On-farm welfare assessment in dairy cattle and buffaloes: evaluation of some animal-based parameters

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ABSTRACT

The aim of this study was to evaluate the repeatability of some animal related variables, which could be used in protocols developed for assessing animal welfare at farm level. Recordings were performed in seven dairy farms (four for cattle and three for buffaloes). The animals were observed on three occasions at three-week intervals. The variables collected for each animal were the following: behaviour during milking (stepping and kicking), avoidance distance, lameness and cleanliness. For each farm and each variable repeatability was computed using the Kendall coefficient of concordance (W). In buffalo farms avoidance distance may be considered highly reliable (W > 0.64), whereas in dairy cattle its reliability ranged from medium (W = 0.43 to 0.59) to high (W = 0.64). Behavioural recordings at milking showed that the reliability of stepping was either medium or high for both buffaloes and cattle (W = 0.51 to 0.52 to 0.76 for buffaloes and cattle, respectively). Conversely, kicking was less reliable. In cattle farms the reliability for cleanliness ranged from medium (W = 0.51) to high (W = 0.62 to 0.71), whereas, it was not reliable in the sole buffalo farm where this variable was monitored. In cattle farms, the concordance for lameness score was high in two farms (W = 0.62 and 0.66) and moderate in one farm (W = 0.43), whereas no animals displayed lameness in the fourth farm. In all buffalo farms no animals showed lameness. For each species, the Kruskal-Wallis analysis of variance with one factor (farm) was performed to evaluate the effect of farm on recorded variables. For cattle, avoidance distance (P<0.001), stepping (P<0.001), cleanliness (P<0.001) and lameness (P<0.01) were affected by farm, whereas kicking was not significantly different between farms. In buffaloes a significant effect of farm was observed only for avoidance distance (P<0.01). The Mann-Whitney U test performed on data obtained from the farm where both species were present showed that avoidance distance was lower in buffaloes than cattle (P<0.001). This variable is reliable, feasible and able to discriminate among farms. Lameness and cleanliness scores were able to discriminate only cattle farms, whereas these two parameters, albeit feasible, seem to have low significance for buffaloes. Although stepping during milking was reliable and different among cattle farms, its use in on-farm assessment may be difficult because it is more time consuming, thus less feasible.

Key Words: Dairy cattle, Buffalo, On-farm assessment, Behaviour, Reliability.
RIASSUNTO
STUDIO DI ALCUNI INDICATORI DI BENESSERE A LIVELLO AZIENDALE
NELLA VACCA DA LATTE E NELLA BUFALA

Obiettivo del lavoro è stato la verifica della attendibilità di misurazioni ripetute di alcune variabili utilizzate per il monito-
raggio del benessere della vacca da latte e della bufala a livello aziendale. La ricerca è stata condotta presso 7 alleva-
menti, di cui 4 bovini e 3 bufalini, effettuando i rilievi in tre occasioni, a distanza di 15-20 giorni sullo stesso campione
di animali. Per ogni soggetto sono stati presi in considerazione i seguenti parametri: comportamento durante la mungi-
tura pomeridiana (sollevamento degli arti, calci, vocalizzazioni, minzioni e defecazioni), distanza di fuga, incidenza delle
zoppie e grado di pulizia. Per ciascuna azienda, l’affidabilità delle indicazioni fornite dalle variabili comportamentali e
dalle variabili igienico-sanitarie è stata saggiata mediante il coefficiente di concordanza W di Kendall e, in base al valore di tale
coefficiente, le singole variabili sono state considerate scarsamente (W < 0,4), mediamente (W = 0,4÷0,6) o altamente
(W > 0,6) attendibili. I risultati ottenuti hanno messo in evidenza che nelle aziende bufaline la distanza di fuga può esse-
re ritenuta altamente ripetibile (W > 0,64), mentre in quelle bovine l’attendibilità di questo parametro varia da media (W
= 0,43÷0,59) ad alta (W = 0,64). La frequenza con cui gli animali sollevano gli arti durante la mungitura rappresenta
un discreto o un buon indicatore dello stato di benessere per entrambe le specie (W = 0,51÷0,66 e 0,52÷0,76 per le
bufale e per le bovini, rispettivamente). Relativamente all’incidenza delle zoppie nei bovini, il livello di concordanza è
risultato elevato in due aziende (W = 0,62 e 0,66) e medio in un’altra (W = 0,43). In un allevamento di bovini e in tutte
le aziende bufaline non è stato evidenziato alcun caso di zoppia. L’effetto del fattore azienda sulle variabili comporta-
mentali e igienico-sanitarie è stato valutato mediante il test di Kruskal-Wallis utilizzando per ogni animale il valore medio
delle tre osservazioni. Nei bovini, l’azienda rappresenta un’importante fonte di variazione per la distanza di fuga
(P<0,001), il sollevamento degli arti (P<0,001), il grado di pulizia (P<0,001) e l’incidenza delle zoppie (P<0,01), ma non
influenza la tendenza a scalciare durante la mungitura. Fra le aziende bufaline sono state osservate differenze significa-
tive (P<0,01) solamente per la distanza di fuga. Pertanto, questo parametro può essere considerato attendibile, facil-
mente rilevabile e discriminante fra le aziende. Elaborando mediante il test U di Mann-Whitney i dati relativi all’azienda
dove erano presenti entrambe le specie, è risultato che la distanza di fuga è minore nelle bufale che nelle vacche
(P<0,001). L’incidenza delle zoppie e il grado di pulizia degli animali possono fornire indicazioni affidabili solo entro le
aziende bovine e, sebbene di facile utilizzazione, rappresentano variabili di limitato interesse negli allevamenti bufalini a
causa della scarsa predisposizione di questa specie a contrarre affezioni podaliche. Sebbene nelle vacche il sollevamen-
to degli arti durante la mungitura sia un parametro caratterizzato da elevata ripetibilità e variabile in relazione all’azi-
enda, richiedendo molto tempo per il suo rilievo, risulta di scarsa applicabilità per la valutazione del benessere a livello
aziendale.

Parole chiave: Vacca da latte, Bufala, Ripetibilità, Benessere, Comportamento

Introduction

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 Western countries there is an increasing public concern about animal welfare. In these countries a number of consumers is influenced by ethical concerns rather than cost with high interests in farming and the associated animal welfare standards. They demand high quality livestock products obtained with methods where animal welfare is also considered. For these products they are willing to pay premium prices (Sundrum and Rubelowski, 2001). As a consequence, several food companies label their products stating that the animals used for that purpose were kept in welfare-friendly farming conditions. This has produced unfair competition (Sundrum, 1996), because there is no agreement about either the definition of animal or the best method to assess animal welfare at farm level.

According to Duncan (1996) animal welfare involves the subjective feelings of animals, such as pain, boredom, frustration, hunger and other unpleasant states. On the contrary, Broom (1996) stated that the welfare of an animal regards its attempt to cope with its environment. The debate is still in progress, because in addition to science, ethical and political concerns regarding animal welfare are also essential.

In the meanwhile, different methods of on-farm monitoring of animal welfare have been developed (Johnsen et al., 2001) in Europe. Some of these methods are concerned with design criteria (Bartussek, 1999), which comprise structural and technical elements (space allowance, feeding
facilities, etc.) and management-related factors such as hygienic and climatic conditions (Sundrum, 1996). Others use animal-based variables or parameters (performance criteria) dealing with behaviour, health and physiology of the animals. However, a combination of design and performance criteria is generally recommended to obtain a valid and holistic assessment of animal welfare (Rushen and de Passillé, 1992; Sandee et al., 1996; Sundrum, 1996). The indicators to be included in a scheme of on-farm assessment of animal welfare should be valid, reliable and feasible and usable throughout Europe. This is also one of the main objectives of COST (European Co-operation in the Field of Scientific and Technical Research) Action 846 “Measuring and Monitoring Farm Animal Welfare”. However, only few animal-related parameters have been tested in on-farm conditions and additional information is required for most of them (Winckler et al., 2003). In particular, a preliminary study on parameter validity and repeatability at individual level was deemed necessary for a possible subsequent application at farm level. In this study repeatability was assessed by observing the variables on three different occasions. A parameter can be considered valid if it is relevant with respect to animal welfare and related to health, physiology and behaviour (Alban et al., 2001). Therefore, the aim of this study was to evaluate the consistency in time of some animal-related variables, which could be used in protocols developed for on-farm welfare assessment. In addition, the link between recorded parameters, immune and productive variables was assessed.

Material and methods

Animals and farms

Recordings were performed in three dairy buffalo (Bubalus bubalis) farms (presented as farms 1, 2 and 3) and four dairy cattle farms (presented as farms 4, 5, 6 and 7) located in the province of Rome. The herd size of the farms ranged from 100 to 150 lactating animals. Farms 2 (buffaloes) and 5 (cattle) were part of the same unit sharing the milking parlour and management. All farms used a loose-housing system and herringbone milking parlour. For each farm 30-40 animals (15-20 primiparous and 15-20 multiparous) at a lactation stage of 100-160 days were selected.

Data on milk traits (production, fat, protein and somatic cell count) of two consecutive months were obtained from the official recordings of the local Provincial Breeder Association.

Observations were conducted by a team of 8 trained assessors wearing blue overalls. Four preliminary sessions (two per animal species) were used to standardise assessments. Each preliminary session was conducted in a different non-experimental farm. Experimental animals were observed in three occasions at 15-20 day intervals to obtain a measure of repeatability. Within each animal species, each variable was always assessed by the same observer.

Behaviour during milking

The behaviour of lactating animals in the milking shed was observed at each farm during the afternoon milking. Observations were designed to measure cow restlessness during the milking. On observation day, an observer was located behind the animals and recorded the number of stepping and kicking movements from the attachment to the removal of cups (Rushen et al., 1999 and 2001). A step was defined whenever one hoof was lifted less than 15 cm off the ground. Kicking was recorded whenever one hoof was raised at least 15 cm off the ground, even if a clear kick was not visible. In addition, defecation, urination and vocalisation were recorded as a single behavioural activity, since previous work has shown that they are highly correlated (de Passillé et al., 1995), but this activity was observed so rarely that it was not included in the statistical analysis.

Avoidance distance

The avoidance distance of an animal is the distance to which the animal will allow a person to approach before it moves (Fisher et al., 2000). This test was performed from 11:00 to 13:00 h, before afternoon milking. The assessor entered the home pen and stood motionless until animals looked at her/him. The observer commenced testing from the opposite end of the longest axis over which the herd was spread and tested the animals moving towards the main body of the herd. The observer
walked slowly towards the animal to be tested with one hand held slightly forward (Krohn et al., 2001). The animal to be tested was approached at a speed of one step per second. The distance between observer and the point at which the cow moved to the side, away or forward (if withdrawal was blocked by a fence) was recorded and defined as avoidance distance (Hemsworth et al., 2000). The distance was measured putting the feet one ahead to another and counting the steps of the observer. Following a measurement, the person moved towards the closest, undisturbed and stationary animal as described above to conduct the next recording. When the test was completed the avoidance distances were converted in meters by measuring the length of observer's step.

Lameness score
The lameness score was recorded after the afternoon milking using a scheme proposed by Breuer et al. (2000). Data were collected while cows were exiting the milking shed. A score of 0 to 3 was used, where 0 was assigned when the animal was not lame (normal gait), 1 was given when the cow was mildly lame (slight limp – no head bob), 2 was attributed when the subject was lame (clearly limp – head bob) and 3 was recorded when the cow was very lame (head bob and held leg up for a period of seconds).

Cleanliness score
Experimental animals were scored using a modification of the system described by Krebs et al. (2001). A scoring chart divided the pelvis into five identifiable areas which were rated on a scale with anchor points at each end: 0: clean and 2: very dirty) and half point increments. Scores were subsequently totalled to obtain a single value for each animal. The five regions were: ano-genital, udder rear view, leg, hind underbelly and udder lateral view, thigh.

Immune responses
Humoral and cellular immune responses were measured in farms 2 (buffalo) and 5 (cattle) on the same animals used for the other recordings. However, animals were handled on different days and by different people. Assessment of humoral immune response was performed on blood samples collected immediately prior to subcutaneous injection of 5 mg of keyhole limpet hemocyanin (Sigma Chemical) as antigen dissolved in 2 ml of sterile saline solution and emulsified in an equal volume of incomplete Freund's adjuvant and then at weekly intervals for four weeks, as described by Grasso et al. (1999).

Briefly, the ELISA was performed using the following operating conditions: 100 ml of coating KLH (0.5 mg/ml), 100 ml of serum (1/100 and 1/200 dilutions in PBS for buffaloes and cattle, respectively) and 100 ml of horseradish peroxidase-conjugated anti bovine IgG (1/48000 dilution in PBS). Optical density was measured at a wavelength of 450 nm using an ELISA reader. The inter and intra-assay coefficients of variation were 9.22 and 5.50 for cattle and 11.11 and 4.32 for buffaloes, respectively. The assay was optimised in our laboratory for concentrations of coating antigen, serum and detector antibody. Immune response was determined by integrating the area under the curve described by the optical density values from 0 to four weeks by:

\[ \text{IntIgG} = \frac{(\text{OD}_s + \text{OD}_{s+1})}{2 \times T} \]

where OD is optical density of sample s and the successive sample, s+1, with an interval of T (one week between the samples).

The phytohemagglutinin (PHA; Sigma Chemical) skin test was conducted according to the procedure used by Grasso et al. (1999). PHA (500 µg in 500 µl of sterile saline solution) was injected intradermally in the upper side of the right shoulder. For each animal an average increase in skin thickness was computed using two diagonal measurements by means of a calliper. Another injection was repeated one month later.

Statistical analyses
The data were analysed using nonparametric statistical tests (Siegel, 1956). For each farm and each variable repeatability was computed using the Kendall coefficient of concordance (W), which expressed the degree of agreement among three observations. It should be emphasized that the level of statistical significance does not say much on reliability because it also depends on the size of
the sample, whereas the value of the coefficient of concordance (W) may be more relevant. Although no threshold figure of W exists above which a variable may be considered reliable, we suggest a general interpretation of W coefficient as an indicator of low agreement if less than 0.4, moderate if between 0.4 and 0.6 and high if above 0.6.

Further analyses were performed on the mean value of the three observations obtained from individual animals. For each animal species, the Kruskal-Wallis analysis of variance with one factor (farm) was performed to evaluate the effect of farm on recorded variables. The Mann-Whitney U test was performed to evaluate the effect of animal species on avoidance distance using only the farms where both species were present (farms 2 and 5).

Bovine milk production data were corrected for fat content (FCM: fat 4%) using the following equation:

\[ FCM = 1 \times [0.4 + (0.15 \times \% \text{ of fat content})] \]

Buffalo milk production was expressed as corrected milk (FPCM: fat 4%, protein 3.1%) using the following equation (Di Palo, 1992):

\[ FPCM = 1 + 0.01155 [(f-40) + (p-31)] \]

where f and p are the grams of fat and protein in 1 kg of milk, respectively. For each animal the mean value of the two consecutive recordings was used.

For each animal species, the link between animal-related parameters, immune and productive traits were calculated taking into account the variation between farms (pooled correlation). In particular, for each farm the difference of each subject from the average of the experimental animals was computed. Subsequently, transformed data from all farms were used to calculate Spearman correlation coefficients (\( r_s \)).

**Results and discussion**

The mean values of corrected milk yield and somatic cell count of experimental animals are reported in Table 1, whereas the repeatability of results obtained by the same observers in three different sessions are shown in Table 2 for buffalo and cattle farms, respectively.

In buffalo farms avoidance distance may be considered highly repeatable (W > 0.64), whereas in dairy cattle its repeatability ranged from medium (W = 0.43 to 0.59) to high (W = 0.64). Similar results were obtained by Rousing and Waiblinger (2004). These authors observed that avoidance testing was valid and applicable for on-farm assessments of dairy cattle. This variable has been considered as an indicator of the quality of the relationship between farm animals and stockpeople (Hemsworth et al., 2000; Waiblinger et al., 2003).

In our study, a significant effect of farm was observed in both species (P<0.01 and P<0.001 for buffaloes and cattle, respectively), as shown in Tables 3 and 4. This result may be attributed to the fact that avoidance distance reflected a different quality of the human-animal relationship. In

| Farm | Milk yield, kg | SCC, n/ml |
|------|---------------|-----------|
| Buffalo | 1 | 13.71 ± 0.48 | 79,500 ± 20,233 |
| | 2 | 14.40 ± 0.70 | 382,720 ± 77,824 |
| | 3 | 14.22 ± 0.56 | - |
| Cattle | 4 | - | - |
| | 5 | 25.90 ± 1.15 | 318,125 ± 89,185 |
| | 6 | 27.92 ± 0.79 | 208,943 ± 38,053 |
| | 7 | 18.67 ± 0.75 | 234,375 ± 43,577 |

1 Expressed as corrected milk (see "Material and methods" for the equations).
modern dairy farming systems human-animal interactions are frequent and the nature of the human contact towards animals can affect their subsequent behavioural response (Lensink et al., 2000) and milk production (Breuer et al., 2000; Waiblinger et al., 2002). Hemsworth et al. (2000) found a correlation between stockperson attitude, animal fear and productivity in dairy cows, thus indicating a possible opportunity to reduce fear of humans and increase milk production by targeting stockperson attitude and behaviour.

The Mann-Whitney U test performed on data

| Farm | Buffalo | Dairy cattle |
|------|---------|--------------|
| 1    | 2       | 3            | 4       | 5       | 6       | 7       |
| Avoidance distance | * | 0.70 | 0.63 | 0.43 | 0.57 | 0.59 | 0.64 |
| Stepping | 0.51 | 0.66 | 0.59 | *    | 0.76 | 0.64 | 0.52 |
| Kicking  | 0.55 | 0.63 | 0.48 | *    | 0.45 | 0.35 | c      |
| Cleanliness score | * | * | 0.29 | 0.62 | 0.51 | 0.68 | 0.71 |
| Lameness score  | 0.62 | 0.43 | 0.66 | c    |      |      |        |

*: not recorded.
**: only two recordings were performed.
*: statistical analysis was not performed due to lack of values different from 0.

| Farm | 1 | 2 | 3 | P< |
|------|---|---|---|----|
| Avoidance distance | m | * | 0.64 (0.63) | 1.44 (1.13) | 0.01 |
| Stepping | n. | 3.33 (2.29) | 3.22 (3.18) | 4.44 (2.51) | ns |
| Kicking  | n | 0.52 (0.71) | 0.52 (0.81) | 0.98 (1.04) | ns |

*: not recorded; ns: not significant.

| Farm | 4 | 5 | 6 | 7 | P< |
|------|---|---|---|---|----|
| Avoidance distance | m | 2.17 (0.84) | 2.42 (0.72) | 1.61 (0.80) | 1.16 (0.72) | 0.001 |
| Stepping | n. | a | 9.81 (7.86) | 9.50 (5.80) | 4.11 (2.68) | 0.001 |
| Kicking  | n | a | 0.51 (0.55) | 0.66 (0.89) | c | ns |
| Cleanliness score | 6.94 (1.08)b | 7.85 (0.75) | 3.17 (1.23) | 6.05 (1.15) | 0.001 |
| Lameness score | 0.13 (0.38)b | 0.39 (0.54) | 0.43 (0.73) | c | 0.01 |

*: not recorded.
**: only two recordings were performed.
*: statistical analysis was not performed due to lack of values different from 0.
ns: not significant.
obtained from the farms where both species were present (farms 2 and 5) showed that avoidance distance was lower in buffaloes (mean ± S.D.: 0.64 ± 0.63) than cattle (2.42 ± 0.72; P<0.001). This result can be attributed to the fact that buffaloes are generally recognised as being more curious than cattle (empirical observations). The higher degree of curiosity of the buffaloes may be interpreted in terms of reduced neophobia or higher motivation to explore. However, this issue has never received scientific attention.

Behavioural recordings at milking showed that the repeatability of stepping was either medium or high for both buffaloes and cattle, whereas kicking was less repeatable. Previous studies showed that stepping may be considered an indicator of agitation, whereas kicking is more related to aggressiveness (Hemsworth et al., 2000; Munksgaard et al., 2001). Animal restlessness at milking is a possible source of injury and may be caused by many different factors, such as pushing of adjacent cows, lameness, low mineral intakes, presence of hematophage insects, poor maintenance of milking machine, etc. In our study, the significant correlation observed between stepping and lameness (r_s = 0.20; P<0.05) may be due to the pain experienced by affected animals. However, Breuer et al. (2000) found a correlation between human behaviour and cow restlessness during milking thus suggesting that at least a component of this animal reaction to milking may be interpreted as a response to the stockperson. In particular, these authors observed that the use of negative tactile interactions, loud harsh vocalisations and quick movements had negative effects on animal calmness, whereas the use of soft and quite vocalisations and movements produced opposite results. Our results confirm that a different quality of the human-animal relationship may be detected using stepping (Table 4), as in cattle this parameter was significantly affected by farm (P<0.001). The presence of aversive handlers during milking also induced increased heart rates, cortisol level and residual milk (Rushen et al., 1999; Hemsworth et al., 2000), which are all expressions of fear and stress. In cattle herds a positive correlation (r_s = 0.24; P<0.05) was found for stepping vs. kicking. Therefore, in accordance with Rushen et al. (2001), the different types of leg movements during milking need to be distinguished.

In three cattle farms a high repeatability was observed for cleanliness (W = 0.62 to 0.71). In farm 4, albeit W was not significant due to a reduced number of repetitions, the value of the coefficient can be considered high (0.62). Farm 5 showed a medium repeatability (W = 0.51). Conversely, it was not repeatable in the sole buffalo farm where this variable was monitored (W = 0.29). The evaluation of body cleanliness may give some indication on cow comfort as well as on stockpeople attitude and care for animals. Although this variable is strictly dependent on weather conditions, frequency of straw substitution, etc., in the present study, for most cattle farms a high value of Kendall coefficient was observed. Cleanliness repeatability was very low for buffaloes in the sole farm where this variable was monitored. This latter result is likely to be due to the peculiar buffalo behaviour of wallowing aimed to gain protection against solar radiation and dermal parasites.

Although cleanliness can give some indications on cow comfort, it may be less relevant than injuries and disease. In cattle farms, the study of concordance for lameness score yielded heterogeneous results. It was very repeatable in farm 4 (W = 0.62) and 6 (W = 0.66) and moderately consistent in farm 5 (W = 0.43). As reported for cleanliness, only two sessions of recording were performed in farm 4, with obvious and evident effects on the level of significance. The state of claws was satisfactory in farm 7, where no animals displayed lameness. In all buffalo farms no animals received scores different from 0, therefore data are not presented. Lameness is a major welfare problem for dairy animals inducing pain and discomfort of long duration. This disease may be caused by several different factors, such as unbalanced nutrition, flooring, social behaviour and related time spent standing, etc. (Galindo et al., 2000; Winckler and Willen, 2001). Previous studies reported a significant correlation between lameness and claw disorders of cows and high inter-observer reliability (Whay et al., 1997; Winckler and Willen, 2001). For individual animals lameness may change within rather short time periods. Therefore, at farm level, herd lameness prevalence, which is not necessarily affected by changes in certain single animals, may be more relevant. However, the concurrence of three observations obtained in this
study represents further evidence that lameness score is a reliable welfare indicator of dairy cattle for on-farm assessments. In addition, both lameness and cleanliness were affected by the farm (P<0.01 and P<0.001, respectively), thus these variables may be able to discriminate the quality of farm management (Table 4). In buffaloes the effect of farm on lameness and cleanliness could not be evaluated due to the fact that no animals received a lameness score different from 0 and cleanliness was scored only in one farm. In cattle a negative correlation between lameness score and milk production (FCM) was observed (r_s = 0.30; P<0.01). Similar results were found by several authors (Rajala-Scultz et al., 1999; Warnick et al., 2001; Juarez et al., 2003). It has been suggested that reduced milk production of lame cows may be due to pain experienced from weight bearing and, as a consequence, to a reduced time spent eating (Juarez et al., 2003).

By contrast, lameness was virtually absent in buffaloes, which may be attributed to either lower genetic predisposition or lower feeding regimen or different metabolism compared to cattle (Campanile et al., 1998).

In our study only two significant correlations with immune variables were observed: FPCM vs. IntIgG in buffaloes (r_s = 0.34; P<0.05) and IntIgG vs. PHA in cattle (r_s = 0.37; P<0.05). Interaction between behavioural, neuroendocrine and immune systems are well documented in farm animals (Husband, 1995; Hicks et al., 1998). However much remains to be clarified about the nature of these interactions and their consequences for the welfare and productivity of the animals.

Conclusions

For both species avoidance distance was repeatable and able to discriminate among farms. No threshold limits have been set so far for animal related variables to be used in on-farm scheme. However, in a preliminary study, Whay et al. (2003) produced five categories of welfare for different animal based parameters. According to the categories produced for avoidance distance, the farms used in the present study would range from the top to the lowest scores, thus confirming that this parameter may be able to detect different levels of management. Lameness and cleanliness scores were able to discriminate only dairy cattle farms, whereas these two parameters, albeit feasible, seem to have low significance for dairy buffaloes. Stepping during milking was consistent 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.

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