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Assessment Methods and Indicators of Animal Welfare

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ABSTRACT

Animal welfare is the ability of an animal to cope physiologically, behaviorally, cognitively and emotionally with its physiochemical and social life environment. With the growing need for reliable methods to assess farm animal welfare, a scientific method for assessing their body language would help to better understand the experience of animals and to interpret health and welfare measurements more accurately. This article reviews various welfare indicators, assessment methods and scientific approaches towards assessing animal welfare. There is no established method for assessing animal welfare; however various frameworks have been put forth. Generally three approaches are followed in assessing animal welfare: (1) naturalistic, (2) functional and (3) subjective. There are various types of indicators which directly reflect the welfare status of an animal. In broader terms, welfare indicators can be grouped under four categories: (1) behavioral, (2) physical, (3) physiological and (4) production oriented. Aggregating relevant welfare indicators into such a welfare protocol, involves evaluating suggested indicators step-by-step concerning their independent welfare relevance, their marginal welfare value and finally their applicability for on-farm studies. The methodology by which the welfare assessed differs between each individual approaches. The latest development in the field is the construction of new frameworks for assessment of animal welfare intended to integrate existing knowledge and to provide practical tools to improve animal welfare.

Key words: Animal welfare, health indicators, behavior, farm animals, companion animals, preference test

INTRODUCTION

Animals are used by human for many purposes including the production of food, clothing, draught power, companionship, recreation, scientific research and education. In all cases, some degree of modification of the genetics and/or environment of the species concerned has taken place (Albert, 1983). Those responsible for the animals and society as a whole, have a duty to ensure that the welfare of animals is not unacceptably compromised in these processes (Leaver, 1999). Animal welfare deals with related, but different, questions of health and well-being of the animals

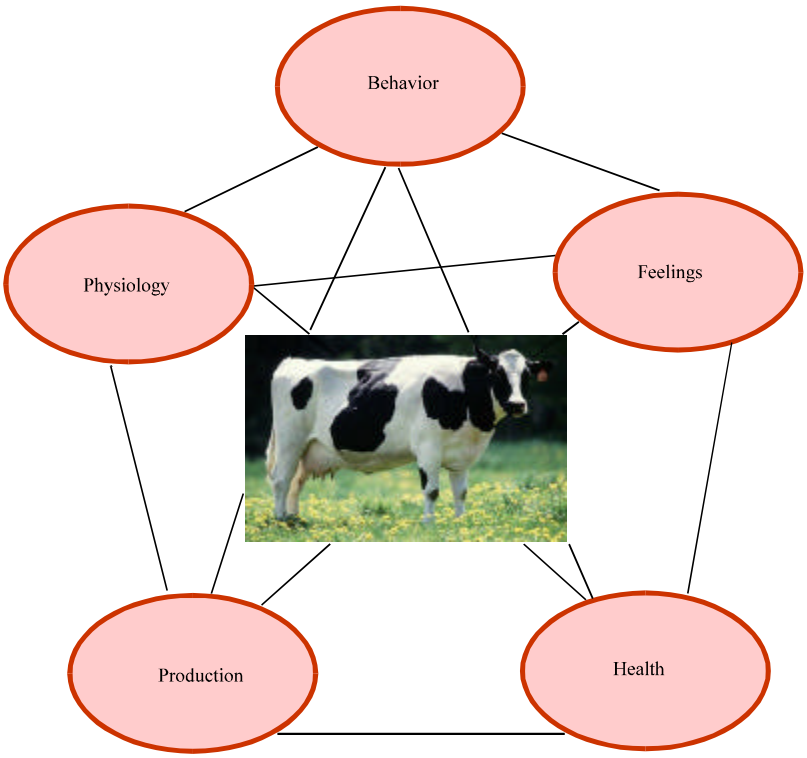

Fig. 1: General concept of animal welfare

in any given situation (McGlone, 2001; Webster, 2005). Whilst this is also often an emotive issue, scientists are continually seeking ways to provide objective and informed judgements (Sorensen *et al.,* 2001). Figure 1 shows the general concepts of animal welfare involving adaptations of normal physiology and behavior leading to health status that ultimately increases productivity.

The need for reliable methods to assess farm animal welfare is growing. It is often said that one cannot know how animals feel, however, as is the case with humans, animals express body language representing how they perceive their world (Swanson, 1995). A scientific method for assessing this body language would improve our understanding of the experiences of farm animals and to interpret health and welfare measurements more confidently (FAWC, 2001).

There is no doubt that animal welfare has been receiving growing recognition in the veterinary field, especially since the 1990s (Durning and Brough, 1991; Becker, 1992). The first animal welfare session was held at the 26th World Veterinary Congress in 1992 and the Royal College of Veterinary Surgeons and Universities Federation for Animal Welfare held an important animal welfare Symposium in 1998. Between 1996 and 2004, the International Companion Animal Conference held six meetings at which, among other things, veterinary involvement in welfare matters was discussed. However, this increasing attention certainly does not mean that there is any consistency in the definition or evaluation of animal welfare.

One of the reasons that animal welfare is often dealt with people to form opinions inside certain paradigms or from a value-judgement point of view. This implies that specific starting points, which will lead to predictable outcomes. Such views may appear self-evident within particular circles, but every one of those views excludes all other opinions (Maschio, 2006). A more universal approach

dealing with animal welfare could be achieved by establishing a science-based assessment (Capdeville and Veissier, 2001). Such an approach to animal welfare should attempt to accommodate most views in widely accepted guidelines. However, before discussing science-based assessment, it is appropriate to recapitulate some general views on animals and their welfare (Sejian, 2007a). The reason is to attempt neither to leave anyone behind in the process nor to establish a divide between scientists and 'non-scientists' (Leeb *et al.*, 2001).

Animal protection is a human action but animal welfare is a varying quality of any living animal. The scientific study of animal welfare has developed rapidly during the last fifteen years. The concepts have been refined and a range of methods of assessment have been developed. Some measures of animal welfare involve assessing the degree of impaired functioning associated with injury, disease and malnutrition. Other measures provide information on animals' needs and affective states such as hunger, pain and fear, often by measuring the strength of animals' preferences, motivations and aversions. Others assess the physiological, behavioural and immunological changes or effects that animals show in response to various challenges (Sejian, 2007b; Sejian *et al.*, 2010a, b). Such measures can lead to criteria and indicators that help to evaluate how different methods of managing animals influence their welfare. This article reviews the various welfare indicators, assessment methods and scientific approaches that are available for assessing animal welfare.

DEFINITION OF ANIMAL WELFARE

Animal welfare is a concept with both ethical and scientific dimensions, but lacks an unambiguous definition (Duncan, 1993). A scientific definition of animal welfare would be: the ability of an animal to cope physiologically, behaviorally, cognitively and emotionally with its physiochemical and social life environment, including the animal's subjective experience of its condition (Gonyou, 1993; Duncan and Fraser, 1997; Scott, 2004). Under modern production systems animals must adapt to environmental conditions to maintain heath and production. According to farm animal welfare council the five freedoms that are required to ensure that animals are in stress free environment are: (1) Freedom from hunger, thirst or malnutrition, (2) Freedom from thermal or physical distress, (3) Freedom from disease or injury, (4) Freedom from fear and (5) Freedom to express most normal behavior.

VETERINARIANS AND WELFARE ASSESSMENT

Expertise in animal welfare assessment is scarce. Animal welfare scientists are experts in mental and natural aspects of welfare, but usually they do not carry out extension work. Veterinarians are experts in physical welfare, but they may not be adequately equipped to give a holistic summary of how an animal or a group of animals are faring. Judgements of welfare are influenced by values. However, judgements should become easier as more is known about the factors affecting the welfare of a given species within a particular management system and how to integrate these factors. Veterinarians are highly skilled at integrating information and this is valuable in welfare assessment. Animal welfare, like disease severity, exists along a continuum and is qualitative. Disease severity ranges from nonexistent (the animal does not have the disease) to extreme (the animal is moribund). Welfare ranges from optimal (the animal's body and mind are in an optimal state and his/her nature is satisfied) to minimal (none of the 3 aspects of welfare is good). The difference between assessing welfare and assessing disease severity is that, in the latter case, assessment is based on a relatively small number of physical measures with (usually) well-established normal ranges (Duncan and Petherick, 1991; Hetts, 1991; Mench, 1993). In

contrast, an assessment of animal welfare must be based on a wide range of measures in addition to health indices (Duncan, 1993; Moberg, 1993). Many of these measures are complex. Normal ranges may be difficult to establish and/or interpret because of individuality due to breed, temperament and other factors. This calls for items to be weighted appropriately. For species kept as individuals, it is difficult to generate a valid, generalizable method of weighting. For example, one dog may not enjoy walks or be very interested in food and his/her real pleasure may be in playing certain games; the reverse may be true of another dog.

As veterinarians become more aware of the developments in animal welfare science, they will be especially well placed to weigh factors affecting welfare in a given case and make judgements. Until adequate protocols for welfare assessment are available, veterinarians should ensure that nonphysical aspects of welfare are included, using one of the frameworks in. In addition, the profession should always be ready to learn from animal welfare scientists and to work with them.

INTERNATIONAL AWARENESS AND OIE GUIDELINES FOR ENSURING ANIMAL WELFARE

Animal welfare was first identified as a priority in the OIE Strategic Plan 2001-2005. OIE Member Countries and Territories mandated the organisation to take the lead internationally on animal welfare and, as the international reference organisation for animal health, to elaborate recommendations and guidelines covering animal welfare practices, reaffirming that animal health is a key component of animal welfare. The OIE convened a First Global Conference on Animal Welfare in February 2004. As well as the Veterinary Services in OIE Member Countries and Territories, the Conference targeted livestock producers and actors in the meat sector, veterinary practitioners and international non governmental organizations (NGOs) working in animal welfare. The main objective of the Conference was to raise awareness of and to explain, the OIE's animal welfare initiative.

The Farm Animal Welfare Council (FAWC) is an independent advisory body established by the British Government in 1979. Its terms of reference are to keep under review the welfare of farm animals on agricultural land, at market, in transit and at place of slaughter; and to advise Ministers in the Department for Environment, Food and Rural Affairs and the devolved administrations in Scotland and Wales, of any legislative or other changes that may be necessary. It is also free to make comments on animal welfare to external bodies. Council believes that adopting global animal welfare standards is an important step forward in protecting the welfare of farmed animals and a potential method of ensuring the welfare provenance of imported animal products (FAWC, 2001). Acceptance of global standards by the WTO is hopefully not far away. FAWC would like to take the available opportunity to pass to you comments on the OIE guidelines on the slaughter of animals for human consumption and for the killing of animals for disease control purposes. Synthesis of data in Table 1 depicts the various legislative initiatives in last three decades ensuring animal welfare.

INDICATORS FOR THE ASSESSMENT OF ANIMAL WELFARE

In recent years there has been increased focus on animal welfare in livestock production (Tosi *et al.,* 2001). Animal welfare assessment systems have been developed in Europe mainly focusing on the housing systems and management. Inclusion of more measures on the animals is assumed to improve the welfare assessment system (Sejian, 2007a). Consequently behavioral and health indicators have to be developed, which can assist the system and management parameters in the provision of a complete welfare assessment (Albright, 1983; Broom, 1991). Development of

Table 1: Thirty years of legislative initiatives aimed at ensuring animal welfare

Years	Legislative initiatives
1974/1993	Stunning and killing
1977/1995	Transport protection transport time limit and densities
1988	Laying hens
1991	Calves - pigs protection
1998	General farm animal protection
1999	Protocol on protection and welfare of animals
1999	Ban on conventional cages for laying hens
2001	Grouping of pregnant sows
2005	Council regulation on animal transport
2005	Proposal on broiler chickens
2006	Community action plan
2007	Ban on trade in cat and dog fur
2007	Council directive on broiler chickens
2008	Proposal concerning the trade in seal products
2008	Proposal on the protection of animals at the time of killing
2009	Council regulation on the protection of animals at the time of killing

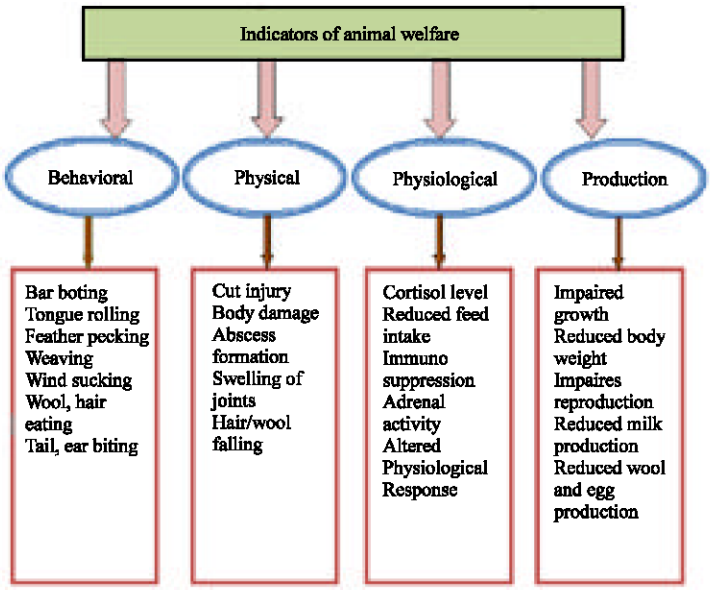

Fig. 2: Different types of indicators of farm animal welfare (Sejian, 2007a; Sejian *et al*., 2008, 2010a, b)

a method for assessing animal welfare at herd level, allowing the farmer to use it as management tool, is approached by aggregating welfare indicators into a welfare protocol. This is based on evaluating the independent welfare relevance of the indicators, the marginal information value and not least applicability for on-farm use. Figure 2 describes the various types of indicators which directly reflect the welfare status of the animal.

DEVELOPING A WELFARE INDICATOR PROTOCOL

A relevant welfare assessment system should describe the welfare of the animals in the herd and allow the farmer to assess the development over time and to respond appropriately

(Main *et al.*, 2001). According to Rousing *et al.* (2001) a welfare indicator that is relevant for inclusion in an operational welfare assessment system should have the following qualities: (1) basis in scientific knowledge and ability to express development over time, (2) measurable on a commercial farm within a realistic framework and (3) relevant as decision support system for the farmer. To fulfill this requirement the welfare indicators must provide information on potential welfare problems and caused of impaired welfare.

Welfare assessment systems, for use in commercial farms may differ according to both the definition of animal welfare and the purpose of the welfare assessment (Mouttotou *et al.*, 1999; Bartussek, 1999). Thus choice of welfare indicators and methods of measurement reflects the basic considerations of how animal welfare is understood (Gonyou, 1993). In addition, the appearance of given welfare assessment system depends on whether the goal is to certify or control the level of welfare on specific farms, to evaluate the welfare in different production systems, or to serve as an advisory tool that allows the farmer to identify, prevent or solve welfare problems on his/her farm (Whaytt *et al.*, 2003). Examples of welfare assessment systems mainly focusing on housing systems and management are the Animal Needs Index (ANI) and RSPCAs Freedom Food Scheme (1994). The ANI system is based on four important husbandry components (possibility of movement, social contact, condition of the flooring, indoor climate and stockman's care) and consists of the scoring of housing systems (RSPCA, 1998). The Freedom Food Scheme is based on five freedoms listed by FAWC (1993) and involves outlining a systematic picture of the standards of resources and records on the farm, but no direct animal and stockmanship indicators are included (Main *et al.*, 2001).

Aggregating relevant welfare indicators into such a welfare protocol, involves evaluating the suggested indicators step by step concerning their independent welfare relevance, their marginal welfare value and finally their applicability for on-farm studies (Rousing *et al.*, 2007). According to these authors, the selection of indicators to be included in welfare indicator protocol depends on three criteria: (1) Independent welfare relevance, (2) Marginal welfare information value and (3) Applicability for on-farm studies.

THE WELFARE INDICATOR PROTOCOL

Animal welfare depends on how the animal may perceives its living environment, taking into account not only the physical aspects of the environment, but the social aspects as well (Chevillon, 2000). A combination of welfare indicators related to production system, husbandry routines and animal behavior and health is suggested to assess the welfare level of the individual farm (Bracke *et al.*, 1999, 2002). In the following the indicators are presented and a general motivation on why they, are included is provided (McInerney, 2004; Keeling, 2005).

Behavior: Behavioral responses are, however, are the most pertinent indicators of the well-being of an animal (Le Neindre *et al.*, 2004; Moura *et al.*, 2006). The choice animals make when facing diverse environments and the amount of stress shown when making those behavioral choices may eventually indicate whether or not they have actual access to their needs (Costa, 2003; Dawkins, 2003). Due to new animal welfare requirements, it is necessary to develop non-invasive technology for behavior and welfare assessment, as well as the correlated methodology. In this sense, several authors have studied behavioral response of animal as a source of welfare information and assessment (Bizeray *et al.*, 2002; Pettit-Riley *et al.*, 2002; Estevez *et al.*, 2003). Behavior measurements are including in the operational welfare assessment system and the behavior performed by the animals in the housing systems is compared to known description of normal

Table 2: Health indicators included in the welfare assessment protocol for dairy cows (Rousing *et al*., 2000)

Body part	Clinical parameter	Welfare relevance
General appearance	Body condition score	A poor body condition may cause long-term discomfort and an increase in disease susceptibility caused by impaired immune competence. It indicates metabolic disorders, sub-optimal management or chronic coping difficulties
Skin	Skin parasites Skin infection pressure sores	Pruritic skin disorders result in long-term discomfort and increase the risk of secondary self-inflicted lesions to e.g. the teats. Skin injury and infection caused acute and chronic pain. Provides information about problems regarding the housing system, management, or underlying diseases.
Legs	Lameness Hoof care	Lameness indicates a painful leg condition and affects the freedom of movement and the performance of behaviors. Overgrown or deformed hooves might indicate foot disorders caused pain and discomfort. The resulting changes in leg confirmation might evolve into chronic articular damages.
Udder	Teat lesions Clinical mastitis	Teat lesion cause acute and chronic pain, which might be aggravated by the daily milking procedure. Clinical mastitis frequently occurs involving pain and discomfort
Systemic diseases	General condition Clinical diseases	Clinical diseases typically involved pain and discomfort. The welfare implications vary according to the intensity and duration of the disease condition and welfare the general condition is affected.
Mortality	Case history of culled animals	The information points out specific problem areas in the herd and provides details on the tackling of serious health problems.

behavior patterns (Potter and Broom, 1986; Phillips and Schofield, 1994; Fregonesi, 1999). In this way behavior measurements and behavior tests, can reveal whether the animals are adapted to the production system or whether the animals show any signs of strain (Singh *et al.,* 1993). More precise welfare assessments need to consider specific behavioral response of genetic lines, as different lines react differently when facing environmental challenges (Keer *et al.,* 1996; Desire *et al.,* 2002; McGary *et al.,* 2003).

Health: Disease can be regarded as important to welfare, because it is in many cases associated with negative experiences such as pain, discomfort or distress (Fregonesi and Leaver, 2001). One indicator in a welfare assessment on farm level may be the prevalence and intensity of certain health problems in the herd (Vallet, 1996; Capdeville and Veissier, 2001). It can for instance be estimated on the basis of clinical examinations. Further critical cases are included (e.g., case histories of culled animals) constructed from herd data files combined with interviews with the owner. Table 2 depicts the health indicators that are included in the welfare assessment protocol for dairy cows.

ASSESSING FARM ANIMAL WELFARE: A NOVEL 'BODY LANGUAGE APPROACH

Body language is an expression of the whole animal: how it holds itself, moves about and interacts with its surroundings (Webster and Main, 2003). An animal may for example behave in a way that appears calm, nervous, tense, relaxed or distressed. Based on Free Choice Profiling techniques developed in food science, this method instructs observers to generate their own descriptive terms and to then use these terms to quantify an animal's expressions (Wemelsfelder *et al.,* 2001). Research with pigs and dairy cattle using this technique has shown that observers reliably agree in their assessment of animal body language, even when they are from different backgrounds (e.g., farmers, veterinarians, animal protectionists). The significant correlation of these assessments to conventional quantitative measures of behaviour further supports the validity of judgements of animal body language. Current research is investigating how

such judgements correlate to physiological indicators (e.g., heart rate, saliva cortisol) of animal welfare (Stern *et al.,* 2001; Wemelsfelder and Lawrence, 2001).

APPROACHES TO WELFARE ASSESSMENT

There is no established method for assessing animal welfare, but various frameworks have been suggested. Their application requires knowledge of animal health and production and species-typical behavior. Knowledge of the latter may come from studies of the species lifestyle in the wild (Broom, 1991; Dawkins, 2003).

Research is being done to develop practical methods of assessing welfare. One approach used the opinions of 35 experts, including veterinarians, to devise a list of questions for assessment of the welfare of poultry, cattle and pigs during a half-day herd or flock visit. In another approach, the welfare of pregnant sows in 15 different housing systems was predicted, by using the available scientific data in a computer model. There is a large but incomplete body of data on the welfare of farm and laboratory animals, but fewer data are available on companion animals. Generally three approaches are followed in assessing animal welfare: (1) naturalistic, (2) functional and (3) subjective experience. Table 3 describes the concept of animal welfare and comparison between these three approaches to ensure animal welfare.

Table 3: Comparison among different approaches of animal welfare (Duncan and Fraser, 1997)

	Approaches to animal welfare		
Criteria	Naturalistic	Functional	Subjective experience
Definition	The welfare of an animal depends on its being allowed to perform its natural behaviour and live a life as natural as possible	Animal welfare is related to the normal functioning of physiological and behavioural processes	The feelings of the animal (suffering, pain and pleasure) determine the welfare of the animal
Concept	Animals should be raised and kept in a natural environment and be allowed to behave in natural ways.	Concentrates on biological functioning of an animal	This approach involves psychological well-being as subjective experiences of animals
Research method	• Study of behaviour of animals in wild of semi-wild state and comparison with similar animals living in captivity	• Quantifying growth, productivity and reproduction • Veterinary epidemiology and pathology • Measurements of suppression of the immune competence	• Operant conditioning experiments • Preference tests • Behavioural measures of psychological well-being • Stereotypes • Conflict behaviours
Advantage	This approach intuitively appeals and fits with popular opinion (call for animals to be raised in more natural environments)	Changes in biological functioning are easier to demonstrate scientifically	Understanding the subjective experience of animals is a great challenge and hard job for scientists in the field of ethology
Disadvantage	This approach idealizes natural environment and neglects the fact that animals are able to adapt to artificial environment	The link between biological functioning and the welfare is not always apparent. It is difficult to draw conclusions about welfare if different measures of biological functioning disagree	The feelings and emotions of animals, like the movement of subatomic particles, cannot be observed directly

Table 4: Differentiation between biological functioning and feelings schools of animal welfare

Criterias	The biological functioning school	The feelings school
Concept of welfare	Welfare is mainly to do with the animal's physical health and well-being	Welfare is a wide term that embraces both the physical and mental well-being of the animal.
Requirement for welfare	Animal should be able to 'cope' with its environment	Welfare is all to do with what the animal feels: with the absence of strong, negative, subjective, emotional states
Primary aim	Protecting life-sustaining needs, health-sustaining needs and comfort-sustaining needs.	Protecting the primary needs of animals
Description of welfare	Mainly concerned with physical well-being	Welfare is a wide term that embraces both the physical and mental well-being of the animal
Means of evaluation	Based on physiological stress response	Based on feelings and behavior of animals

SCIENCE-BASED ASSESSMENT OF ANIMAL WELFARE: FARM ANIMALS

Animal welfare is a term that has arisen in society to express ethical concerns about the quality of life experienced by animals, particularly animals that are used by human beings in production agriculture (Duncan, 2005). The term is therefore not one that expresses a scientific concept. Nevertheless, because the scientific method is used to identify, interpret and implement societal concerns about animal quality of life issues, animal welfare has become established as a scientific field (Duncan and Fraser, 1997; Fitzpatrick *et al.*, 2006). But researchers concluded that it was impossible to give welfare a precise scientific definition (Dawkins, 1990, 2003; Fregonesi and Leaver, 2001). However, the scientific definition of animal welfare includes the broad working description of animal welfare encompasing both the physical side of welfare and the mental aspects of subjective feelings. But there are divided thoughts on the concept of animal welfare involving physical and mental well-being. This non-conformity of the evidence led to a protracted debate within the animal welfare research community, with two distinct schools of thought emerging. One group suggested that welfare is mainly to do with the animal's physical health and well-being. The other group proposed that welfare is more to do with psychological health and how the animal feels. These two groups have become known as the biological functioning school and the feelings school. The major concept and differences in functioning between the two schools were depicted in Table 4.

The biggest advantage of assuming that welfare is determined by good biological functioning and the satisfaction of primary needs is that the variables involved are substantive and fairly easily measurable. Feelings, on the other hand, are poorly defined, impossible to measure directly and difficult to measure indirectly. This probably accounts in part for the resistance of the biological functioning school to the idea that welfare is all about feelings. Science should be objective when assessing welfare and measuring biological functioning ensures objectivity (Bracke, 2007). The other reason why many behavioural scientists have been reluctant to consider feelings in their welfare research is the antagonism to this topic left behind by behaviourism, a school of North American psychology that was strongly opposed to paying any attention to feelings or consciousness. However, in the last quarter of the 20th Century, the grip of behaviourism slackened and there has been a growth of literature on the topic of feelings.

In spite of the obvious difficulties of measuring feelings, if it is feelings that govern welfare, then it is feelings that should be assessed (Duncan, 1996). The problem with a feeling is that it is a subjective state and therefore is only available to the animal experiencing it. Only I know what I feel, whether it is fear or hunger or happiness. With regard to human beings, we are all built

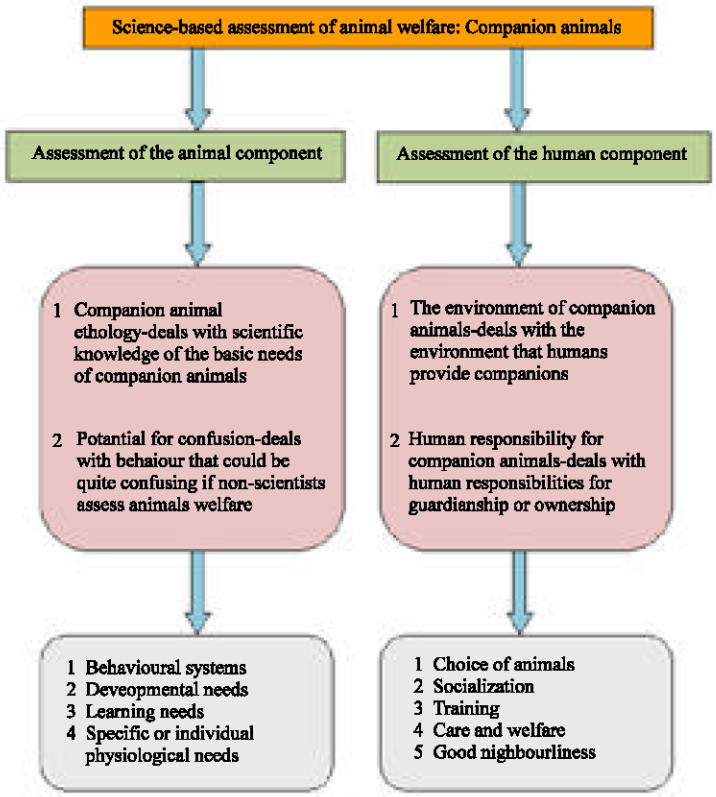

Fig. 3: Components and sub components of the science based assessment of animal welfare of companion animals

similarly and so we can argue by analogy and homology that what you feel when you stub your toe is probably similar to what I experience when I stub my toe. Moreover, we have language and so we can describe what we feel to each other. It turns out, in very general terms, that human beings seem to have fairly similar feelings in response to similar circumstances. But what can we conclude about animals? They are built rather differently and humans have no common language with animals so they cannot tell us directly how they feel. Nevertheless, great progress is being made in understanding the communication systems of many species and this may open a window on their feelings (Weary *et al.*, 1998; Taylor and Weary, 2000).

SCIENCE-BASED ASSESSMENT OF ANIMAL WELFARE: COMPANION ANIMALS

Animal welfare concerning to companion animals consist of two components viz., (1) Animal component and (2) Human component (Odendaal, 2005). Recent trends affecting companion animal welfare are: modern philosophies on animal issues, the specialized and varied roles that companion animals play in modern societies, new results from animal neuroscience, human-animal interaction studies and the new profession of companion animal ethology (Odendaal and Meintjes, 2003; Scott, 2004; Odendaal, 2005). The synthesis in Fig. 3 depicts the components and sub components of the science based assessment of animal welfare of companion animals.

A NEW FRAMEWORK FOR THE ASSESSMENT OF ANIMAL WELFARE

This framework is based on integrating existing knowledge from a practical ethics perspective (Wemelsfelder *et al.*, 2001; Webster and Main, 2003). This framework combines the three

determinants that are important when dealing with animal welfare on a farm: animals, humans and housing. This way it adheres more closely to the situation as it exists under farm conditions and gives you the information necessary to identify and resolve problems that occur (Keeling and Veissier, 2005; Aerts *et al.,* 2006). Framework is made up out of three basic elements: the classical welfare analysis with an existing welfare assessment tool, an assessment of the stockholder and an implementation of the Free Choice Profiling technique. This new framework does not pretend to be a different or better animal welfare matrix; it is intended to integrate existing knowledge and to provide a practical tool to improve animal welfare (Sorensen *et al.,* 2001). It identifies whether there are welfare problems on a farm, if present whether these problems are caused by the housing system or the stockholder and what can be done to improve the situation.

CONCLUSION

In conclusion, animal welfare is seen as integral strategy involving the role of farmers, veterinary surgeons and welfare groups and this coordination is identified as key to delivery of the outputs to ensure a benefit to animals. Ensuring farm animal welfare requires taking into account all available scientific evidence. The various scientific approaches for animal welfare provide relevant data. In addition these approaches may allow the formulation of various assessment rules. Approaches involving animal-based parameters are very effective. A crucial step in the assessment is to reconcile the predicted and the measured values in an overall assessment of animal welfare. This requires an evaluation of the reliability and availability of all parameters, including the on-farm measured, animal-based parameters, the environment-based parameters and the predicted animal based parameters. A more universal approach dealing with animal welfare could be achieved by establishing a science- based assessment. The approaches and methods described in this review are to increase our fundamental understanding of animal welfare and further different methods may be required to assess welfare on the farm or production unit.

FUTURE PERSPECTIVES

Having considered the development of animal welfare in the past and the present, it is pertinent to reflect on how it is going to develop in the future. In future research, emphasis should be given to the deeper understanding of neurophysiology or on human-animal interaction studies. To date, most welfare research has been concerned with identifying various states of suffering with a view to eliminating them in animal production. However, there is an emerging view that welfare is more than simply the absence of suffering and future studies may have to start examining states of pleasure with a view to promoting these states in farm animals. There may be increased conflict between supporters of improved welfare standards for animals, welfare standards for humans and the welfare of the environment. However, true progress will only be made when the integrated nature of these three objectives is realized and pursued by all.

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