

Dairy animal welfare: Review on scientific concept and assessment methodologies

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"It shall be the fundamental duty of every citizen of India to protect and improve the Natural Environment including forests, lakes, rivers and wildlife and to have compassion for all living creatures."

- The Constitution of India Article 51-A (g)

Welfare of the dairy cows is one of the major concerns in most of the developing countries due its impact on the productivity of cows, health of the animal, climate as well as on public health in the present day context. Consumers are increasingly more aware of the impact of dairy cow welfare on public health, dairy product safety and health propriety as well as environmental protection. As a result, to-day more and more consumers are oriented towards buying products from animals whose welfare is not threatened and where it is guaranteed that the products from farm animals are in the line with the standards of good husbandry practices in the farm.

Animals are used by human for production of food, clothing, draught power, companionship, recreation, scientific research and education. In all cases some degree of modification of the genetic and/or environment of the species concern has taken place¹. 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 this process.

Animal welfare has been receiving growing reorganization in the Veterinary field, especially since 1990s². 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, involvement of the Veterinary Science in welfare matter 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 opinion inside certain paradigms or form a value judgement point of view. This implies that specific starting points, which will lead to predictable outcome. Such views may appear self evident within particular circles, but every one of those views excludes all other opinion. A more universal approach dealing with animal welfare could be achieved by establishing a science based assessment³. Such an approach to animal welfare should attempt to accommodate most views in widely accepted guidelines⁴. 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 last twenty years. The concept has been refined and range of methods of assessment has 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 animal's needs and affective states such as hunger, pain and fear, often by measuring the strength of animals' preferences, motivations and aversions. Other assesses the physiological, behavioural and immunological changes or affects that animal shoe to response to various challenges⁴.

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Welfare represents the long term mental condition of an animal which is result of its acquired experiences in particular living conditions; it is a method by which animals deal with their environment^{5,6}. There are different methods of assessing animal welfare. Four fundamental criteria on which basis an integral welfare assessment is made are feeding, housing, health status and behaviour of animals. Feeding and housing directly, positively or negatively affect the welfare of animals. Inadequate housing and feeding expose animals to numerous stressors and unpleasant emotions, which all affects the occurrence of diseases, injuries and behavioural disorders⁷.

ANIMAL WELFARE DEFINITIONS

The long debate about animal welfare includes the possibility of defining the term 'welfare' itself. This word must reflect a clear concept, which can be scientifically assessed and which can be used by the scientific community and can be included in laws⁸. The definition should also explain the meaning of animal welfare to various categories of people, such as corporations, consumers, veterinarians, politicians and others⁹.

The term 'welfare' is not uniformly defined and used in the literature. This may be due to the different attitudes towards animals, but implies also the different methodologies used to evaluate welfare. Thus many definitions of welfare have been proposed, according to cultural developments of the societal view about the relationship between man and animals. In the past welfare had been seen, mainly by veterinarians and farmers, chiefly in terms of the body and physical environment. But such a view has limitations: for example good physical outcome, due to genetics and environment, do not mean that mental state is not compromised. Moreover, physical state may be affected by both positive and negative experiences⁹. Thus the definitions of animal welfare proposed by various researchers reflect their different backgrounds.

Saunders Comprehensive Veterinary Dictionary define animal welfare as "The avoidance of abuse and exploitation of animals by humans through appropriate standards of accommodation,

feeding, general care, prevention, treatment of disease, assurance of freedom from harassment, unnecessary discomfort and pain". This definition has completely ignored its psychological and emotional needs and at the same time accepting that some degree of pain and discomfort may/will be inflicted on animals as they thrive to serve humans as food, for entertainment, work and research tool. Today these assumptions are challenged. Welfare is measured by their behaviour physiology, longevity and reproduction. Collectively animal welfare is defined as a state of body and mind as sentient animals which attempts to cope with its environment.

According to¹⁰, behaviour is a significant indicator of health in animal and understanding behaviour is the key to good animal welfare. The OIE (The World Organization for Animal Health) define animal welfare as the ability of an animal to cope up with the condition in which it lives. An animal is in good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behavior and if it is not suffering from unpleasant states such as pain, fear and distress. Good animal welfare requires disease prevention and treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/ killing. Animal welfare refers to the state of animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry and humane treatment.

The term animal welfare can also mean human concern for welfare of animal. Welfare is not just absence of cruelty or unnecessary suffering. It includes three different states:

- 1. Physical state:** Animal copes with its environment. Coping is essentially a reflection of the physical condition of the animal, although mental stress may have contributed to this condition.
- 2. Mental state:** Neither health nor lack of stress nor fitness is necessary and/or sufficient to conclude that an animal had good welfare. Welfare is dependent upon what animals feel.
- 3. Naturalness:** It refers to the ability of the animal to fulfill its natural needs and desires.

This dimension has been recently recognized and added.

ANIMAL BASED INDICATORS FOR WELFARE ASSESSMENT

The assessment of welfare at farm level can be used as an advisory tool by farmers, as source of information for legislation and as a component of quality assurance schemes for consumers.

In 1979, the UK's FAWC (Farm Animal Welfare Council) determined general rules associated with animal welfare based on five privileges proposed in 1965. They are grouped into what is currently known as "five freedoms". These freedoms or animal needs that should be met to attain biological control are currently the pillars for assessment of welfare of animals and are internationally recognized in terms of welfare of production animals. All the five freedoms represent an ideal in animal welfare but they are not completely realistic in the livestock farms. Most of the farming system causes some of the freedom to compromise and such compromise should be identified. The quantification of such freedom is equally important to assess the depth of seriousness.

According to the "five freedoms", the following conditions should be provided to the animals to ensure its welfare in production system:

- 1. Freedom from thirst, hunger and malnutrition:** Animals should receive a suitable diet in amount and quality, they should not be exposed to prolonged hunger and they should have ready access to sufficient water quality and quantity for their needs.
- 2. Freedom from discomfort:** Animals should have access to suitable and safe environment in adverse climatic condition including shelter and comfortable resting areas.
- 3. Freedom from pain, injury and diseases:** Animals should be free from lesions, diseases

and pain induced by management procedure. Preventive schemes and timely and rapid diagnosis and treatment should be established to avoid disorders.

These three freedoms or needs are technical problems to be solved, related to animal production and are easily quantified by using appropriate indicators.

- 4. Freedom from fear:** Animals are less fearful of people, their handling facilities and their environment. Consider animal behaviour when developing farm infrastructure and herd management routine.
- 5. Freedom to engage in relatively normal patterns of animal behaviour:** Animals should be housed in a comfortable manner and with a positive human- animal relationship. They should be allowed to express their social and other behaviours. Animals should be provided with sufficient space, suitable infrastructure and company of animals of same species to facilitate their interaction. The last two freedoms or needs are ethical problems to be resolved, because they are related to subjective aspects that have technical difficulties for their evaluation and of recent technical-scientific interest. ^{11,12} agreed that three important aspect should be considered in evaluating animal welfare: biological functioning (health), natural living (behaviour) and emotional state (mental state). These authors suggested that the overlap of these functions lead to the ideal welfare state, since the success of a single one does not ensure that a welfare state has been reached.

There are a number of valid indicators that can be surveyed in the field for each aspect of animal welfare to be assessed. These indicators can all be measured scientifically and are independent of any moral assessment.

Table 1. Welfare principles and criteria identified in welfare quality

Welfare principles	Welfare criteria	Examples of animal based measurement
Good feeding	1. Absence of prolonged hunger 2. Absence of prolonged thirst	Body condition score, emaciation Dehydration status
Good housing	3. Comfort around resting 4. Thermal comfort 5. Ease of movement	Animals should be comfortable, especially within their lying areas, cleanliness of the body, animal lying partly or completely outside lying area. Panting, huddling Animals should be able to move around freely, incidence of slipping or falling
Good health	6. Absence of injuries 7. Absence of disease 8. Absence of pain induced by management procedure	Lameness, skin lesion, dermatitis, wounds on the body Animals should be free from diseases like mastitis, metritis, diarrhoea, hepatitis, respiratory disorders. Animals should not suffer from pain induced by inappropriate management (dehorning, castration, tail docking etc.)
Appropriate behaviour	9. Expression of social behaviour 10. Expression of other behaviour 11. Good human- animal relationship 12. Positive emotional state	Temperament, aggression, social grouping, scratching wound Exploration, playful nature Avoidance distance test, fear of human Distress, frustration or apathy

(Source⁶)

Behavioural measures

Behavioural responses, however, are the most pertinent indicators of the well-being of an animal. The choice animals makes when facing diverse environment and the amount of stress shown when making those behavioural choices may eventually indicate whether or not they have actual access to their needs¹³. Due to new animal welfare requirements, it is necessary to develop non-invasive technology for behaviour and welfare assessment, as well as the correlated methodology⁴. In this sense, several authors have studied behavioural response of animal as a source of welfare information and assessment¹⁴. Behaviour measurements are including in the operational welfare assessment system and the behaviour performed by the animals in the housing systems is compared to known description of normal behaviour patterns¹⁵. In this way behaviour measurement and behaviour tests, can reveal whether the animals are adapted to the production system or whether the animal show any sign of strain. More precise, welfare assessments need to consider specific behavioural response of genetic lines, as different lines react differently when facing environmental challenges.

Display of resting behaviours on other premises than their stalls may indicate the fact that they consider them uncomfortable. Flooring type may increase the risk of lesions and injuries and at the same time restricts certain behavioural display. Laminitis cases are the manifestation of pain behaviour in dairy cows which negatively impacts the health and productivity of animals' affected¹⁶.

Animal avoids an object or event, provides strong indication of its feelings and about the status of its welfare. The degree of avoidance provides the idea of welfare status. Other abnormal behaviour such as stereotypes, self-mutilation, tail-biting in pigs, feather pecking in hens or excessively aggressive behaviour indicates that the perpetrator's welfare is poor. Stereotypes and other abnormal behaviour can be used as welfare indicators. A stereotype is a repeated, relatively invariant sequence of movement that has no obvious function. The examples of stereotypes are drinker pressing in sows, tail chasing in dogs, crib biting and tongue drawing in horses etc. All stereotypes tend to occur in circumstances where the individual lacks control over its environment. Other abnormal behaviour that can be quantified and can be used as an indicator of long term welfare

problems include excessively aggressive behaviour and inactive responses¹⁷.

Some behaviour is also associated with illness. There is a close association between animal behaviour and Veterinary diagnosis. Veterinarians rely on behavioural observation in diagnosis of illness. Examples include deficiency diseases such as aphosphorosis, metabolic diseases hypocalcaemia and hypo magnesaemia and infectious condition like encephalitis. For example, the hyper excited state in a cow may be due to hypo magnesia; the stiffened bull's gait is the result of traumatic reticulitis; the aggressively prancing mare has possibility of presence of an ovarian tumour; the depress steer is a sign of toxic state; the asymmetric forelimb posture of horse is due to navicular disease; the subdued sheep has toxemia; the pig that ceases to eat has an infection; the calf with abnormal reaction has a neural impairment; the horse walking stiffly has tetanus¹⁸.

Physiological measures

Some signs of poor welfare are measured through physiological measures. The indicators of physiological measures include heart rate, adrenal activity; adrenal activity followed by ACTH challenge

or reduced immunological responses following challenge. The variation in these traits indicates the welfare status¹⁰. The heart rate is also a useful indicator for short term welfare problem. The heart rate of animals changes in response to stimulus in the environment. The response is relatively rapid and brief, often adopting in a minute or two. If a cat stands up from lying position, start walking, then starts running, its heart rate will increase with each of these activity changes. Where the cat detects imminent danger at any stage during this changes, a further increase in heart rate would be superimposed. ¹⁹ recorded the ovine heart rate during different activity. Measurement of glucocorticoid in plasma and saliva is also useful in the studies of welfare of animals during short term managemental practices¹⁰. When animals are transported, the effect of various components of the transport process can be assessed by monitoring glucocorticoid concentration. It has been established in different reports that the measurement of cortisol concentration can provide information about welfare of animal over relatively short period²⁰. A variety of other measurement can be used when attempting to assess the welfare of animals during transportation or other relatively short term treatment. A summary of such measurement is shown below.

Table 2. Physiological indicator of welfare- short term problems

Sl. No.	Stressor	Physiological indicators
1.	Food deprivation	Increase FFA, β -OHB, urea; decrease glucose
2.	Dehydration	Increase – osmolarity, total protein, albumin, PCV
3.	Physical exertion, bruising	Increase CK, LDH-5, lactate
4.	Fear	Increase cortisol, PCV, heart rate, heart rate variability, respiration rate, LDH-5
5.	Motion sickness	Increase vasopressin
6.	Inflammation	Acute phase proteins, e.g. hepatoglobulin, C- reactive protein, serumamyloid-A
7.	Hypothermia/ hyperthermia	Change in body and skin temperature, prolactin

FFA- free fatty acid; β -OHB- beta hydro butyrate; PCV- pack cell voloum; CK- creatine kinase; LDH 5- lactate dehydrogenase isoenzyme 5

(Source¹⁰)

Health measures

Disease can be regarded as important to welfare, because it is in many cases associated with negative experiences such as pain, discomfort or distress. One indicator in a welfare assessment on farm level may be the prevalence and intensity

of certain health problems in the herd. 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 the interviews with the owner⁴.

Table 3. Health indicators included in the welfare assessment protocol for dairy cows

Sl. No.	Body parts	Clinical parameters	Welfare relevance
1.	General appearance	Body condition score	A poor body condition may cause long term discomfort and increase in disease susceptibility caused by impaired immune competence. It indicates metabolic disorders, sub-optimal management or chronic coping difficulties
2.	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 the teat. Skin injury and infection cause acute and chronic pain. Provides information about the problems regarding the housing system, management or underlying disease.
3.	Legs	Lameness Hoof care	Lameness indicates a painful leg condition and affects the freedom of movement and the performance behaviour. Overgrown or deformed hooves might indicate foot disorders cause pain and discomfort. The resulting changes in leg conformation might evolve into chronic articular damage.
4.	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.
5.	Systemic disease	General condition Clinical disease	Clinical diseases typically involve pain and discomfort. The welfare implications vary according to the intensity and duration of the disease condition
6.	Mortality	Case history of culled animals	The information point out the specific problem areas in the herd and provides detail on the tackling of serious health problems

(Source²¹)

Body condition score

Animal malnutrition favours the appearance of diseases, especially those related to metabolic disorders and calving problems; it also has a negative influence on ovulation and fertility rate²². The purpose of including body condition score in a rapid evaluation of animal welfare in the field is to identify the animals that are too fat or too thin, since level of body reserves in both cases is associated with increased risk of disease²³. Body condition and animal welfare make up a complex relationship that is influenced by diverse factors such as genetic

merit, feeding and especially production system. Accordingly²² suggest that subjective estimation of body reserves in dairy cattle can contribute to the establishment of an individual's welfare, provided that the score assigned to each animal is interpreted within a boarder context that considers production, health and management aspect.

Foot lesions

These type of lesions are widely recognised as a greatest incidence on welfare of dairy cattle due to the pain they produce and consequent alterations

at production, reproduction and animal behaviour level. Foot diseases can be the consequences of an individual's disorders, such as nutritional deficiency, as well as poor dairy farm infrastructure, such as pathways, pens or milking parlour. Prolonged lameness generally affects productive and reproductive performances of dairy cows. Indeed, lame cows spend most of the time lying down compared to normal cows; consequently, they lose weight due to lower food consumption.²⁴ stated that lameness caused by sole ulcer and white line disease produce hyperalgesia, with lame animals exhibiting a lower pain threshold than health animals.

Mastitis

Clinical and subclinical mastitis are the most frequent conditions affecting dairy animals Worldwide with negative effect on cow welfare and on milk production and composition²⁵. Inflammation caused by mastitis is painful and therefore, associated with animal welfare. The negative effect of mastitis may affect cow longevity.²⁶ found that the index of environmental sanitation based on the amount of manure on the cow and its environment was a predictor of the occurrence of coliform mastitis. Furthermore, in a study conducted in four dairy farms,²⁷ observed that the lowest incidence of mastitis occurred in the farms with cleanest cows and most satisfactory bedding condition. The presence of mud is a serious animal welfare issue affecting animal hygiene and causing stress. Thus, muddy conditions become a predisposing factor for increased incidence of clinical mastitis and therefore, a higher number of cows need to be treated. Inappropriately designed pathways used by the cows generally become muddy after prolonged rainy season making cows prone to the foot lesion and mastitis.

Disease and injury

Disease, injuries, movement difficulties and growth abnormalities, all indicate poor welfare. The

welfare of the disease animal is poorer than that of healthy animal. The effect of an animal suffering laminitis, mastitis, pneumonia or severe diarrhoea is easy to appreciate. Any disease, which causes pain or other kinds of discomfort or distress, treatment reduces the effect of the disease and improves the welfare of the animal. One of the consequences of the poor welfare associated with disease is that resistant to other disease is reduces. The simple relation between disease and poor welfare is disease always means poor welfare and whenever welfare is poor for any reason, there will be a greater susceptibility to pathogen replication. It is fact that, the welfare of any diseased animal is worse than an animal with sound health.

Mortality

Despite great importance of mortality or culling in dairy herd economy, literature on the subject is relatively scare²⁸ mentioned that mortality ranges between 1% to 6% yearly or per lactation. A mean annual mortality rate of 13 % was recorded in dairy farms during the survey conducted in Valle de Larma. The most common reason for mortality or culling include traumatic accident, calving disorders, digestive disorders, locomotion disorders, metabolic and udder disorders^{28,29}.³⁰ in his studies stated that avoidance distance may be able to detect different levels of management. Lameness and cleanliness scores were able to discriminate only in dairy cattle farms, whereas theses two parameters, albeit feasible, seem to have low significance for dairy buffalos. Stepping during milking was consistence in time and different among cattle farms. However, this variable is time consuming, thus less feasible and it can be influenced by confounding factors that are not indicative of human- animal relationship quality.³¹ studied on animal linked parameters and performance efficiency to assess the welfare of dairy cattle in Tunisian dairy herds. According to him the assessment system should include the animal based measures directly related to animal body condition, health aspect, injuries and behaviour.

Table 4. Description of the scale for scoring lameness

Score	Clinical Description	Description
1	Normal	Stands and walk normally with a level back, makes long confident strides
2	Mildly lame	Stands with flat back, but arches when walks, gait is slightly abnormal
3	Moderately lame	Stands and walk with an arched back and short strides with one or more legs, slight sinking of dew claws in limb opposite to the affected limb may be evident.
4	Lame	Arched back standing and walking, favouring one or more limbs but can still bear some weight on them, sinking of the dew claws is evident in the limb opposite to the affected limb.
5	Severely lame	Pronounced arching back, reluctant to move with almost complete weight transfer off the affected limb.

(Source³²)

SCIENCE BASED ASSESSMENT OF ANIMAL WELFARE

Animal welfare is a term that has arisen in society to express ethical concerns about the quality of life experienced by animal, particularly animals that are used by human being in production agriculture³³. The term is therefore not one that expresses a scientific concept. However, the scientific definition of animal welfare includes the broad working description of animal welfare encompassing both physical side of welfare and the mental aspects of subjective feelings. 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. Feeling, on the other hand, are poorly defined, impossible to measure directly and difficult to measure indirectly. Science should be objective when assessing welfare and measuring biological functioning ensures objectivity.

NEW FRAMEWORK FOR THE ASSESSMENT OF ANIMAL WELFARE

This framework is based on integrating existing knowledge from a practical ethics perspectives³⁴. 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 exist under farm conditions and gives the information necessary to identify and resolve problems that occur³⁵. Framework is made up out of three basic elements: the classical welfare analysis with existing welfare

assessment tool, an assessment of the stakeholder and an implementation of 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 welfare³⁶. It identifies whether there are welfare problems on a farm, if present whether these problems are caused by the housing system or the stakeholder and what can be done to improve the situation.

CONCLUSION

Welfare research provides the scientific basis for reliable and feasible welfare assessment system and standardised tool for the conversion of welfare measures in to accessible and understandable information. The concern for animal welfare is increasing Worldwide and specifically in cattle milk production. Animal welfare is seen as an integral strategy involving the entire stakeholder: farming community, veterinarians and welfare groups and this coordination is identified as a key to delivery of the outputs to ensure a benefit to animals. Approaches involving animal based parameters are very effective. A crucial step in the assessment is to reconcile the predicted and measured values in an overall assessment of animal welfare. Efforts should include research and validation of indicators and practical, low cost and safe methods to classify animal welfare. The different approaches and methodologies discussed in the review will intensify the knowledge on animal welfare and an universal approach to assessment the animal welfare could

be framed converging science- based and animal-based parameters.

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