



**Integrating innovative TECHNOlogies along the value Chain
to improve small ruminant welfARE management**

Lamb Welfare Assessment Measures

A description of animal-based measures and their definition as used in the *finishing lamb welfare* studies by TechCare. These are NOT intended to be a comprehensive protocol for assessing overall welfare of finishing lambs but are individual measures of different welfare issues as identified by the TechCare stakeholders as the most important issues for their industry.

As far as possible these are validated indicators drawn from a number of different studies (particularly the Animal Welfare Indicators (AWIN) project, national projects), which were considered the best methods to measure each issue by the TechCare WP2 team.

Indicators are described in two ways: firstly, for measures that can be taken in the field in undisturbed animals (typically extensively managed animals where it would not be feasible for desirable to need to handle the animals frequently) and secondly for those that can be made at close quarters, likely with some handling required (e.g. restraint).

Indicators are measured at the level of the individual animal. This is required to allow validation of the sensor measures (which are recorded at the animal level). Thus, each animal must be identifiable at close quarters and at a distance if the field measures are to be used.



Welfare issues identified for lambs

Welfare issues for growing and finishing lambs are relevant to many sectors and other studies (e.g. Phythian et al., 2011 for meat sheep lambs) have also provided some prioritisation. For finishing lambs that key welfare issues were identified as:

- Water availability and quality*
- Food competition
- Housing and environment
- Stocking density*
- Respiratory disease

Other relevant issues are:

- Gastrointestinal parasitism
- Lameness
- Ectoparasites (especially myiasis)
- Ewe-lamb relationships

**Water quality and stocking density are not considered here as measures that can be assessed at the level of the individual animal.*

NB: lamb weight gain, lamb mortality and a poor ewe lamb relationship (for growing meat lambs) may also be indicative of welfare issues. A poor ewe-lamb distance is suggested to be assessed at the level of the ewe (see Meat sheep welfare protocol).



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Lamb Welfare Indicators: Definitions and Descriptions

1. Housing and environment issues, including bedding

a Unhandled or field measures

Bedding quality can be assessed at the individual level without handling animals (or with handling as described below) by assessing fleece cleanliness (Table 1). Lying time is influenced by environmental conditions, bedding and is affected by some disease conditions. Housed adult sheep spend nearly 70% of the time lying, and synchronous lying can indicate sufficient space for sheep to lie in comfort. Time spent lying may need prolonged observation periods to be assessed but can help to validate sensor protocols. Lying synchrony can be assessed by shorter observations but requires repeated measures (NB: time spent lying has not been validated for use in lambs).

Housing can also be assessed at group level by assessing stocking density, bedding quality, and air quality. These are detailed in the Environment and Resources checklist Tables.

b Handled measures

Housing/environment/bedding quality is assessed at the animal level by various proxy measures of fleece cleanliness, limb dirtiness, wool moisture, leg injuries, hoof overgrowth, ocular discharge and coughing. NB measures of heat stress (panting), competition, and respiratory distress/infection are also relevant to this assessment and are given elsewhere.

1. Fleece cleanliness

Table 1. Scores for assessing fleece cleanliness, adjusted from the AWIN score (Munoz et al., 2018).

Score	Photo	Description
Score 0		Clean and dry. Fleece shows no sign of dirt or contamination
Score 1		Dry or slightly damp due to current weather conditions. Slight mud/dirt on body attributed to handling or pen from that day

Score 2		Very damp or wet. Coat contaminated with mud or dung from fields/pens
Score 3		Very wet. Very heavily soiled with mud or dung, usually on the ventral surface/legs
Score 4		Filthy, animal is very wet and coated in mud or dung, which may be on face and back as well as belly, flanks and legs

2. Limb cleanliness

Limb cleanliness may be scored by close inspection of the individual animal using the scores in table 2.

Table 2. Description of cleanliness scores for limbs (adapted from Idele score on udder cleanliness, from Roquefort farmers).

Measure	Cleanliness of the limbs				
Description	Legs are free of dirt	There are some small stains/dirt	The stains/dirt are extensive but represent less than 50% of legs	The stains are spread/dirt over more than 50% of legs but do not form a thick crust at any time	The belly and legs are completely soiled and/or covered with a thick crust
Score	0	1	2	3	4

3. Wool moisture (Idele score)

Protocol used to perform the measurement: The moisture content of the wool is assessed by touch. For external moisture, the observer places their (dry) hand on the back of the animal and moves it along the spine. For internal moisture, the observer spreads the wool with one hand and touches the skin of the lamb with the fingers of the other (dry) hand. This assessment is also carried out on the animal's back.

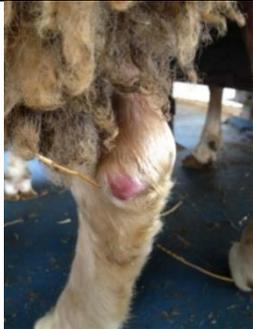
Evaluation: The external and internal humidity is rated in two classes (0 = dry and 1 = damp-wet):

Table 3. Evaluation of the external and internal moisture in the wool of the sheep by placing a dry hand on the back of the lamb.

Measure	External moisture	
Description	Dried	Wet / moist /damp
Score	0	1
Measure	Internal moisture	
Description	Dried	Wet / moist /damp
Score	0	1

4. Body measures of appropriateness of housing/environment

Table 4. Scores for bodily indicators of housing quality (AWIN scored as present = 1; absent = 0).

Measure	Present (photo)	Present (descriptor)	Absent (photo)	Absent (descriptor)
Leg injuries		Presence of swellings, hairless patches, callus, lesions or scabbed areas on leg joints.		No lesions, swellings or abrasions
Hoof overgrowth		Overlong or mishapen feet. Score 1 if at least one claw is overgrown		Hooves show an appropriate length and shape



<p>Ocular discharge</p>		<p>Eyes wet or with pus, tear-staining or patches below the eyes</p>		<p>No discharge present</p>
<p>Coughing</p>		<p>Persistent coughing (2+ bouts within 10 minutes)</p>		<p>No coughing heard or single short bout</p>
<p>Ears</p>		<p>Ear tags torn or lost, ear injuries</p>		<p>Ear tags in place, ears clean and uninjured</p>
<p>Horns</p>		<p>Horns broken or lost, bleeding</p>		<p>Horns intact</p>

2. Competition/Aggression

a Unhandled or field measures

Only measured in housed animals, hard to assess individual animals without a prolonged observation period, all studies that have measured this (not as a welfare assessment), have used group assessment. Evidence of competition or aggression is indicated by counting the frequency of the following behaviours:

Table 5. Ethogram of behaviours indicating competition or aggression.

Behaviour	Description
Lying displacement	Lying animal stands up and moves away or lies down in same position in response to the direct approach of another lamb (with or without physical contact), or because another lamb pushes it with the head, or paws at it with front feet.
Feeding displacement	Lamb moves away from feeder (trough or hay rack) in response the direct approach of another lamb from behind or alongside with or without physical contact (striking with head or feet, pushing with shoulders)
Standing displacement	Lamb moves away from location in response to direct contact from another lamb: resting chin on back, head or shoulder push or strike, foreleg kick
Aggression	Lamb strikes another with force with the head on any part of another animal's body. This can be direct contact head-to-head/flank etc, or sideways movements of the head (usually directed against a flank).
Aggression threat	Activity that signals intent to cause aggression but does not result in actual contact. This includes head threats (sharp downward or sideways movements of the head directed towards another lamb), staring with rigid body posture and threat vocalisations (low-pitched guttural rumbles).
Mounting	Usually by male lambs. Animal rears up to place the chest on the back of another animal. Mounted lamb will often run forward and is 'ridden' – mounting lamb remains on the back and walks or runs on the hindlegs for some steps.

b Handled measure

None possible.

3. Respiratory Problems

a Unhandled or field measures

None possible.

b Handled measure

Due to the variety of responses that can be related to respiratory disease a simple presence/absence score to cover the presence of any conditions relating to respiratory infection or distress is suggested (AWIN protocol).

Table 6. Scores for respiratory condition.

Score	Description	Score	Description
0	Breathing is normal with no obvious effort to draw breath; no audible noises accompany breathing; no coughing; no nasal discharge 	1	Presence of any of the following: breathing requires obvious effort on inspiration; breath sounds are audible (rattle, snore, puffing etc); persistent coughing; nasal discharge is present

4. Gastrointestinal parasites

a Unhandled or field measures

The only suitable proxy measure without handling the animals is the use of faecal soiling assessed around the anus, breech, tail and hindlegs, which is increased with parasitism (and a risk factor for myiasis). This assesses the presence of faecal material on the wool and dags (lumps of matted faecal material hanging from wool). In the field this is assessed at only 3 levels, but at 5 as a handled measure (Table 6).

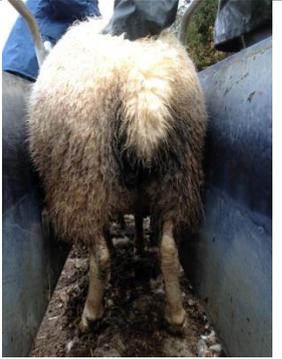
b Handled measures

Parasitism can be assessed by collection of faecal material from the anus and faecal egg counting if the study allows. Otherwise, lambs can be assessed for the external scores of faecal soiling on a 5-point scale. Lambs can be scored using the diarrhoea score (DISCO) given later.

Table 7. Scores for assessing faecal soiling.

Score (field)	Score (handled)	Photo	Descriptor
Score 0	Score 0		No faecal soiling, the wool around the breech area and under the tail is clean
Score 0*	Score 1		A small quantity of faecal matter can be seen in the wool around the tail



Score 0*	Score 2		Some soiling around the anus and dags in this area only
Score 3	Score 3		Soiling and dags extending beyond the anus to the tail and upper part of the legs
Score 4	Score 4		Wide area of soiling with dags extending down the legs at least as far as the hocks

*It can be difficult to separate scores 0, 1 and 2 when conducting field observations without handling the sheep. To improve reliability for field observations these are all scored as 0.



5. Diarrhoea

a Unhandled or field measures

No unhandled measure is possible. Dag or faecal scoring (Table 6) may be relevant.

b Handled measure

DISCO score (Cabaret et al., 2006) has been assessed for repeatability and reliability in several climatic conditions and breeds.

Table 8. Scores for DISCO diarrhoea scoring.

Score	Description
1	Normal hard pellets typical of sheep faeces
2	Soft faeces (similar to ‘cow pats’ in consistency)
3	Semi-liquid faeces

6. Lameness

a Unhandled or field measures

Lameness in the field can be assessed by behaviours associated with lameness (gait scoring). Although there are many gait scores, including well validated scores, with categories up to 7 (Kaler et al., 2009), TechCare recommends using the AWIN scores which already assessed these different scores and combined categories where required. Field observations require animals to firstly be observed in an undisturbed state, and any animals that cannot weight bear on a foot or is grazing on their knees assessed (Score 2) Sheep should then be moved gently such the individual locomotion can be observed at walk, animals should not be running when assessed. For field observations the score is modified (Table 9) to account for the potential impact of uneven ground.

b Handled measure

Here animals are individually required to walk on a hard flat surface and their gait is assessed.

Table 9. Scores for lameness assessment.

<i>Score</i>	<i>Descriptor</i>
Score 0	Movement is smooth, weight is borne equally on all 4 feet with no shortening of stride. Some minor head nodding is allowed if the animal is walking on an uneven surface (field observations).
Score 1	Clear shortening of the stride with obvious head nodding or flicking as the affected limb touches the ground
Score 2	Very obvious head nodding and not weight-bearing on the affected limb whilst moving, or lame on more than one limb. Foot may be held up whilst standing (hindlimb lameness) or may be seen grazing on knees (forelimb lameness) in field assessment.
Score 3	Recumbent or reluctant to stand or move. In field assessments the sheep may not be able to stand or unable to move away from approach. The sheep should not be forced to stand if clearly recumbent.

7. Ectoparasites

a Unhandled or field measures

In the field or unhandled situation this is assessed by two measures: a behavioural response (excessive scratching or rubbing) and a physical measure of fleece condition. In field both are scored as present or absent:

Table 10: Scores and descriptors for field measures of ectoparasites (AWIN).

Indicator	Present	Descriptor	Absent	Descriptor
Irritation	1	Repeated or prolonged scratching/itching with hooves, horns or against pen or paddock fixtures, for 5+ minutes per 20 minutes 	0	No excessive itching or rubbing observed
Fleece condition	1	Loose fleece and shed areas or bald patches, trailing fleece may be present 	0	Sufficient and even fleece cover for breed/time of year; no sign of wool pulls or loss 

NB. Wool pulls or fleece loss can occur due to handling, or stress or mounting interactions with other lambs (see Competition/Aggression) and is not conclusive for ectoparasites unless confirmed at handling. Dag scores measures can also be relevant as a risk factor for myiasis (flystrike).

b ***Handled measures***

Fleece condition can be assessed and presence of ectoparasites and/or myiasis scored, e.g. AWIN scores.

Table 11. AWIN scores for fleece condition and assessment of ectoparasites

Score	Image	Descriptor
0		Sufficient fleece for breed and time of year with even coverage over the whole body, no trailing or over long patches of fleece; fleece is normal when parted with no scurf or lumpiness or evidence of ectoparasites, no bald patches or trailing areas of fleece, the body has even coverage of fleece.
1		Loose fleece in some areas but not shed, small shed or bald patches of no more than 10 cm in diameter, fleece when parted may have some lumpiness or scurf but little evidence of ectoparasites
2		Loose fleece and shed areas or pulls with bald patches of greater than 10 cm, some areas of fleece may be trailing, on inspection there may also be evidence of ectoparasites
3		Myiasis or other ectoparasites – open wounds or abrasions with clear presence of maggots or wet scabbed areas associated with presence of mites. Observed on any part of the sheep’s head, feet or body.

8. Heat/cold stress

a Unhandled or field measures

Panting or respiration rate can be measured in unhandled animals can give an assessment of heat load at an animal level. Panting scores have been developed in some studies but reliability has not been tested (often occur at low frequency).

Table 12. AWIN scores for heat stress/panting.

Score	Descriptor
0	Breaths are at normal rate (approx. 20 breaths per minute) and with the mouth closed [no heat stress]
1	Respiration rate is elevated (above 30 breaths per minute but less than 40), respiration occurs with mouth closed. [mild heat stress]
2	Panting – respiration rate is elevated above 40 breaths per minute and/or occurs with the mouth open. [heat stress]

Table 13. Phythian score for cold stress in lambs (Phythian et al., 2013).

Score	Descriptor
0	No evidence of shivering
1	Rapid muscle contractions, trembling or quivering of the body of the lamb

b Handled measures

Panting scores are not suitable for handled animals as the exertion of gathering or stress of restraint can cause elevated respiration rates not directly related to environmental temperature and thermal comfort.

Direct measures of temperature via rectal or InfraRed Thermography may be useful.

9. Qualitative Behavioural Assessment (QBA)

a Unhandled or field measures

QBA is a holistic method of assessing animal affective state. It focuses on measuring animal emotions expressivity (or demeanour) and has been shown to be repeatable and reliable for use in sheep, and has been shown to be useful in the assessment of for example, parasitism, transport and pain (e.g. Grant et al., 2020; Maslowska et al., 2020; Collins et al., 2018). QBA is also included in the welfare assessment protocols for Welfare Quality® for pigs and cattle, and in AWIN for sheep and goats. This is best/only validated when assessed in unhandled animals.

Animals are observed for a short period (1-5 minutes have been used in various studies) either live or from video (e.g. video collected associated with a WoW has been used for this purpose: Grant et al., 2018). The animal's behaviour is then scored on a VAS for a number of subjective terms (to capture how the animal is behaving, not what they are doing). For AWIN a lists of 24 descriptive terms were developed, we have refined this to the 17 terms below (Table 14). The outcomes are integrated into a PCA with 4 quadrants: high arousal/activity, positive valence (e.g. excitement); high arousal, negative valence (e.g. fear or agitation); low arousal, positive valence (e.g. relaxed); low arousal, negative valence (e.g. dull/depressed).

Table 14. AWIN terms and descriptors, modified for lambs, for Qualitative Behavioural Assessment of lambs:

Descriptor	Definition
Alert	Observant and vigilant.
Active	Animal is physically active. Engaged in task e.g. grazing, walking, or fighting.
Relaxed	At ease, free from anxiety, agitation or tension. The animal appears to be unthreatened.
Fearful	Attention is focussed on one specific object/being which is either a real or perceived threat. Animal may also be fleeing.
Content	Satisfied and at peace. The animal's needs are met, or the animal is successfully working towards their completion.
Agitated	Excessive cognitive and/or motor activity due to tension or anxiety. The animal is uneasy and if moving their actions are twitchy.
Sociable	Seeking and interacting with other sheep. The sheep appears to be enjoying/taking comfort from their contact. The sheep is choosing to be part of a flock and not fully isolate themselves.
Aggressive	Hostile and tense. Attacking/ready to attack, usually unprovoked or to compete for resource.
Vigorous	The animal is carrying out task in an energetic or forceful way. If stationary or moving slowly the animal expresses an inner strength and energy. May imply good physical health.



Subdued	Submissive and docile. Often removed from social group and self absorbed.
Physically uncomfortable	Giving impression of pain or other physical discomfort through posture/movement.
Calm	Placid and sedate. If physically active the animal's movements are smooth and unhurried.
Frustrated	Dissatisfied. Unable to fulfil satisfaction and achieve goal.
Wary	Shy, cautious, apprehensive and possibly distrustful.
Bright	Alert, lively and aware of environment.
Inquisitive	Curious, interested and intrigued by the environment or other animals.
Listless	Lack of vigour and energy. Animal appears lacklustre.

References cited

AWIN Welfare Assessment Protocol for Sheep (2015)

Cabaret, J., Gonnord, V., Cortet, J., Sauve, C., Balet, J., Tournadre, H., Benoit, M. (2006) Indicators of internal parasitic infections in organic flocks: the diarrhoea score (Disco) proposal for lambs. Organic e-prints (Joint Organic Congress, Theme 8: Animal Health and Disease Handling).

Collins, T; Stockman, CA; Barnes, AL; Miller, DW; Wickham, SL; Fleming, PA. (2018) Qualitative Behavioural Assessment as a Method to Identify Potential Stressors during Commercial Sheep Transport. *Animals*, 11, 209.

Grant, EP; Brown, A; Wickham, SL; Anderson, F; Barnes, AL; Fleming, PA; Miller, DW. (2018) What can the quantitative and qualitative behavioural assessment of videos of sheep moving through an autonomous data capture system tell us about welfare? *Applied Animal Behaviour Science*, 208, 31-39.

Grant, EP; Wickham, SL; Anderson, F; Barnes, AL; Fleming, PA; Miller, DW. (2020) Preliminary Findings on a Novel Behavioural Approach for the Assessment of Pain and Analgesia in Lambs Subject to Routine Husbandry Procedures. *Animals* 10, 1148.

Kaler, J., Wassink, GJ., Green, LE. (2009) The inter- and intra-observer reliability of a locomotion scoring scale for sheep. *Veterinary Journal* 180, 189-194.

Maslowska, K; Mizzoni, F; Dwyer, CM; Wemelsfelder, F. (2020) Qualitative behavioural assessment of pain in castrated lambs. *Applied Animal Behaviour Science*, 233, 105143.

Munoz, C; Campbell, A; Hemsworth, P; Doyle, R. (2018) Animal-Based Measures to Assess the Welfare of Extensively Managed Ewes. *Animals*, 8, 2.

Phythian, CJ; Michalopoulou, E; Jones, PH; Winter, AC; Clarkson, MJ; Stubbings, LA; Grove-White, D; Cripps, PJ; Duncan, JS. (2011) Validating indicators of sheep welfare through a consensus of expert opinion. *Animal*, 5, 943-952.

Phythian, CJ; Toft, N; Cripps, PJ; Michalopoulou, E; Winter, AC; Jones, PH; Grove-White, D; Duncan, JS (2013) Inter-observer agreement, diagnostic sensitivity and specificity of animal-based indicators of young lamb welfare. *Animal* 7, 1182-1190.