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

Dairy Sheep Welfare Assessment Measures

A description of animal-based measures and their definition as used in the ***dairy sheep*** studies by TechCare. These are NOT intended to be a comprehensive protocol for assessing overall welfare of dairy sheep 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.

This project has received funding from the European Union's Horizon 20202 research and innovation programme under grant agreement No. 862050

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Dairy sheep welfare issues

The most important welfare indicators for dairy sheep identified by TechCare stakeholders were:

- Mastitis
- Lameness
- Gastrointestinal parasites
- Nutritional issues
- Indicators demonstrating the quality of the housing and environment, including bedding
- Diarrhoea
- Abortion

Several other welfare issues were also identified as somewhat important overall, and were very important in some countries:

- Respiratory infection (which can be related to housing and environmental quality as key issues)
- Competition and aggression in indoor managed animals
- Water quality
- Heat stress
- Rough handling
- Ectoparasites
- Poor ewe-lamb relationship (only relevant to lactating dairy sheep in the rearing phase)

This document provides advice on how these issues can be measured.

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Dairy Sheep Welfare Indicators: Definitions and Description

1 Mastitis

a) Unhandled or field measures

Mastitis cannot be reliably assessed without handling the animals therefore no field or unhandled measure is given. Note however that hindlimb lameness can be as a result of mastitis and not a foot or leg issue thus lameness recorded in the field should be checked when animals are handled to determine the cause. In addition, an increasing ewe-lamb distance, poor lamb growth rates and lamb mortality may also be secondary to mastitis in ewes with lambs at foot.

b) Handled measure

For dairy sheep mastitis should be assessed by Somatic Cell Count (SCC) on an individual animal basis (NB: bulk milk tank measures of SCC can only describe mastitis at the flock level and thus is not useful in assessing individual mastitis cases).

Only for those countries with limited ability to measure SCC regularly, this could be supplemented with assessment by manual palpation as a more frequent addition to periodic SCC measures. If manual palpation is used this should be scored as:

Manual palpation: a number of studies have suggested this as an approach, with some validation work (inter-observer reliability, AWIN). The suggested score here is an amalgamation of AWIN (palpation only) and Munoz et al., 2018, after Quinlivan, 1968 (palpation and secretions))

Table 1. Scores for Mastitis assessment.

Score	***Descriptor***
Score 0	Normal udder – udder is soft and pliable, no redness or hardness, normal secretions (AWIN 1st level)
Score 1	One small fibrotic lump or area of hardness can be felt in the mammary tissue, normal secretion
Score 2	More than 1 lump is present, or areas of hardness on one side of the udder, or small lesion (<10 cm at widest part); milk can be normal or purulent (AWIN 2nd level)
Score 3	Extensive swelling of the udder, lumps or hardness on both sides or larger lump on one side, or lesions >10 cm at widest part. May be absessed or ruptured. (AWIN 3rd level)
Score 4	Peracute mastitis: Complete udder involvement with severe inflammation, secretions range from serum-like to purulent, Mammary lymph nodes enlarged, elevated body temperature.

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2 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 2) 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 2. Scores for lameness assessment.

Score	***Descriptor***
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.

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3 Gastrointestinal parasites

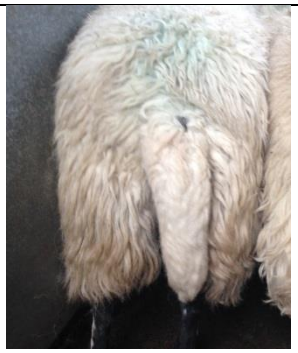
a) Unhandled or field measures

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 3).

b) Handled measures

Parasitism can be assessed by collection of faecal material from the anus and faecal egg counting if the study allows. Otherwise adult animals can be assessed for two external scores: faecal soiling on a 5 point scale) and use of the FAMACHA© scores in adults (for blood feeding parasites – *haemonchus* and fluke). FAMACHA© scores are not considered accurate for lambs. Lambs can be scored using the diarrhoea score (DISCO) given later.

Table 3. 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

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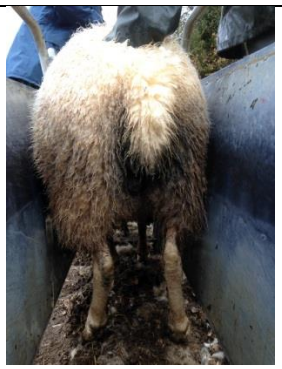
Score 0	Score 2		Some soiling around the anus and dags in this area only
Score 3	Score 3		Soiling and dags extending beyond the anus to the tail and upper part of the legs
Score 4	Score 4		Wide area of soiling with dags extending down the legs at least as far as the hocks

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4 Nutritional Issues

a) Unhandled or field measures

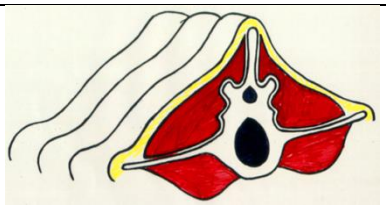
Wool biting, eating or pulling can be an indicator of nutritional inadequacies and has been associated with micronutrient deficiency and low fibre intake. Almost exclusively seen in artificial environments so may also be a form of oral stereotypy (Broom & Fraser, 2007). The behaviour is defined as: nibbling, biting, pulling or ingesting the wool of another sheep (wool biting of their own body is more commonly an indicator of ectoparasites).

Proxy measures such as low ewe milk production, poor lamb growth during the suckling phase, increased lamb mortality and increased clinical disease might be possible without needing to handle sheep but are not very sensitive to changes in nutrition.

b) Handled measures

Body condition scoring should be assessed in restrained standing animals in a race. Body condition scoring is assessed by manual palpation of the spine in the lumbar region just after the last rib, and assessment of the amount of fat and muscle overlying the bones. Scores can be given in 0.5 or 0.25 increments (as described in Russell et al., 1969), but for welfare assessments the scores on a 4-point scale as shown in Table 4 are sufficient.

Table 4. Scores for assessing body condition.

Score	***Russell BCS range***	***Diagram***	***Descriptor***
Emaciated (0)	Less than 1.0		All parts of the spine can be easily felt with little or no pressure, fingers can be easily inserted under the transverse processes. There is no fat cover, and very little muscle tissue can be distinguished.
Thin (1)	Between 1.0 and 2.0		The horizontal and vertical processes can be easily felt without pressure, fingers can pass under the ends of the transverse processes. There is a small amount of muscle tissue under the skin
Good (2)	Greater than 2.0, less than 4.0		Spinal processes can be easily distinguished with light pressure. Clear muscle and fat cover present.

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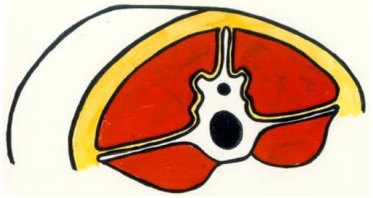
Fat (3)	Greater than 4.0		Transverse spinal processes cannot be felt, vertical processes distinguished only with pressure if at all. Full and rounded fat and muscle cover.

Milk composition measures can also be valuable in the assessment of nutritional imbalance in dairy ewes.

Measures of **milk fat and protein** by MIR is valuable to assess energy balance and shortage of fibre/excess of starch.

Milk urea, is valuable as an indicator of crude protein content in the diet but also of the ratio between CP and energy intake (CP/E) (Giovanetti et al., 2019). It can be measured by colorimetric method or by MIR, both calibrated by differential pH measurement. A general classification developed in Sarda breed is the following:

- milk urea < 300 mg/L of milk– risk of CP deficiency or too low CP/E ratio (score L);
- milk urea ≥ 300 mg/L and ≤ 500 mg/L – diet probably balanced (score M);
- milk urea > 500 mg/L then score H - risk of CP excess or too high CP/E ratio.

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5 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 5). Lying time is influenced by environmental conditions, bedding and is affected by some disease conditions. Housed 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.

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, udder 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 later.

1. Fleece cleanliness

Table 5. Scores for assessing fleece cleanliness (AWIN score, also used in 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

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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. Udder Cleanliness

Table 6. Scores for assessing udder cleanliness (Idele score, from Roquefort farmers).

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

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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 ewe and moves it along the spine. For internal moisture, the observer spreads the wool with one hand and touches the skin of the ewe with the fingers of the other (dry) hand. This assessment is also carried out on the animal's back.

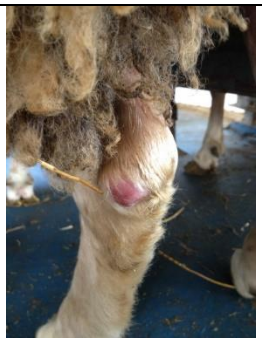
Evaluation: The external and internal humidity is rated in two classes (0 = dry and 1 = damp-wet):

Table 7. Scores for assessing wool moisture (Idele score).

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*

Table 8. 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 mishappen feet. Score 1 if at least one claw is overgrown		Hooves show an appropriate length and shape

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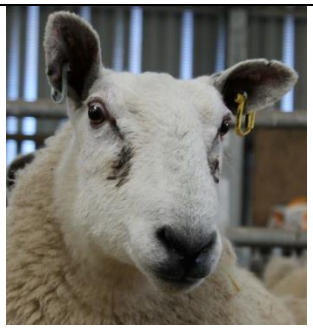
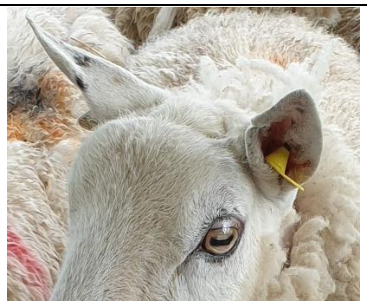
Ocular discharge		Eyes wet or with pus, tear-staining or patches below the eyes		No discharge present
Coughing		Persistent coughing (2+ bouts within 10 minutes)		No coughing heard or single short bout
Ears		Ear tags torn or lost, ear injuries		Ear tags in place, ears clean and uninjured
Horns		Horns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

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6 Diarrhoea

a) Unhandled or field measure

No unhandled measure is possible. Dag or faecal scoring (Table 3) may be relevant.

b) Handled measure

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

Table 9. 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

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7 Abortion

a) Unhandled or field measure

No scoring system found in the literature for this condition. Usually confirmed from presence of foetal lambs at scanning but no lamb present at lambing.

Delivery of early (<140 days gestation) stillborn lambs, showing signs of death in utero (brownish coat colour, pronounced forehead) may also be seen.

b) Handled measure

A tentative and untested score for handled animals is proposed (although for many abortions no obvious signs may be seen, especially if occurred early and spontaneously reabsorbed).

Presence of blood or membranes at the vulva or staining the wool in the breech region. Scored as present (1) or absent (0).

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8 Respiratory Problems

a) Unhandled or field measure

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 10. 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

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9 Competition/Aggression

a) Unhandled or field measure

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 11. Ethogram of behaviours indicating competition or aggression.

Behaviour	***Description***
Lying displacement	Lying ewe stands up and moves away or lies down in same position in response to the direct approach of another ewe (with or without physical contract), or because another ewe pushes her with the head, or paws at her with front feet.
Feeding displacement	Ewe moves away from feeder (trough or hay rack) in response the direct approach of another ewe from behind or alongside with or without physical contact (striking with head or feet, pushing with shoulders)
Standing displacement	Ewe moves away from location in response to direct contact from another ewe: resting chin on back, head or shoulder push or strike, foreleg kick
Aggression	Ewe strikes another with force with the head on any part of another ewe's body. This can be direct contact head-to-head/flank etc, or sideways movements of the head (usually directed against a flank).

b) Handled measure

None possible.

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10 Water quality

a) Unhandled or field measure

No animal-based measures have been validated for use in sheep. Water quality can only be assessed at the group level by assessing availability, accessibility and cleanliness of water sources (e.g. AWIN includes a scoring system for water quality). These are suitable for welfare assessment at farm level but may have limited value for TechCare (at least in pilot studies).

Table 12. AWIN scores for water quality (assessing type of watering point, its functionality and its cleanliness).

Type of water point			
None No source of water provided	**Bucket or trough** Any water container requiring manual filling	**Automatic drinker** Any water container connected to a water network which is filled automatically with use	**Natural water source** Pond, stream or other water course that is accessible by sheep and contains fresh water
Functional and accessible			
Automatic drinker	Automatic drinker is working properly	**Natural water course**	Water source is accessible and shows evidence of sheep use
Cleanliness			
Dirty Water points and water dirty. Natural water sources are stagnant and polluted 	**Partly dirty** Water points dirty or contaminated with rubbish but water appears clean and fresh 	**Clean** Water points and water clean and fresh. Natural water sources are clean and unpolluted. 	

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11 Heat stress

a) Unhandled or field measure

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 13. 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]

b) Handled measures

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

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12 Rough handling

a) Unhandled or field measure

Rough handling can increase the reactivity of the sheep to the presence of humans. This can be assessed by measuring their response/flight distance to an approach (familiar human test – AWIN) when in the field. This is usually a group level assessment as animals tend to respond to the reactivity of each other, although an individual animal assessment may be possible. For AWIN for welfare assessment purposes this was conducted by a familiar person. For TechCare a more standardised and individual animal assessment might be best achieved through the use of an unfamiliar person.

Avoidance distance is assessed by the approach of the observer in a standardised manner as described below. The closest possible approach that elicits flight (steps away from the observer) is recorded. If no flight occurs and the animal remains motionless then record as 0 m. If the animal approaches the human (actively steps towards the observer and elicits contact) score as ++.

b) Handled/housed measures

Housed animals can be assessed by measuring flight distance (approached by an unfamiliar person in a pen or at the feeder: Napolitano et al., 2011). These are relevant for housed animals or penned animal only, not animals held in a race or restrained. The feeder test has better reliability and would be the preferred option if this is feasible in the set up/farm system.

Human Approach test at the feeder: Avoidance distance at the feeder is assessed 5 minutes after food is distributed, animal must not be restrained during feeding. The observer waits for an individual to look at them before approaching in a standardised way (directly from the front, starting from 3 m aways, approaching at 1 step per second, focusing on the animals muzzle and keeping 1 arm extended in front of the body at an angle of 45°). Test ends when: animal withdraws (steps away from observer or turns head more than 45°) or accepts touch on the muzzle/nose. If touch is accepted the animal is stroked on the cheek for 1-3 seconds.

Scored as: Distance from observer's hand to animal at the moment that withdrawal occurs (in increments of 10 cm). If ewe withdraws immediately on a touch on muzzle or nose distance is recorded as 5 cm. If ewe permits stroking scored as 0 cm.

Human approach test in the pen: unfamiliar human/observer approaches, avoidance distance scored in the pen. Test is conducted as described above for feeder but approach starts from perimeter of the pen. Observer enters pen, walks around the perimeter and stands still at entry point before beginning the test when a ewe looks at observer (Munoz et al., 2018).

Munoz et al., (2018) also suggests adding a behavioural score (as in some situations animals may be very agitated by approach and flight distance can be immediate thus ceiling effects may occur):

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Table 14. Scores for assessing rough handling or fear of humans in small ruminants.

Score	***Descriptor***
0	Sheep behaved calmly when approached, relaxed and alert, no movement on the spot or bodily tension observed
1	Some avoidance: ewes moves away but does so in a calm manner (walking)
2	Marked avoidance: ewe moves away quickly, or barges other ewes to escape, movement is jerky and rushed.
3	Ewe attempts to escape the observer by jumping against the pen or walls, or actually manages to escape

NB for all scores: these cannot necessarily distinguish between animals that are unfamiliar with close human contact and those that have been handled roughly. Also animals in the same social group may be more or less reactive depending on the group, which can influence individual responses.

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13 Ectoparasites

a) Unhandled or field observation

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 15: 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, stress or interactions with lambs and is not conclusive for ectoparasites unless confirmed at handling. Dag scores measures can also be relevant as a risk factor for myiasis (flystrike).

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b) Handled measures

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

Table 16. 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

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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.

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14 Poor ewe-lamb relationship

a) Unhandled or field measure

A poor ewe-lamb relationship can manifest as hungry lambs (see lamb welfare assessment protocol), poor lamb growth and as a behavioural measure of ewe disinterest and a large ewe-lamb distance or infrequent ewe-lamb interactions. Ewe-lamb distance is correlated with the quality of maternal behaviour (Pickup & Dwyer, 2011), but can only be reliably assessed by repeated measures rather than a single assessment. For this reason, it is not commonly included in welfare assessment but may be useful in TechCare.

Ewe-lamb distance – the distance between the ewe and lamb is estimated (or measured) when both partners can be reliably identified. Although actual measures can be made, a score may be sufficient as:

Table 17. Scores for assessing ewe-lamb relationships under field conditions.

Score	***Descriptor***
0	Ewe and lamb are in very close contact – either touching of within 1 ewe body length of each other. Ewes and lambs are usually performing similar behaviours at this point or engaged in social interaction.
1	Ewe and lamb are in close contact – lamb is further than 1 ewe body length but within approximately 10 m of the ewe. Ewes and lambs may not be performing the same behaviour
2	Ewes and lambs are within the same social group, but lamb is greater than 10 m from the ewe (but generally within 50 m of the ewe.
3	Ewe and lamb are not in the same social group, or greater than 50 m apart if social group is very dispersed, or lamb cannot be seen near the ewe.

b) Handled measure

Ewe-lamb distance or behaviour in contact with one another is not very helpful when animals are handled or restrained. A measure of response to separation and reunion has been proposed in other situations and is correlated with maternal behaviour (Everett-Hincks et al., 2005; modified by Menant et al., 2020). Lamb is caught and held for 3 minutes, whilst the ewe is unrestrained and may approach and contact the lamb. Distance of ewe after 3 minutes is recorded (whilst the lamb is still restrained), then the lamb is released and time to reunite and time to suckle for at least 3 seconds is measured. Ewes and lambs which do not reunite or do not suckle are given max value of 3 minutes.

This project has received funding from the European Union's Horizon 20202 research and innovation programme under grant agreement No. 862050

15 Assessment of social order/milking parlour order

a) Unhandled or field measure

Sheep often maintain a consistent social order in movements through gateways and into the milking parlour. There is some evidence that animals with disease (e.g. infection with *T gondii:* Gorecki et al., 2008), lameness or other welfare issues may change their position in the order, often moving further back to enter the parlour later.

Assessment of parlour order (especially if detected by EID) may be a useful early warning indicator for sheep welfare.

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16 Qualitative Behavioural Assessment (QBA)

a) Unhandled or field measure

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 (Table 13). 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 18. AWIN terms and descriptors for Qualitative Behavioural Assessment of sheep.

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.

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Physically uncomfortable	Giving impression of pain or other physical discomfort through posture/movement.
Defensive	Ready to potentially defend herself or lamb from harm/perceived threat.
Calm	Placid and sedate. If physically active the animal's movements are smooth and unhurried.
Frustrated	Dissatisfied. Unable to fulfil satisfaction and achieve goal.
Apathetic	Unresponsive and dull.
Wary	Shy, cautious, apprehensive and possibly distrustful.
Tense	Uneasy and/or on-edge. Posture may show physical tension.
Bright	Alert, lively and aware of environment.
Inquisitive	Curious, interested and intrigued by the environment or other animals.
Assertive	Displaying confidence or determination.
Listless	Lack of vigour and energy. Animal appears lacklustre.

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This project has received funding from the European Union's Horizon 20202 research and innovation programme under grant agreement No. 862050