
Volume 83, Issues 1–3, May 2009 ISSN 0921-4488
ELSEVIER
SMALL
RUMINANT
RESEARCH
The Official Journal of the International Goat Association

Small Ruminant Research 83 (2009) 49–57

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Monitoring the welfare of sheep in organic and conventional farms using an ANI 35 L derived method

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ARTICLE INFO

Article history:
Received 31 July 2008
Received in revised form 17 December 2008
Accepted 8 April 2009
Available online 14 May 2009

Keywords:
Animal welfare
Animal-based parameters
Sheep
Organic farming
Reliability
Welfare monitoring scheme

ABSTRACT

The present study was undertaken to evaluate the inter-observer reliability of a welfare monitoring scheme to be applied to sheep, and compare the welfare state of the animals between 10 organic and 10 conventional sheep farms. Two trained observers performed recordings. A graded point protocol was used, that relies on five sheets mostly derived by the Animal Needs Index, which is mainly based on resource-based parameters. Therefore, in the fifth sheet animal-based parameters, deemed relevant to sheep welfare, were taken into account. In particular, the following animal-based variables were assessed: integument alterations, animal dirtiness, hoof overgrowth, lameness and lesions, which where scored on the basis of their prevalence (number of affected animals/numbers of observed animals), longevity (age in years), and mutilations, such as de-horning and caudotomy, evaluated in terms of presence/absence. No significant differences were observed between organic and conventional farms in terms of ANI scores, housing characteristics and animal-based parameters. This result was not surprising, as most of the farms, both conventional and organic, based their farming systems on an extensive use of the land by grazing animals. The monitoring protocol proved to be feasible (the mean time needed to perform the assessment of welfare was 85 min per farm) and reliable: a significant Spearman's correlation coefficient between observers was observed for total score and all sheets. As to animal-based parameters, body condition could not be assessed visually due to the presence of flee in winter; the correlation between observers was significant for integument alterations, animal dirtiness, hoof overgrowth and lameness, whereas inter-observer reliability was not significant for lesions. This result indicated that more training is needed for the assessment of lesions in order to increase the reliability of the measure. In addition, we suggest visiting farms in early summer, soon after shearing, in order to make easier the detection of lesions and the assessment of body condition.

1. Introduction

Organic farming promotes high levels of animal welfare as a means to increase health and longevity of the animals and fulfil consumer ethical needs. Numerous standards of welfare have been produced for both conventional and organic sheep farms in order to meet the increasing demand of consumers for transparency in food production processes (El Balaa and Marie, 2006). El Balaa and Marie (2006) noted many differences between organic and conventional labelling schemes. However, the general belief that organic systems always provide the best conditions to the animals has been recently challenged (Athanasiadou et al., 2002) and if consumer ethical needs have to be fulfilled,

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doi:10.1016/j.smallrumres.2009.04.001

the actual level of sheep welfare should be checked. Therefore, in organic systems the need of reliable tools for monitoring the welfare state of the animals at farm level is urgent (Knierim et al., 2004). Monitoring systems rely either on resource/design criteria, which comprise structural and technical elements (space allowance, feeding facilities, etc.), the quality of human–animal relationship and management-related factors (hygienic and climatic conditions and routine farming practices), or animal-based variables (performance criteria) dealing with behaviour, health and physiology of the animals, or a combination of resource and performance criteria to obtain a valid assessment of animal welfare (Johnsen et al., 2001). They could allow the certification of farms based on animal welfare and provide both a system for comparing different husbandry systems and an advisory/management tool for the farmer aiming at detecting both housing and management risk factors (De Rosa et al., 2005). However, the features of the scheme depend on its aim and application field (Main et al., 2003).

Although numerous studies have assessed the effect of management stressors on sheep welfare, such as handling (Rushen, 1986), space restriction (Horton et al., 1991), restraint and isolation (Minton et al., 1992), shipping (Cockram et al., 2004), regrouping and relocation (Sevi et al., 2001), artificial rearing (Napolitano et al., 2008) and weaning (Orgeur et al., 1998), monitoring schemes for assessing small ruminant welfare at farm level are lacking. Due to this lack a protocol scientifically validated for cattle, the Animal Needs Index 35 L 2000 (ANI) may be fitted to sheep. The ANI proposed by Bartussek et al. (2000) for cattle has proven to be valid (Ofner et al., 2003), reliable (Amon et al., 2001) and to have some common criteria with consumer perception of animal welfare (Napolitano et al., 2007). It relies on a graded point system that assesses five aspects of the housing relevant to animal welfare. However, these aspects are mostly based on design criteria with a lack of animal-based variables. According to Dawkins et al. (2004), design variables alone are not a good predictor of animal welfare and the assessment should be based on animal measures, as they are the results of the interaction between the animals and the environment. Animal-based parameters are particularly relevant to sheep in Mediterranean areas, where they are traditionally housed for short periods of time in winter. However, resource-based parameters are also important as these animals are usually kept indoor during the night while intensive production systems for sheep have spread through the northern countries of the Mediterranean basin and specialized dairy flocks have increased in size (Caroprese et al., in press). Therefore, some animal-related indicators, possibly relevant for monitoring the welfare of sheep (Waterhouse et al., 2003; Goddard et al., 2006; Ganter, 2008) should be included in a welfare monitoring scheme.

The indicators to be included in a scheme for on-farm assessment of animal welfare should be valid (meaningful with respect to animal welfare), reliable (reflecting the tendency to give the same results on repeated measurements) and feasible (concerning time and financial requirements). In particular, inter-observer reliability is a measure of the agreement between two or more observers while measuring the same object (Martin and Bateson, 2007). In addition, on-farm welfare monitoring systems should provide a standard way of converting welfare-related measures into information that is easily understood by the consumer. This is also one of the main objectives of the European project Welfare Quality® (Blokhuis, 2007) along with the development of European standards for the assessment of animal welfare. However, in this project, small ruminants are not taken into account. Although a project entitled "Economics and Welfare of Extensive Sheep (EWES)" is currently sponsored by the Department for Environment, Food and Rural Affairs (UK), no on-farm assessment protocol for sheep is presently available.

Therefore, the present study was undertaken to evaluate the inter-observer reliability of each sheet and each animal-based variable to be included in a scheme specific to sheep. In addition, the welfare state of the animals in organic and conventional sheep farms was also compared.

2. Materials and methods

2.1. Farms

Recordings were performed in 10 organic and 10 conventional sheep farms located in Basilicata (southern Italy) at an average altitude of 844 m above sea level. The mean number of heads per farm was 350 and Merinizzata Italiana the most common breed. The average milk yield was 80 kg per lactation, including the amount ingested by the lambs. Observations were conducted on lactating animals from January to March 2007.

2.2. Application of the monitoring scheme

Two trained observers performed assessments. Four preliminary sessions, conducted in different non-experimental farms, were used to standardise assessments. The protocol used in the present study relies on four sheets derived by the Animal Needs Index (Bartussek et al., 2000), mainly based on resource-based parameters, and a fifth sheet where animal-based parameters, deemed relevant to sheep welfare, were assessed. The sheets were developed in collaboration with academics and certification body representatives expert in the field of sheep farming and health. These five sheets are reported in Appendix A. Sheet 1 assesses the opportunity given to the animals for locomotion using space allowance as well as accesses to outdoor areas and pasture. The possibility given to the animals to interact with co-specifics is also evaluated taking into account herd structure, management of young animals, access to manger and drinker. The condition of floor is assessed in Sheet 2 on the basis of softness, cleanliness and slipperiness of lying area, slipperiness and technical conditions of activity and outdoor areas. Steepness, access and condition of pasture, shade and shelter availability at pasture, indoor ventilation and access to outdoor areas are considered in Sheet 3. Stockmanship and management are assessed in Sheet 4 using cleanliness of feeding, drinking and lying areas, technical condition of equipment, presence of a hospital pen and frequency of animal checking. In Sheet 5, which accounts for 36.6% of the total score [(range of score for Sheet 5/range of total score) × 100], were included the following animal-based variables recorded on at least 20% of lactating animals: integument alterations (skin damages due to ecto-parasites, wool-less patches, hyperkeratosis), animal dirtiness (major splashing or distinct plaques of dirt at hind quarters and udder), hoof overgrowth (at least one overgrown claw), lameness (any sign of abnormal gait) and lesions (swellings, wounds and scabs) which where scored on the basis of their prevalence (number of affected animals/numbers of observed animals), longevity (age in years), and routine mutilations, such as caudotomy, evaluated in terms of presence/absence. Table 1 summarizes the five assessment sheets. The final score can range from 71.5 to −10.5, the higher the score the better the sheep welfare.

2.3. Statistical analyses

Data on housing characteristics and animal-based parameters gathered from the two observers were pooled and analysed using ANOVA

Table 1
Summary of the variables scored in each sheep farm.

Sheet	Columns								Total score
	a Indoor space allowance	b Herd structure	c Management of replacement	d Space at manger	e Water availability	f Outdoor space allowance	g Pasture months/year	h	
I, Locomotion/social interaction	0.0–3.5	0.0–2.0	−0.5 to 3.0	0.0–3.0	0.0–2.5	0.0–3.0	0.0–3.5		−0.5 to 20.5
	a Lying area	b	c	d Passage ways	e	f Outdoor	g	h	
	Comfort	Cleanliness	Slipperiness	Ease of passage	Slipperiness	Floor			
II, Flooring	−0.5 to 2.5	0.0–2.5	0.0–2.5	0.0–1.0	0.0–2.0	−0.5 to 1.5			−1.0 to 12.0
	a Thermoregulation	b	c	d Outdoor	e Pasture	f	g	h	
	Pasture		Barn	Paddock	Grass quality	Steepness	Months/year		
III, Environment	0.0–1.5		0.0–1.5	0.0–1.5	0.0–1.5	0.0–1.5	0.0–2.5		0.0–10
	a Cleanliness of feeding area	b Cleanliness of drinking area	c Cleanliness of resting area	d Conditions of equipments	e Animal checking	f Hospital pen	g	h	
IV, Management	0.0–1.5	0.0–1	0.0–1.5	0.0–1	0.0–1.0	−1.0 to 1.0			−1.0 to 7.0
	a Condition of integument	b Cleanliness of sheep	c Condition of hooves	d Lameness	e Lesions	f Mutilations	g Body condition	h Culling age	
V, Animal-based parameters	−1.0 to 3.0	−1.0 to 3.0	−1.0 to 3.0	−1.0 to 3.0	−1.0 to 3.0	−1.0 to 1.0	−1.0 to 3.0	−1.0 to 1.0	−8.0 to 22.0
All									−10.5 to 71.5

with one factor (conventional vs. organic). Data about the presence of the outdoor paddock and hospital pen were analysed using the χ^2-test. Inter-observer reliability was computed for each sheet, total score, integument alterations, animal dirtiness, hoof overgrowth, lameness and lesions using the Spearman's coefficient of correlation (r_s).

3. Results and discussion

3.1. Comparison between organic and conventional farms

The mean time needed to perform welfare assessment was 85 min per farm and no sophisticated equipment was necessary in both time-consuming and economical terms. Although the protocol allows compensation between poor and good conditions, it could be used to provide recommendations to farmers. In particular, within each sheet and each column any score equal or below 0 indicates that actions should be taken to improve that specific aspect. For instance, in Sheet 1 the 0 score for column a (indoor space allowance) is attributed for a space allowance <1 m^2/head, which is below the standards for organic sheep farming (1.5 m^2/head) as set by the European Union (2007) and close to the minimum RSPCA (2006) requirements (1.1–1.2 m^2/head for 45–60 kg ewes). In the same sheet, the availability of water only for part of the day is scored as 0; accordingly, the RSPCA standards specify "sheep must be provided with continuous access to . . . drinking water each day". Both organic and RSPCA standards give particular relevance to the fact that animals have access to grazing, as also specified in Sheets 1 (column g) and 3 (column f) of the present protocol, where no points are awarded if sheep are not allowed to pasture. Other parameters of the present protocol in common with the RSPCA standards are "presence of shade and shelter" (see Sheet 3) and "body condition" (see Sheet 5), whereas "mutilations" (see Sheet 5) are not allowed by the organic standards.

The mean total scores of the sheep farms (39.8 ± 1.5 and 40.3 ± 1.6 for organic and conventional farms, respectively; $P > 0.10$) were well above the central point of the scale (71.5-10.5/2 = 30.5), which indicated an overall satisfactory level of welfare.

No significant differences were observed between organic and conventional farms in terms of housing characteristics, animal-based parameters and ANI scores ($P > 0.10$). The latter are reported in Table 2 and indicate that both systems provide acceptable levels of welfare to the animals. This result is not surprising. Most of the farms, both conventional and organic, based their farming systems on an extensive use of land by grazing animals. Therefore, the decision not to certify their products as organic was dependent on market constraints (lack of distribution channels for organic products, which are often sold in local markets as undifferentiated) rather than on obstacles to the conversion originated from the farming system (most of the conventional farms could become organic with little or no changes). In the same region no marked differences in terms of welfare were observed between ewes raised using organic and conventional practices by Braghieri et al. (2007), whereas in Germany organic dairy cattle farms showed higher welfare conditions than conventional farms (Hörning, 2000). These results are not necessarily in contrast as the organic approach may be more effective in sustaining the welfare of high producing animals such as dairy cattle, which in conventional systems are raised in intensive conditions (large herds, limited or no access to pasture, high incidence of production-related diseases), as compared to extensively reared sheep.

The animal-related variables monitored in this study are shown in Table 3. The most significant welfare issues in sheep are widely acknowledged to include lameness, parasitism and malnutrition (Waterhouse et al., 2003; Goddard et al., 2006; Ganter, 2008). All are associated with weight loss and poor body condition (Athanasiadou et al., 2008; Winter, 2008). In addition, lameness and parasitism are also associated with chronic pain (Fitzpatrick et al., 2006).

The management of endo-parasites is likely to be significantly different in organic sheep flocks as compared to conventionally managed farms. Organic standards preclude the routine use of allopathic antihelmintics, therefore the possible welfare effects of endo-parasitism should be monitored. As already stated, body condition score may be a good indicator of parasitism, albeit also affected by nutrition (Athanasiadou et al., 2008; Winter, 2008), whereas dirtiness score may be a less reliable indicator, as fresh grass grazing can cause liquid faeces as well as endo-parasites (Thamsborg et al., 1996). Similarly, in organic flocks ecto-parasite control may be different from that performed in conventional farms. Nevertheless, in this study no differences were found for integument alteration, where the

Table 2
Mean (±SE) ANI scores.

Farms	Sheet 1	Sheet 2	Sheet 3	Sheet 4	Sheet 5	Total score
Organic	10.0 ± 0.7	12.8 ± 0.5	2.9 ± 0.2	2.9 ± 0.4	11.1 ± 0.6	39.8 ± 1.5
Conventional	11.3 ± 0.8	11.5 ± 0.5	2.8 ± 0.3	2.6 ± 0.4	12.0 ± 0.6	40.3 ± 1.6

Table 3
Mean (±SE) of the animal-related variables.

Farms	Longevity (years)	Integument alterations (%)[a]	Hoof overgrowth (%)[a]	Lameness (%)[a]	Lesions (%)[a]	Dirtiness (%)[a]
Organic	8.0 ± 0.56	19.2 ± 7.0	1.0 ± 0.55	6.6 ± 2.4	1.35 ± 0.93	28.3 ± 8.9
Conventional	8.5 ± 0.61	17.0 ± 6.9	0.40 ± 0.52	3.5 ± 2.0	1.79 ± 0.93	35.3 ± 8.9

[a] (Number of affected animals/number of observed animals) × 100.

Table 4
Mean (±SE) of the main housing characteristics of the sheep farms.

Farms	Indoor space allowance (m^2/head)	Outdoor space allowance (m^2/head)	Space at manger (m/head)	Presence of outdoor paddock (% of farms)	Presence of hospital pen (% of farms)
Organic	1.2 ± 0.15	1.7 ± 0.4	0.28 ± 0.03	45	27.3
Conventional	1.0 ± 0.17	1.2 ± 0.5	0.26 ± 0.03	33	44.4

Table 5
Inter-observer reliability (r_s)[a] for each assessment sheet.

	Sheet 1	Sheet 2	Sheet 3	Sheet 4	Sheet 5	Total score
r_s	0.955	0.883	0.823	0.878	0.729	0.901
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

[a] Spearman's coefficient of correlation.

detection of ecto-parasite infestation was performed, and animal dirtiness, possibly associated with endo-parasitic infestation ($P > 0.05$). A weak point of the protocol is represented by the lack of a direct measure of internal parasites (e.g. egg counts). Therefore, its inclusion is recommended to increase the validity of the scheme, although feasibility may be reduced.

No differences between organic and conventional flocks were observed in terms of lameness ($P > 0.05$). There are different types of foot lameness caused by infectious agents or trauma in sheep (Winter, 2004). However, this paper only focuses on lameness as a cause of reduced welfare: sheep are stoical prey animals that are unlikely to express obvious signs of pain, and lameness *per se* indicates that the animal is experiencing pain (Winter, 2008). Therefore, an indirect measure of foot disease (i.e. gait assessment) may represent a valid parameter for welfare assessment, as also suggested in cows, where a strong relationship has been found between animal gait and claw disorder (Winckler and Willen, 2001).

In this study farms were visited in winter when sheep are unshorn. The unshorn fleece did not allow the assessment of body condition by visual means. Therefore, thin and even emaciated sheep could not be identified and did not contribute to the welfare score and to the possible differentiation of the organic flocks from the conventional ones. Nevertheless, the assessment of body condition should be included in any schemes concerning sheep welfare as indicator of malnutrition and disease. In particular, farm visits should be performed in early summer, after fleece shearing, in order to facilitate body condition scoring.

The main housing characteristics of the sheep farms are depicted in Table 4. The application of the scheme showed that the most critical aspects were the low indoor and outdoor space allowance and the lack of an outdoor paddock in several farms (67 and 55% in conventional and organic farms, respectively). However, these aspects were compensated by the frequent access to the pasture, which was always precluded during the night and only in very bad weather conditions during the day. In addition, pasture was steep in most of the cases, thus allowing a good physical exercise to the animals. As to animal-based parameters, the prominent aspect to be improved was dirtiness, as it affected the highest percentage of animals (see Table 3). This aspect is obviously dependent on the low space allowance offered to the ewes in the barn and also related to the fact that the animals were observed in the early morning, before access to pasture.

3.2. Inter-observer reliability

Assessing the degree of agreement between observers is particularly important to establish the reliability of welfare monitoring schemes, as the observations conducted on the farm can be made by different observers. Therefore, if the degree of agreement between observers is low, apparent differences between farms could entirely depend on differences between observers. Reliability is usually expressed as a correlation coefficient (e.g. Rousing and Waiblinger, 2004). Spearman correlation coefficients were significant ($P < 0.001$) for total score and all assessment sheets (Table 5). Inter-observer reliability of qualitative animal-based parameters is displayed in Table 6. A significant correlation between the observers was detected for all parameters ($P < 0.001$), apart from lesions ($P > 0.10$). However, the level of statistical significance of the correlation says little about the degree of reliability, as significance also depends on the sample size, whereas the value of the correlation coefficients is much more informative on the

Table 6
Inter-observer reliability (r_s)[a] for each qualitative animal-based parameter.

	Integument alterations	Hoof overgrowth	Lameness	Dirtiness	Lesions
r_s	0.85	0.82	0.81	0.84	0.22
P	<0.001	<0.001	<0.001	<0.001	NS

[a] Spearman's coefficient of correlation.

strength of the association. Martin and Bateson (2007) suggest that, although acceptability of coefficients depends on several factors, a satisfactory threshold for important parameters that are difficult to measure (e.g. qualitative assessment of animal-based parameters) may be considered 0.7. The rationale behind this is that with a correlation coefficient of 0.7, roughly 50% of variance in one set of observations is explained by the other set of observations ($0.7^2 = 0.49$). Conversely, the agreement between observers should be well above this value for variables of simple measurement. In this study the r_s of Sheet 1 exceeded 0.9 possibly because it is mainly based on objective technical criteria and design measures, whereas it was between 0.8 and 0.9 for sheets 2–4, where many subjective design measures are included. The lowest r_s value was obtained for sheet 5, where subjective animal-based parameters are scored. However, the total score showed a Spearman correlation coefficient higher than 0.9. Only four out of five animal-based parameters (integument alterations, hoof overgrowth, lameness and dirtiness) showed coefficients higher than 0.7, thus indicating that the assessment of lesions was unreliable. This latter result may be due to the fact that lesions were often small and hidden by the fleece. The problem could be approached by (a) monitoring only lesions wider than 2 cm, as suggested by Westerath et al. (2006) for cattle, (b) visiting farms in early summer, soon after shearing, in order to make easier their detection, and (c) performing a specific training of observers for this parameter.

Due to the fact that farm visits were performed in winter in this study body condition was not scored, as a consequence inter-observer reliability for this parameter was not calculated. However, in previous studies this parameter has proven to be highly reliable (e.g. Evans, 1978).

4. Conclusion

No marked differences in terms of animal welfare were observed between organic and conventional sheep farms thus indicating that both systems provide adequate welfare. This result is not surprising as both conventional and organic farms based their farming systems on the extensive use of land.

The present monitoring protocol proved to be feasible and reliable, as the inter-observer reliability of each sheet and most of the animal-based variables was high. The inter-observer reliability was not significant for lesions, therefore more training is needed in order to increase the reliability of the measure. In addition, we suggest visiting farms in early summer, soon after shearing, in order to make easier the detection of lesions and the assessment of body condition.

More studies are needed to test the scheme on a larger sample size and assess its validity. However, it provides a provisional and practical tool for on-farm assessment of organic and conventional sheep welfare until schemes of proven validity will be available.

Acknowledgments

This study has been conducted within the project E.QU.I.ZOO.BIO. (Efficienza, Qualità e Innovazione in Zootecnia Biologica). Thanks are due to Sara Barbieri for help in selecting the parameters and Amelia Maria Riviezzi for expert technical assistance.

Appendix A

See Tables A1–A5.

Table A1
Locomotion and social interaction (range of score: −0.5 to 20.5).

Scores	Columns						
	a Indoor space allowance (m^2/head)[a]	b Herd structure	c Management of replacement	d Space at manger (cm/head)	e Water availability	f Outdoor space allowance (m^2/head)	g Pasture months/year
3.5	No barn						>7
3.0	≥3.5		Internal replacement kept within the flock	≥0.35		≥3.5	
2.5	≥2.65		Internal replacement in visual contact with the flock		Drinker always available	≥3.0	1–6
2.0	≥1.85	Ram always in the flock		≥0.30		≥2.5	
1.5	≥1.0	Ram in the flock only in reproductive seasons				<2.5	
0	<1	Ram never in the flock	Internal replacement in separate building	<0.30	Drinker available for part of the day	No paddock	0
−0.5			External or partial buying of replacement				

[a] If animals are always kept on pasture, then score as "no barn".

Table A2
Flooring (range of score: −1 to 12.0).

Scores	Columns					
	a Lying area	b	c	d Passage ways	e	f Outdoor floor
	Comfort[a]	Cleanliness[a]	Slipperiness[a,b]	Ease of passage[c]	Slipperiness[b]	
2.5	No barn	No barn	No barn			
2.0	≥60 mm adsorbing substrate	Clean	Good grip		Good grip	
1.5	≥60 mm non-adsorbing substrate					Natural floor
1.0	≥30 mm adsorbing substrate	Medium	Medium	Easy	Medium	Concrete, well maintained
0.5	≥30 mm non-adsorbing substrate					
0	<30 mm substrate	Dirty	Slippery	Not easy	Slippery	Concrete, slippery
−0.5	No substrate					No paddock

[a] If animals are always kept on pasture, then score as "no barn".
[b] To be assessed qualitatively by pushing the boot on the floor.
[c] Score as "easy" if at least two animals can walk simultaneously through the passageways, otherwise score as "not easy".

Table A3
Environment (range of score: 0–10).

Scores	Columns					
	a Thermoregulation	b	c Outdoor paddock	d Pasture	e	f
	Pasture[a]	Barn ventilation[b]	Access[c]	Grass quality	Steepness	Months/year
2.5						>7
1.5	Sufficient shade and shelter	Sufficient ventilation	Always	Diffused, well developed	Steep	1–6
1.0						
0.5	Insufficient shade and shelter		Partly	Damaged	Slightly steep	
0	No shade and no shelter	Insufficient ventilation	No paddock	Poor quality with rocks	Flat	0

[a] If all the flock can simultaneously recover under shade then score as "sufficient shade", if only part of the flock can simultaneously be under shade then score as "insufficient shade".
[b] If the windows and/or openings represent more then 15% of the floor, then score as "natural ventilation"; if the windows and/or openings represent less then 15% of the floor, then score as "insufficient ventilation".
[c] If access to the outdoor paddock is available whenever the flock is in the barn then score as "always", if the access is available only in particular occasions (e.g. animals cannot be taken to the pasture) or is restricted in time then score as "partly".

Table A4
Management (range of score: −1 to 7).

Scores	Columns					
	a Cleanliness of feeding area[a]	b Cleanliness of drinking area[a]	c Cleanliness of resting area[a]	d Condition of equipments[a,b]	e Animal checking	f Hospital pen
1.5	No barn		No barn			
1.0	Clean	Clean	Clean	Good	>1/d	Present
0.5	Medium	Medium	Medium	Medium	1/d	
0	Dirty	Dirty	Dirty	Poor	<1/d	
−1						Absent

[a] If animals are always kept on pasture, then score as "no barn".
[b] Proper working and maintenance of the following equipments should be assessed: milking machine, feeding rack, drinkers, windows, gates, fences.

Table A5
Animal-based parameters (range of score: −8 to 22).

Scores	Columns							
	a Condition of integument and fleece[a,g]	b Cleanliness[b,g]	c Condition of hooves[c,g]	d Lameness[d,g]	e Lesions[e,g]	f Body condition[f,g]	g Routine mutilations	h Culling age (years)
3	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal		≥10
2	Good	Good	Good	Good	Good	Good		≥8
1							No	≥6
0	Medium	Medium	Medium	Medium	Medium	Medium		
−1	Poor	Poor	Poor	Poor	Poor	Poor	Yes	<6

[a] Affected animals present skin damages due to ectoparasites, wool-less patches or hyperkeratosis.
[b] Affected animals present major splashing or distinct plaques of dirt at hind quarters and udder.
[c] Affected animals present at least one overgrown claw.
[d] Affected animals present sign of abnormal gait.
[e] Affected animals present swellings, wounds or scabs.
[f] Affected animals are thin.
[g] At least 20% of the flock has to be observed. The assessment has to be based on the percentage of affected animals, as indicated below:

Percentage of affected animals

Assessment	Columns	
	a, b	c, d, e, f
optimal	≤ 5	≤ 5
good	≤ 10	≤ 10
medium	≤ 50	10-25
poor	>50	>25

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