain many confounding factors to complicate interpretation. In consequence, fundamental welfare scientists sometimes consider that on-farm welfare assessment is of limited value. However, adherents emphasise that on-farm application is the final objective of all livestock welfare science endeavours, and also gives unique options for large-scale population studies and access to a diversity of environmental circumstances. On-farm welfare assessment not only provides an opportunity for extending knowledge on animal requirements, but is also a necessary tool in the growing requirement to assess and certify animal welfare status for legislators and consumers. However, the economic and time limitations, combined with difficulty of close access to individual animals, restrict the range and detail of possible measures. It is also essential that a consensus exists that the measurements taken are objective and meaningful to stakeholders. These constraints have tended to drive the techniques used in Farm Assurance schemes towards assessment of resource provision and management records. However, animal-based measures of health and behaviour are now being more widely explored, and the validation and standardisation of simple integrative measures for such approaches is an important future development.

Keywords: *animal welfare, farm assurance, on-farm measurement, stakeholder perception, welfare assessment*

Introduction

On-farm welfare assessment involves the practical evaluation of animal state under commercial farm conditions. This is an exercise carried out by scientists and practitioners for many different reasons, including assessment of adherence to legislation, assessment of welfare standards for the purposes of farm assurance schemes, development of practical methods for production system improvement and experimental investigation of scientific welfare principles. This paper explores the relationships between fundamental welfare science and on-farm assessment in these different contexts, discusses the methodological and interpretational challenges inherent in working under practical farm conditions and highlights the significant opportunities offered by farm studies for improving animal welfare through these varied activities.

Conflicting opinions about on-farm welfare assessment

The assessment of animal welfare under commercial farm conditions is sometimes viewed as a second-class science by fundamental research scientists. In support of this opinion, they cite the many difficulties experienced in trying to take objective measures under these conditions. The most obvious problem relates to the lack of control over conditions which pertain during any given farm visit. On any given day, seasonal and climatic factors can be highly variable, and these can have a significant impact on both physical and behavioural measures in extensively kept livestock (eg Buckner *et al* 1998). In contrast, it could be argued that the intensive livestock sectors maintain animals under very controlled environmental conditions, often analogous to the best laboratory circumstances. However, here a different factor can come into play because the nature of the close day-to-day interactions between the animals and their human carers is outside the control of scientists, but can have a major influence on both behavioural and physiological measures of welfare (eg Hemsworth *et al* 1987).

A second criticism of on-farm welfare assessment is that treatments or circumstances are frequently highly confounded. Farms operate production systems rather than controlled comparisons and these systems, by definition, can differ simultaneously in many respects (Edwards 2000). For example, comparison of slatted and straw bedded housing systems for pigs (eg Scott *et al* 2006) is likely to involve differences not only in substrate provision, but also in floor type, nutrition, space allowance, climate and degree of human contact. It is possible to select out a single factor

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of difference for evaluation under experimental conditions, and such experiments are very helpful in understanding the role of individual factors in animal welfare. However, it is questionable whether the results of many single factor comparisons have anything other than academic relevance, since they compare systems which would never occur under practical conditions. This trade-off between scientific precision and practical relevance is at the root of much debate on the value of on-farm welfare assessment. To individually assess the effect of all the different factors, and their interactive effects, involved in typical commercial systems is plainly unrealistic, but to extrapolate conclusions from confounded studies is scientifically invalid, although meta-analyses of results from many different studies may help. A combination of both approaches would seem to offer the best way to advance applied welfare science (Edwards 2000).

The third factor making interpretation of on-farm welfare measures difficult is the presence of diverse and usually unknown animal histories. The normal biology of an animal, and its response to a welfare challenge, will depend upon its genetic predisposition, previous experience and current circumstances. It has been known for many years that there are significant breed differences in behaviour and physiology relevant to welfare (eg in maternal behaviour; Dwyer & Lawrence 1999) and it has been demonstrated that selection line differences within breeds can also occur (eg in feather pecking; Jones *et al* 1995). Practical farms use diverse breeds, and often have mixed breed groups and crossbred animals, making genetic factors difficult to control. Similarly developmental history of the animals, in terms of both physical and social environment, can have many effects on welfare-relevant measures (eg fear in poultry; Jones & Waddington 1992), but is generally uncontrolled and unknown.

Perhaps the most telling criticism is that the measures used in on-farm welfare assessment are oversimplified and therefore provide information of limited value. Measures are certainly constrained by circumstances such as difficulty of access to the animals, especially under extensive conditions, and lack of sophisticated facilities. Furthermore, in many countries, legal constraints on locations in which potentially stressful scientific procedures can be carried out (eg the Animals Scientific Procedures Act in the UK) can preclude all but the most simple invasive or interventionist measures. Such considerations would appear to militate against attempts to measure welfare in a practical farm situation, and lead some to suggest that on-farm welfare assessment can only deliver science of limited value. However, the adherents would point out that on-farm application is actually the final objective of all livestock welfare science endeavour and, unless appropriate methodologies can be implemented, welfare science will remain in the realms of academia with limited impact in the real world.

Measures of welfare

While applied scientists recognise that current on-farm welfare measures have limitations, they might validly complain that fundamental science has failed to deliver good welfare assessment tools which they can apply. Welfare criteria have been defined from different perspectives, focusing on natural living, biological function, and affective state (Fraser 2003). The concept of natural living has often been dismissed by experimental welfare scientists, since it can be expressed as subjective opinion making no allowance for adaptability of animals, and is therefore of questionable validity in determining real animal welfare state. However, it is important to remember that the evolutionary context of a species has governed the priorities for its survival and hence the genetic adaptations which have taken place. Physiological and behavioural strategies which have been essential for survival under natural conditions have often become an integral part of the biology of the species and can persist under domesticated conditions. This process has generated true behavioural needs in the animals (eg nest building in periparturient sows despite the redundant role of the nest for piglet survival; Lawrence *et al* 1994). Thus, whilst re-creation of natural habitat is not always necessary to ensure good welfare, meeting inherent behavioural needs by appropriate environmental provision is a welfare requirement. This might require assessment of whether key aspects of the natural environment are adequately represented in farming systems, based on a clear understanding of their role in the species biology.

Biological functioning, at first sight, is a type of measure which is very relevant to practical farming and on which farmers and welfare scientists should find common ground. In an evolutionary sense, fitness can be defined by reproductive success: this is the goal of all commercial breeding enterprises and is often well documented in farm records. There are, however, some qualifications on the interpretation of such measures. In evaluating true biological functioning, a long-term view of reproductive success is necessary. Thus a high average herd reproductive output, if combined with a high culling rate of individual animals unable to cope metabolically with such pressure, cannot be considered a positive welfare indicator. Furthermore, under modern farming conditions, controlled reproduction involving pharmaceutical intervention for oestrus induction, artificial insemination, cross-fostering, artificial rearing and early weaning may mask true individual differences in fitness. For some types of farming enterprise, not all animals live to reproduce because they are slaughtered for meat or other product at a relatively immature age. It could be considered that, in such a situation, measures indicative of potential reproductive success are still valid measures of biological fitness. These would include good health, fast growth and efficient utilisation of nutrients for body tissue accretion, which are also standard measures of commercial production performance (English & Edwards 1999). However, once again, the long-term sustainability of high levels of performance and the extent of pharmaceutical or other interventions are valid qualifiers in interpreting such measures in a welfare context.

The most difficult aspect of welfare to evaluate under farm conditions are measures of affective state. Classically this

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has been assessed by measures of stress physiology, and in particular changes in activity of the sympathetic nervous system and HPA axis, or by observation of abnormal behaviours (English & Edwards 1999). Such measures are often either invasive or very time consuming, and can require repeated interventionist approaches which are not acceptable under farm conditions. More sophisticated approaches inferring affective state under given circumstances from the results of preference testing and 'willingness to pay' by animals in behavioural demand function assessments have been very informative (Jensen *et al* 2004), but correct interpretation often involves carefully controlled experimental designs and sophisticated operant equipment. There are, however, notable exceptions in which very valuable assessments of animals preferences or circumstances giving rise to negative emotions have been made under farm conditions (Rushen 1996).

Whichever welfare perspective is adopted, it is generally accepted that overall welfare assessment must involve multidisciplinary approaches and that, to interpret results unambiguously, a high level of control over the experimental conditions is required. To deal with such issues as individual differences, developmental changes and diurnal variations in measures, critical assessment of welfare state often involves repeated interventionist approaches, either with invasive physiological measures or controlled behavioural tests. These pose difficulties under commercial farm conditions.

Interpretation of welfare measures

While many different and validated measures of welfare therefore exist, a major issue lies in the interpretation and weighting of these measures in an ethical context in order to draw applicable practical conclusions. The different aspects of welfare, exemplified by the requirements of the Five Freedoms (Farm Animal Welfare Council [FAWC] 1993), may sometimes be in conflict, resulting in disagreement between different individual welfare measures made within any overall assessment. This may apply to different measures made on the same animal to assess the same aspect of welfare state. For example, physiological and behavioural indicators may sometimes appear to suggest different answers (eg for pain associated with different methods of castration; Molony *et al* 1995). Secondly, there may be differences in response of different individuals in the population under the same apparent circumstances. It is known that, because of variable coping strategies arising from both genetic and developmental differences, different animals within a population may respond in different ways to welfare challenges (Hessing *et al* 1994). Thirdly, there may be differences between different welfare domains, for example behavioural and health indicators may suggest different conclusions regarding the provision of bedded systems for pigs (Scott *et al* 2006).

Where such apparent conflicts occur, there is a need to weight different measures in some way to come up with an overall conclusion about the absolute or relative welfare status in a given circumstance. In order to apply such a weighting, which is currently a subjective rather than objective exercise, it is necessary to consider the reason why the welfare assessment is being made and for whom the information is required. Whilst in the ideal world the answer would be required for purely ethical reasons, to enhance the welfare state of the animal, in the real world there are often also more pragmatic reasons. These include enforcement of legislation and documentation for product marketing schemes, which require unambiguous measures that will be accepted by the stakeholders involved.

Stakeholder perspectives on welfare (the 'P' words)

At a scientific level, welfare can be considered as the result of the interactions between the *predispositions* of the animal, the environmental *provisions* made for it and the *processes* to which it is subjected. However, many different stakeholders have an interest in the outcome for widely differing reasons (Figure 1). For the animal itself, one can consider that the objective is to maximise *pleasure*, whilst minimising *pain* and *perversion* (abnormal behavioural or physiological modifications necessary to cope under prolonged challenging conditions). In contrast, the farmer must seek to maximise *production* and *profitability* (although *pride* in the farming enterprise can still be a significant driver for some people). For society and the consumer, the required output can be considered as a *product* of acceptable quality and *price*, and *peace of mind* about the way in which that product was produced. In the latter case, this will be strongly influenced by both the *perception* of the production system and the *preconceptions* that exist about the correct way for animals to live. These can be highly subjective and individual opinions. For the scientist, seeking to inform and benefit these other stakeholders, the goals are *precision* of measurement and *prediction* of outcomes, illustrating a true understanding of the underlying mechanisms. However it must also be recognised that *publications*, for personal career advancement, are a not inconsiderable driver of scientific activity.

These different needs, from different stakeholders, therefore generate two different types of use for on-farm welfare assessment. At the farmer-society interface, the need is for assessment of outcomes in a way which can be used in legislation and certification processes for Farm Assurance schemes. At the farmer-scientist interface, the need is for understanding of underlying processes which will allow development of risk management strategies to reduce welfare problems and refine efficient production systems.

Requirements for outcome assessment measures

On-farm welfare assessment measures for outcome assessment purposes must be practicable within the constraints imposed by Farm Assessment schemes. This means that they must be quick, cheap and sufficiently flexible to adapt to different production systems. They need to be repeatable, objective and representative, such that relatively non-specialised assessors can make a valid assessment which truly reflects the farm in question. Above all, they need to

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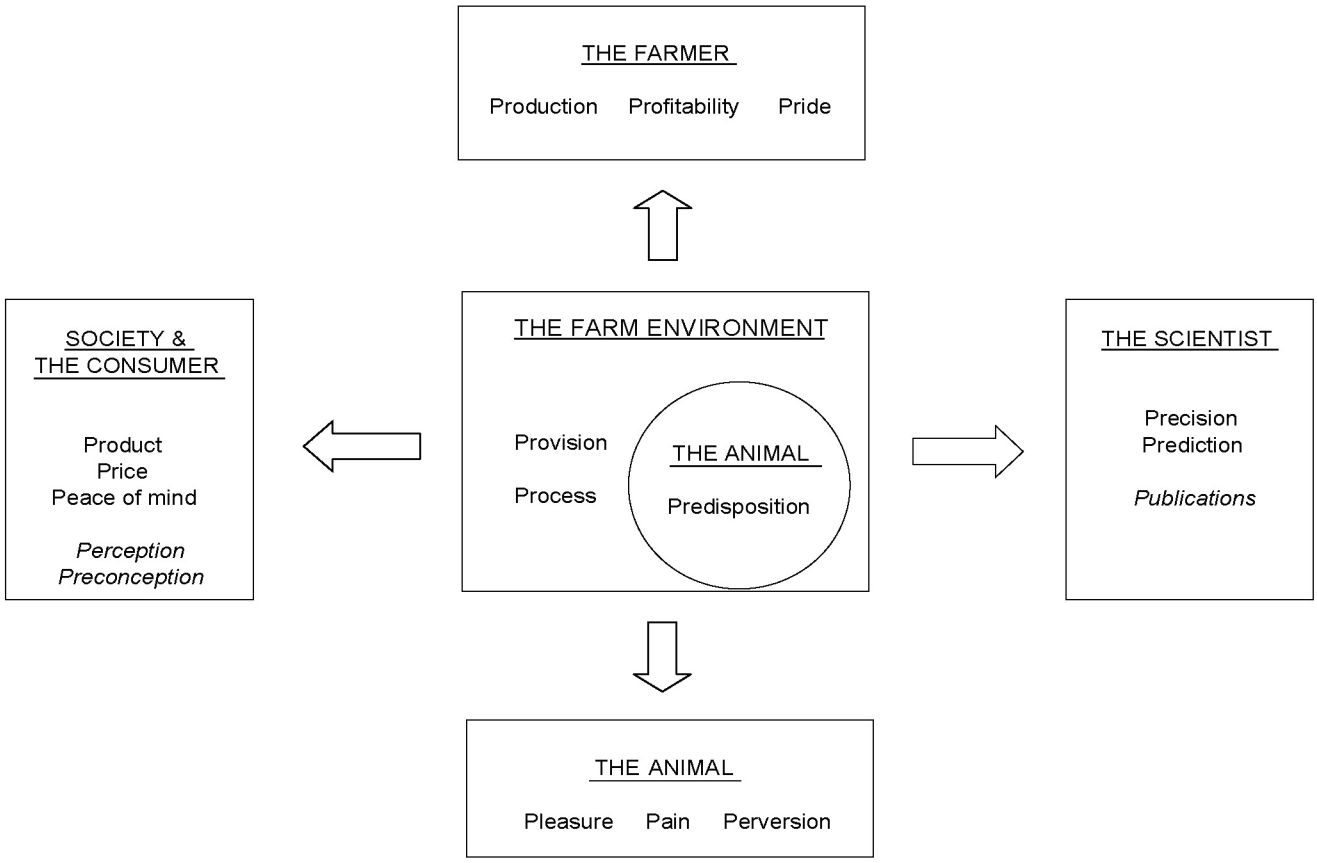
Figure 1



Different stakeholder perspectives regarding animal welfare. Their desired outcomes from on-farm welfare assessment can be summarised by the 'P'words.

be meaningful to the end user, in this case society, if they are to have credibility for the purpose for which they are being obtained. For reasons of speed and simplicity, on-farm assessment measures taken to date have generally focused on resource provision (eg space, climate, food), with management records often used to assess efficacy of this provision (eg mortality, morbidity, veterinary inputs, reproductive and productive performance). Such indirect measures do give a good indication of the likelihood of long-term welfare adequacy of a system, since correct resource provision provides the appropriate context for meeting the welfare needs of many animals over the long term, and management records indicate any gross inadequacy causing breakdown in biological functioning. However, such measures have been justly criticised as making no direct assessment of the welfare state of the animals themselves.

In response, a search for practical measures which can be made on samples of individual animals has ensued. Two approaches can be considered. One involves abattoir screening, allowing large numbers of animals from different farms to be screened for retrospective health and welfare indicators in a single abattoir visit (eg Valros *et al* 2004), with development of automated recording and reporting systems now fast advancing. The other approach involves population sampling on farms and is less well developed. For this exercise, there is a need to find quick and simple integrative measures of different aspects of welfare. Some measures of this nature do exist and have been successfully used. For example, skin lesion scoring (which integrates consequences of both physical and social challenges; de Koning 1985), body condition scoring (which integrates components of health and nutritional adequacy), health measures (eg lameness, diarrhoea) and measures of the consequences of vice (eg tail biting and feather pecking) all provide valid information on real welfare issues of significance. Such measures, although primarily assessments of impaired physical state, are likely to be associated with psychological stress but they will not cover all aspects of affective state. More work is needed to develop new and practical on-farm measures to assess this aspect of welfare. Systematic observational measurements of abnormal behaviour are unlikely to be practical on time grounds, but staged intervention measures of provoked responses which are currently undergoing development could be carried out within a limited visit time. Similarly non-invasive measures

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of chronic stress physiology, such as corticosteroids or their metabolites in faeces, urine, saliva or hair, have yet to deliver reliable and applicable outcomes but have the potential for development of on-farm tests in the future (Möstl & Palme 2002). The validation and standardisation of simple integrative measures for such approaches is an important future development, and is the subject of the current EU 'Welfare Quality' project.

Opportunities for measures to enhance understanding

While on-farm studies have many drawbacks, as discussed earlier, they also offer significant opportunities for advancing critical scientific knowledge. On-farm assessment gives options for large-scale population studies which are beyond the scope of most research institutions (eg in studies of behavioural genetics of farm livestock; Knol *et al* 2002). Farm studies also offer access to a greater diversity of environmental circumstances, representative of commercial practice and therefore highly relevant, which facilitate epidemiological studies using multivariate statistical methodologies (eg in risk factors for feather pecking; Huber-Eicher & Audige 1999). These provide valuable complementary approaches to the detailed individual assessments in fundamental studies under laboratory conditions.

Conclusions

On-farm welfare assessment not only provides opportunities for extending knowledge on animal requirements, but is also a necessary tool for the growing requirement to assess and certify animal welfare status as part of Farm Assurance schemes for legislators and consumers. Whilst the circumstances place constraints on the complexity and invasiveness of assessment methodologies which can be employed, simple and objective measures can readily be made and provide valid information on real welfare issues of significance. Controlled experimental studies and on-farm studies should therefore be seen as complementary – each can inform the other and develop in tandem the future knowledge on welfare science.

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