ORIGINAL ARTICLE

Implementation of the Welfare Quality® protocol in dairy farms raised on extensive, semi-intensive and intensive systems in Costa Rica

Adalinda Hernández ▪ Sandra Estrada König ▪
Juan Jose Romero Zúñiga ▪ Carlos Salvador Galina ▪
Charlotte Berg ▪ Mariano Rojas Gonzales ▪ Alice DiGiacinto Villalobos

A Hernández (Corresponding autor) ▪ **C Berg**
Department of Animal Environment and Health, Swedish University of Agricultural Sciences, Sweden.
e-mail: adalinda.hernandez@slu.se

SE König ▪ JJR Zúñiga
Programa de Investigación en Medicina Poblacional, Escuela de Medicina Veterinaria, Universidad Nacional, Costa Rica.

CS Galina
Departamento de Reproducción, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México, Mexico City, Distrito Federal, Mexico.

MR Gonzales
Asesor Veterinaria de importaciones S.A (VETIM), Costa Rica.

AD Villalobos
Business Economics Group, Wageningen University, Netherlands.

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Abstract Most developing countries are situated in non-extreme climates; this characteristic facilitates outdoor farming the whole year around and animals are kept at pasture most of the day. This characteristic may influence the feasibility of some animal welfare assessment protocols developed for intensive systems. With the objective of testing the Welfare Quality® protocol for dairy cattle in Costa Rica, 60 farms in three different farming systems were assessed. The farms were visited only once to assess the observational part and workers were interviewed to obtain the information related to the management and health of the animals. Descriptive statistics for continuous variables was performed; a one-way Anova and a multiple Student's t-test were applied for a comparison between groups of farms, in general and by each aspect. The farms were grouped according to the management system: Intensive, semi-intensive and extensive. None of the groups reached an excellent welfare state in all three principles of the protocol (good feeding, good health and appropriate behaviour), and only the extensive group achieved an excellent welfare state in good housing. The principle of good health was the lower for the three systems and on average all farms were placed below a neutral welfare state. The protocol underlines differences between the farms studied. There might be a need for modifications of the assessment protocol directed towards specific features in extensive and semi-intensive farms. Indicators of well-being for this type of enterprises are in demand.

Keywords: animal welfare; *Bos taurus*; cattle; tropics

Introduction

During the last decades, the welfare of animals in production units for meat and milk has become a major issue to members of society. The demand for high quality of food is important, affecting political and economic issues as consumers consider that this feature is not only determined by the nature and safety of the products, but also by the welfare of the animals in production (Moynagh 2000; Blokhuis 2008).

Numerous groups in Europe have created diverse certification schemes allowing consumers to identify high welfare standard products (Botreau et al 2007). However the methods and indicators covered in the assessment of welfare varies among these schemes, thus a standardized protocol to evaluate on-farm animal welfare was in demand. To address this concern the European Union funded a research project that later was developed as the Welfare Quality® (WQ®) animal welfare assessment protocol, which is based on the premise that welfare is related to a mental state of the animals and therefore, welfare indicators should primarily be animal-based (Botreau et al 2007).

The WQ® has become the largest integrated research instrument for assessing animal welfare in Europe as it is assumed to have a relatively high validity for an on-farm welfare assessment tool. Furthermore, it has been shown that improving the welfare of animals on a farm can raise the quality of food, reducing pathologies and increasing resistance to diseases, thereby becoming an important aspect of food safety (Welfare Quality® 2011). In fact, there is an abundant concern about animal welfare among the scientific community

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which has led to conduct diverse studies on the matter highlighting the advantages and limitations of the WQ® protocol, stating that the WQ® on-farm assessment approach can be regarded sufficiently valid, reliable and feasible, but with still a considerable number of challenges to overcome (eg Knierim and Winckler 2009; de Vries et al 2013; Andreasen et al 2013).

Since the WQ® protocol was originally created to cater for the conditions of intensive production systems in Europe, there have been little attempts to apply it in developing countries where, due to the geographical circumstances, climate plays an important role as it modifies the production systems as compared to those relevant to severe temperate climates. Most developing countries are situated in non-extreme climates, this characteristic facilitates outdoor farming the whole year around and, in many cases, animals are kept at pasture most of the day. This characteristic may influence the feasibility of some animal welfare assessment programmes and protocols developed/intended for intensive systems. The lack of a standardized trustworthy tool to evaluate animal welfare in developing countries may situate them at a disadvantage on the competitive market widening the gap between industrialized and developing countries. Thus, a validation method needs testing to evaluate its accuracy under tropical conditions.

The objective of the present study was to utilize the WQ® protocol for dairy cattle to evaluate the animal welfare of dairy farms in Costa Rica, Central America, established under intensive (in enclosure), semi-intensive (partly in enclosure, partly at pasture) and extensive (completely at pasture) housing and management systems.

Materials and Methods

Farms

The study was carried out evaluating 60 farms allied to an association of milk producers in Costa Rica. The farms were specialized in milk production, employing breeds such as Holstein and Jersey. The farms used mechanic milking, supplementary feeding and additional mineral salts were provided. The average size of the farms was 60±7.7 cows, ranging from 42 to 1480. The farms were divided according to three possible management systems, resulting in 31 in an extensive system, 24 in a semi-intensive and 5 under an intensive system, the average size of farms and the number of animals evaluated are depicted in Table 1. All observations were performed by the same trained assessor.

At the extensive farms, animals spend all day at pasture, going to a milking parlour twice a day. Some features may vary depending on the farm, however, most of the farms have concrete floor, specially built for the animals in the milking parlour. At pasture, water points are small and scarce, but bigger troughs are found in the milking parlour. In this type of system, the animals receive supplementary feed in the milking parlour.

The semi-intensive farms are characterized by keeping animals indoors, in loose-house, from afternoon milking to morning milking. After the first milking, cows are released to pasture. During the period indoors, the animals receive supplementary feed and mineral salts, as well as having access to water points. The indoor flooring commonly consists of sand.

In the intensive systems, animals are kept indoors during the whole day. Feeding is based on chopped improved grasses and commercial concentrates. Pens have floors of sand and are big enough to let the animals walk around and have access to water troughs all the time. Cows are milked twice a day.

Welfare assessment

The animal welfare was assessed utilizing the method of evaluation specified by the protocol for dairy cattle of the Welfare Quality® Project (2009). The within herd sample size of animals to assess was calculated according to the WQ® protocol recommendation depicted in Table 13 of the dairy cows protocol. "Suggestion A" was always the priority and performed in most cases, however when the normal routine of the farm did not allow us to perform "suggestion A", the second suggestion was performed. As a result of the management system in this region, the animals could not be locked in a feeding rack and were instead selected as every n^{th} animal as they were coming out from being milked. Data collection was then carried out immediately.

Table 1 Size of farms and number of animals evaluated.

System	No. of farms	Farm size			Sample size			
		Average	Minimum	Maximum	Average	Minimum	Maximum	Total
Extensive	31	129	32	435	43	28	73	1419
Semi-intensive	24	151	36	463	50	30	75	1208
Intensive	5	243	107	351	66	60	72	332

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The farms were visited only once to assess the observational part of the WQ® protocol, which is in accordance with the WQ® instructions. The assessment was performed on the adult cows after being milked in the morning. After the assessment, workers were interviewed to obtain the information related to the management and health of the animals.

Because of the characteristics of extensive farms (i.e. hilly pastures with abundant foliage), some of the observations, such as the clinical examination and the avoidance distance, were performed during milking in a semi-open space (small pens) where animals still had the chance to avoid human intervention if desiring to do so. Behavioural observations were performed on pasture since this is the place where the animals spend most of their time, and hence their behaviours would only be minimally affected by the evaluations. The assessor utilized binoculars for the pasture-based observations, to minimize any interference with the animals.

The results were analysed using the formulas provided by the National Institute of Agricultural Research (INRA) in France for calculation of the final scores, in accordance with the methods proposed by the protocol of the Welfare Quality® Project (2009).

Statistical analysis

Descriptive statistics for continuous variables were utilized. Central tendency (mean) and dispersion of the data (standard deviation) were calculated for the general farm score and for each aspect. Furthermore, a one-way Anova and a multiple Student's test were performed for comparison between groups of farms, in general and by each aspect. All test were carried out at a α value of 0.05.

Descriptive statistics for continuous variables were used. Central tendency (mean and median) and dispersion of the data (standard deviation) and measures of position (median, minimum and maximum) were calculated for the general farm score and for each criterion. Furthermore, a one-way non-parametric ANOVA using the Kruskall-Wallis test was used for comparison between groups of farms, in general and by each principle. All tests were carried out at an α value of 0.05, using SAS 9.4 statistical package.

Results

As mentioned above, the farms were grouped according to the management system applied, reflecting common practice in Costa Rica: Intensive (8.3%), semi-intensive (40.0%) and extensive (51.7%). As can be seen in Table 2, none of the groups reached a score of excellent welfare state in all three principles of the protocol (good feeding, good health and appropriate behaviour), and only the extensive group achieved the level of excellent welfare state in relation to good housing. The section related to good health was the lower for the three systems and on average the farms were considered to be above the poor welfare state, but below the neutral level.

Table 2 Comparison and statistical summary of the scores by principle and management system. Different characters represent statistical differences between management systems, within each principle, with a significance value of < 0.05.

Principle\System	Intensive (n=5)			Semi-intensive (n=24)			Extensive (n=31)		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Good feeding	69.6[a]	21.5	75.5	36.0[b]	21.8	35.6	34.7[b]	23.3	33.5
Good housing	65.1[a]	5.2	65.0	79.0[b]	13.4	77.0	88.6[b]	11.0	93.3
Good health	38.2[a]	5.2	39.2	40.0[a]	7.0	37.7	40.5[a]	10.5	38.5
Behaviour	45.8[a]	7.1	45.1	57.0[a]	12.7	56.6	56.2[a]	15.5	59.1

n = Sample size; SD = Standard deviation

The results related to the good feeding principle can be seen in Figure 1. None of the groups of farms reached the excellent welfare state with reference to the absence of prolonged hunger. The farms in an extensive system scored lower than the other two, but still on average reaching the classification of neutral welfare state. Intensive systems scored significantly higher, almost reaching the excellent welfare state in the absence of prolonged thirst, whilst extensive and semi-intensive systems were placed above the poor welfare state, but below the neutral level.

In the principle of good housing and comfort around resting, the extensive farms obtained the highest score reaching an excellent welfare state; while the semi-intensive farms achieved a neutral level and the intensive farms were placed below the neutral welfare state (Figure 2). All farms obtained the highest score related to ease of movement.

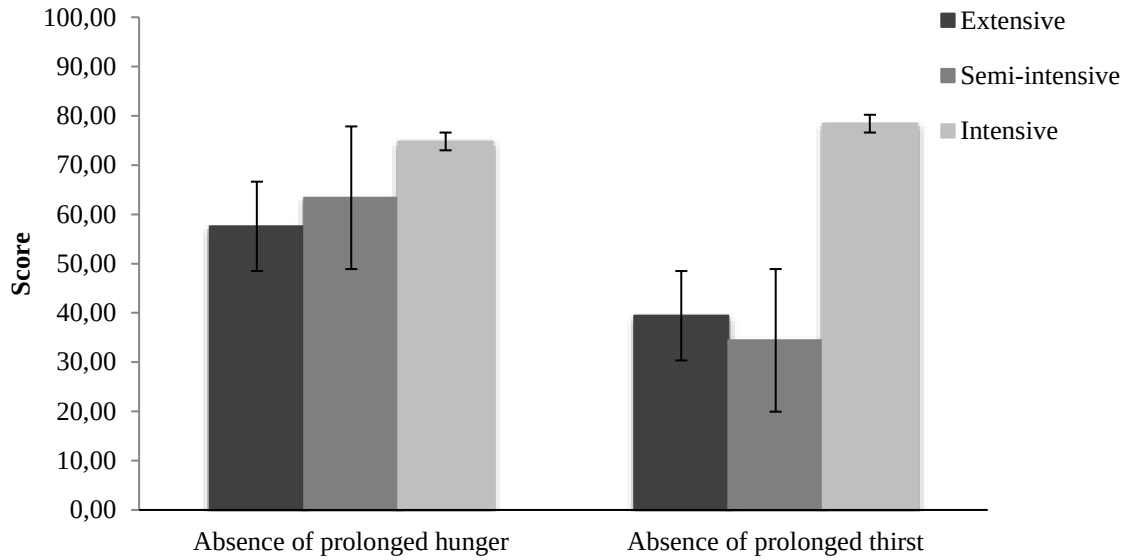

Figure 1 Comparison between averages of the Welfare Quality® principle of good feeding divided by the three management systems and the two evaluated criteria, absence of prolonged hunger and absence of prolonged thirst.

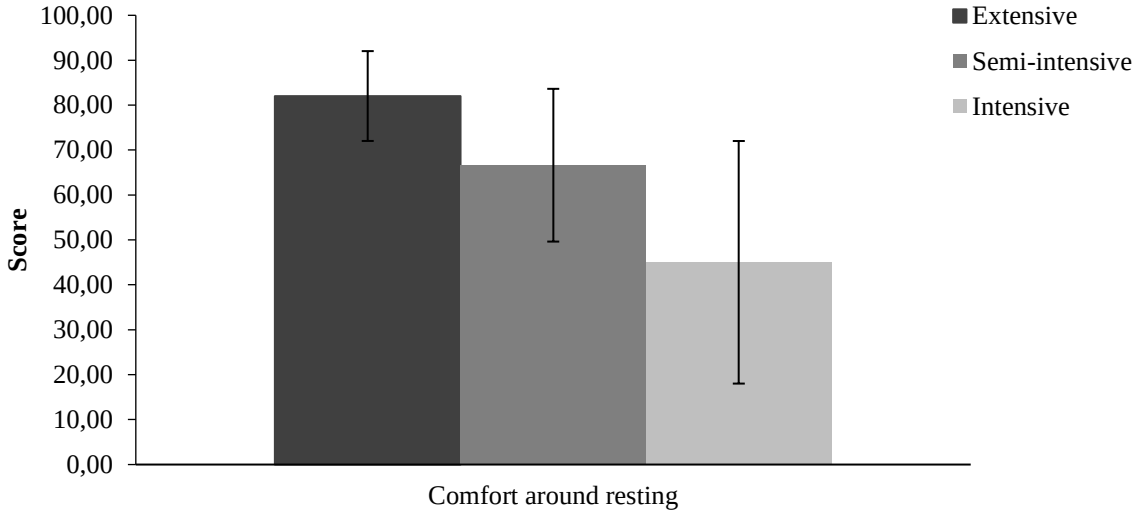

Figure 2 Comparison between averages of the Welfare Quality® criteria of comfort around resting. Ease of movement is not presented in the graphic since all farms reached the maximum score in this criteria.

The results from the principle of good health can be seen in figure 3, where problems related to the question of absence of pain induced by management procedures was one of the main animal welfare shortcomings in the three groups of farms, since the use of anaesthetics and analgesics was non-existent. Therefore, all farms scored below 30 points, although above the limits of being considered as having a poor welfare state. The three groups all scored as neutral in absence of disease and were placed as above the neutral level with reference to the absence of injuries, however the intensive farms scored significantly lower when compared to extensive and semi-intensive farms.

The principle of appropriate behaviour can be seen in figure 4. All farms reached the level of excellent welfare state in expression of social behaviour, however in expression of other behaviours the intensive system scored significantly lower than farms under the other two systems, not achieving the neutral welfare state. With respect to good human-animal relationship, the three type of systems reached the neutral welfare state. On average, the three groups of farms obtained a neutral level for positive emotional state.

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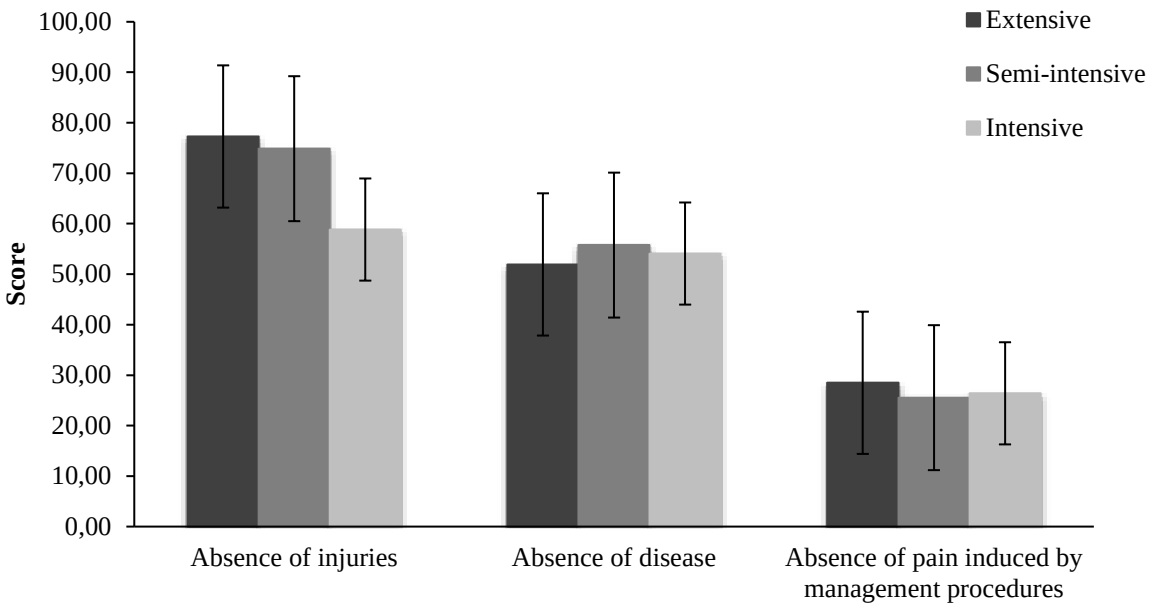

Figure 3 Comparison between averages of the Welfare Quality® principle of good health, subdivided in absence of injuries, absence of disease and absence of pain induced by management procedures.

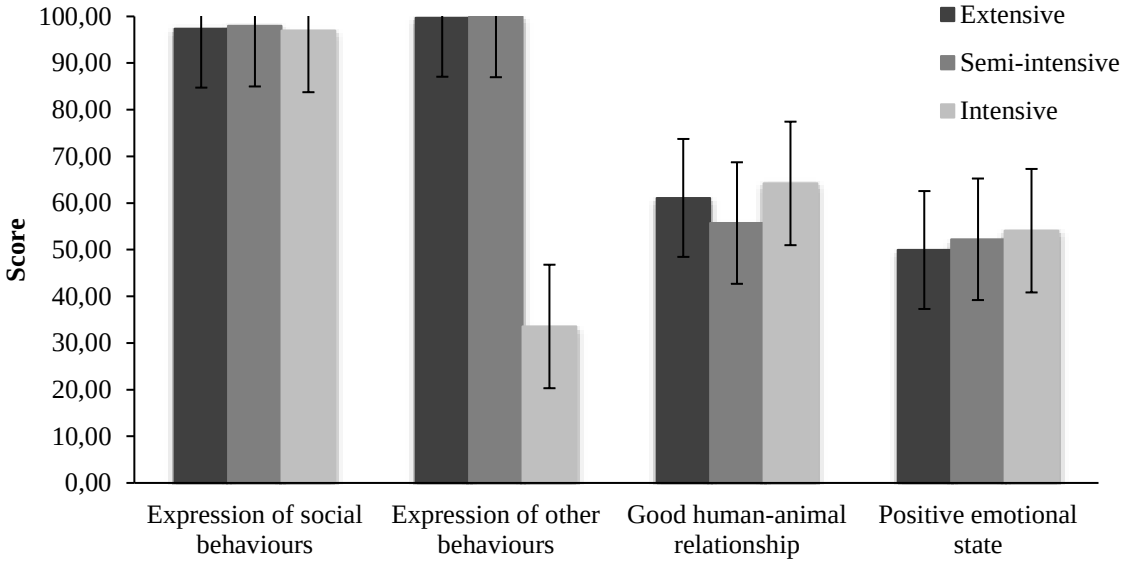

Figure 4 Comparison between averages of the Welfare Quality® principle of appropriate behaviour, involving expression of social behaviours, expression of other behaviours, assessed by the amount of time the cows spend at pasture, good human-animal relationship and positive emotional state.

Discussion

The aim of the study was to evaluate the animal welfare in relation to three different systems of production commonly implemented on dairy farms in Costa Rica (intensive, semi-intensive and extensive) utilizing the Welfare Quality® protocol for dairy cattle. The WQ® protocol was originally developed to be applicable under the conditions of intensive European systems and has proven to be a useful tool for assessing on-farm welfare (see eg Popescu et al 2013). However, when applied to the conditions of dairy production in other housing and management systems, some differences can be observed.

In the section of good feeding, absence of prolonged hunger is evaluated assessing the body condition of the animals. Extensive farms obtained a lower score in this feature when compared to semi-intensive and intensive systems, probably related to the quality of pasture, which partly consisted of native grass species, where the nutritious quality is bound to be lower than on specialized, cultivated pasture

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land with more nutritious types of introduced grass. Additionally, most of animals in these farms lack access to supplementary feed and the physical activity in searching for fodder might represent a higher use of energy, but not necessarily reflecting the absence of prolonged hunger. Moreover, defined seasonal rainfall in some areas may affect the cycle of pasture changing the quantity and quality, causing variations in the body condition of the animals from one season to another. During the dry season, animals can lose more that 10% of their live weight (Winks 1984). European breeds can be highly affected by this situation since their adaptation to the effects of poor nutrition is minor compared to tropically-adapted cattle (Frisch and Vercoe 1984; Petherick, 2005). This has an implication when assessing the welfare of herds composed mainly of European breeds, impairing the welfare when compared to adapted animals (Petherick 2005).

The WQ® protocol considers water intake to be associated with the number and size of water points available for the animals. In this study, extensive and semi-intensive farms also scored considerably lower than intensive farms in the area of absence of prolonged thirst, this could be due to the easiness of providing water in an enclosure, but being difficult to provide a clean, good quality water supply at pasture. Water intake can also be affected by other features such as climate and diet (Dahlborn et al 1998; Meyer et al 2004) and thus, as pointed out by de Vries (2013), basing the assessment exclusively on the number of water points is questionable, although such simplifications do of course improve the feasibility of the protocol.

In the principle of good housing, the criterion comfort around resting will be scored at high levels in extensive farms since animals are not kept indoors. The extensive farms in the present study obtained the highest score reaching the excellence level, while semi-intensive farms scored slightly lower and intensive farms obtained the lowest results. This could be the consequence that, in extensive farms, animals are kept on an open space thus encounters with structures (colliding with equipment) are improbable and competition for space is kept to a minimum.

Related to good health, is still a common practice in the region of study, as well as it is in most developing countries, to perform all management procedures, including disbudding and dehorning, without any application of anaesthetics or analgesics. Therefore, the section of absence of pain induced by management procedures was one of the main problems observed in the three groups of farms and even if the scores fell within the limits considered as acceptable, this may not be a reflection of well-performed practices, but rather the complete absence of some practices evaluated in the protocol, such as tail docking and castration, whilst some other practices commonly performed and which could also negatively influence the well-being, are not taken into account (ie iron branding and ear tagging). Iron branding may inflict similar pain to disbudding with a hot iron, since both interventions involve very similar equipment, intervention duration and physical reactions in the calves, in fact, Millman (2013) reported a greater number of vocalizations during branding than during disbudding or castration. This is a very important feature, since there is evidence that animal pain has a very high impact on their welfare (Fraser 2008). In accord, society is increasingly aware of pain as it is seeing as one of the most obvious aspects of discomfort, and consumers are unlikely to accept such practices if hearing about them. Nevertheless, disbudding and dehorning are still widely performed in the tropics, and at the herd level the long-term consequences of not having horns are probably more beneficial (Stafford and Mellor 2005). Therefore, proposing feasible and cheap alternatives to attend these problems, including routine administration of sedatives and pain medication during such interventions, should be a priority whilst assessing welfare at farms.

On the appropriate behaviour principle, all farms reached high scores in expression of social behaviour regardless of the management system, as it was assessed in their common environment (pasture in extensive farms and pens in semi-intensive and intensive farms). However, in the criterion of expression of other behaviours which is measured by the time the animals spend at pasture. Consequently, it is a feature that is only evaluating intensive farms, but not necessarily extensive farms where animals are kept free all the time. Future actions to assess this variable should bear in mind this feature, since it is quite common in farms in developing countries (Nicholson et al 1994; González-García et al 2012).

In the criteria of good human-animal relationship, all farms scored the minimum level to be in a neutral welfare state, and extensive farms scored even higher that semi-intensive systems farms, which could indicate that even though the animals have less contact with humans as consequence of being released to the pasture all day, this does not have any negative effect in their interaction. Nevertheless, there is plenty of evidence that human-animal interactions in intensive systems can affect the welfare and productivity (Hemsworth 2003; Raussi 2003), but the evidence of similar effects in extensive systems needs further research (Petherick 2005). In addition, temperament of cattle may also play an important role, especially when assessing herds of non-European breeds, widely used in developing countries. Several studies have demonstrated that temperament of cattle, measured by flight speed, plays a major factor related to the productivity of the animals (Voisinet et al 1997; Fell et al 1999; Petherick et al 2002) and may, indeed, affect their welfare (Petherick et al 2002).

The part related to positive emotional state includes items to assess the emotions of the animals; however, these are inevitably somewhat subjective and can be perceived

differently depending on the assessor (Andreasen et al 2013), and even more so if the assessors have not all been formally trained in the application and use of the WQ protocol.

The protocol as proposed by the Welfare Quality® project underlines differences in the farms studied. However, there is a need for modifications directed towards specific features in extensive and semi intensive, and less in the case of intensive systems. Moreover, a common feature in developing countries is the so-called dual purpose system (Vaccaro et al 1993), generally present in farms based on grazing, with a minimum investment, whose main objectives are a mixture of dairy and beef products. There is a need for indicators of well-being for these types of enterprises as well. Thus, it is important to attend to the demands of modern society, to avoid dismissing the production in developing countries. All this, due to a lack of a suitable tool for proper measurement, affecting the earnings of producers working under these systems.

Finally, due to the special characteristics of the tropics, there are two defined seasons (dry and rainy) and further research is needed to test the best time to apply animal welfare assessment protocols since simply concluding that one season is better than the other is not necessarily accurate due to the multifactorial nature of items affecting animal welfare.

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