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

Dairy Goats Welfare Assessment Measures

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

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Dairy goat welfare issues

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

- Mastitis
- Nutritional issues, like insufficient food and water
- Housing and environment issues, including bedding
- Health in general

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)
- Oblivion
- Competition and aggression in indoor managed animals
- Heat stress
- Water quality

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

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Dairy Goat Welfare Indicators: Definition 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 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 goat-kid distance, poor kid growth rates and kid mortality may also be secondary to mastitis in goats with kids at foot.

b) Handled measure

For dairy goats, 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	***Description***
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. Nutritional issues like insufficient food and water

a) Unhandled or field measures

1. Proxy measures

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

2. Queuing at feeding

Queuing at feeding is a behaviour of goats that wait behind animals that are feeding (exactly like being in a queue) and it may be used to detect animals suffering from hunger, due to inadequate number of feed places or to inadequate distribution of feed along the whole feeding rack. Furthermore, goats are quite well synchronized animals and an inability to express synchronised feeding behaviour may cause (or may be caused by) altered social behaviours (e.g. low ranking position, presence of mixed groups with both horned and hornless goats). A sufficient number of feeding places helps to reduce aggressive interactions and queuing at feeding (Jørgensen et al. 2007). Also see section «Aggression».

Queuing at feeding is visually assessed from outside the pen. The observation period should start two min after the end of feed distribution. Start observing the behaviour of the goats. A goat is queuing if it is standing within 50 cm behind another goat that is feeding, with its head usually oriented towards the feed barrier. The whole feeding rack (or other feeding places) is observed at the same time, meaning that the assessor should select an observation point that allows a good view of the feeding rack. When needed, slight movements are permitted.

Record the number of queuing goats by using a scan sampling method during 15 min/observation (2 min/scan). With this sampling method, the behaviour (number of queuing animals) of all the animals in the pen is recorded at predetermined time intervals (every 2 min when the stopwatch rings). Make sure goats that are queuing are differentiated from those that are transiting in the feeding alley (Figure 1).

Normal feeding behaviour		No goat is queuing.
Normal feeding behaviour		The goats are transiting in the feeding alley.

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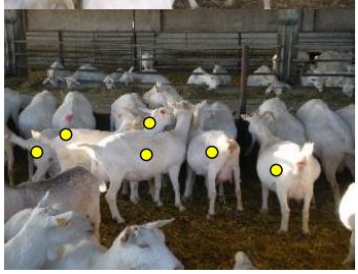
Queuing at feeding		A goat is queuing.
Queuing at feeding		Two goats are queuing at feeding.
Queuing at feeding		Six goats are queuing at feeding.

Figure 1. Number of goats queuing at feeding (after AWIN 2015).

3. Queuing at water source

Queuing at water source is a behaviour of goats that are forced to wait for their turn to drink (exactly like in a queue) and it may be used to detect animals suffering from thirst due to inadequate number of water places. Furthermore, goats are quite well synchronized animals and the impossibility to express the drinking behaviour with synchrony may cause (or may be caused by) altered social behaviours (e.g. low ranking position). A sufficient number of drinking places helps to reduce aggressive interactions and queuing at drinking (Ehrlenbruch et al. 2010). Also see section «Aggression».

Queuing at drinking is visually assessed from outside the pen. Ask the farm manager which water places are functioning and only observe those. The observation period begins when the first goat starts drinking after feed distribution. If no goat starts drinking during the observation of queueing at feeding, the observation of queueing at drinking starts at the end of the observation of queueing at feeding. The total duration of the observation of queueing at drinking will last 15 min. During this time, observe the behaviour of goats. A goat is queuing if it is standing within 50 cm behind another goat that is drinking (or queuing), with its head usually oriented towards the water place.

The assessor should select an observation point that allows a good view of the water place(s). When needed, slight movements are permitted. Record the number of queuing goats by using a scan sampling method during 15 min/observation. With this sampling method, the number of queuing animals in the pen is recorded at predetermined time intervals (every 2 min, when the

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stopwatch rings). All the functioning water places are assessed at the same time (e.g. water place A: two queuing goats + water place B: three queuing goats = five total queuing goats). Be aware of goats drinking together from the same water place. They are not queuing, as they are both able to drink at the same time (Figure 2).

Figure 2. Number of goats queuing at drinking (after AWIN 2015).

b) Handled measure

1. Body condition scoring

Body condition scoring should be assessed in restrained standing animals in a race. We propose the body condition scoring system published in AWIN (2015) (Figure 3).

Each goat is scored in three levels:

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Very thin (score -1): General condition: Raw or slightly raw-boned goat, with backbone and some ribs visible. Rump region: Hip and pin bones are prominent. The line that connects the hip bone and the thurl assumes a markedly concave shape. There is little muscle and/or fat between the skin and bone structures.

Normal (score 0): General condition: Backbone not prominent but still visible and ribs difficult to assess visually. Rump region: Hip and pin bones still visible, but not prominent. The line that connects the hip bone and the thurl assumes a slightly concave or straight shape. It is possible to see some muscle and/or fat between the skin and bone structures.

Very fat (score 1): General condition: Backbone and ribs not visible. Goat has a rounded appearance, sometimes with abdominal fat deposits visible. Rump region: Hip and pin bones are difficult to identify. The line that connects the hip bone and the thurl assumes a slightly or markedly convex shape. The entire rump region is coated by muscle and fat, contributing to the rounded appearance of the goat.

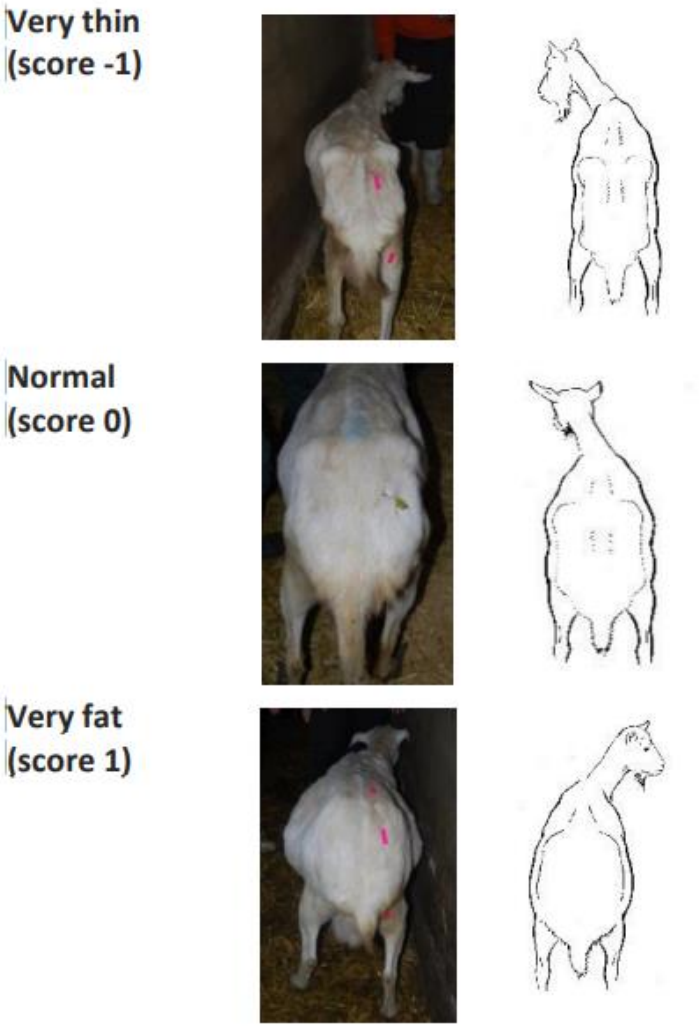

Figure 3. Body condition score of goats (after AWIN 2015).

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2. Milk composition

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

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; Rapetti et al., 2014). It can be measured by colorimetric method or by MIR, both calibrated by differential pH measurement. A general classification developed in Sarda sheep 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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3. 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 moisture of the shag (Table 3). Lying time is influenced by environmental conditions, bedding and is affected by some disease conditions. Housed goats spend nearly 70% of the time lying, and synchronous lying can indicate sufficient space for goats 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.

1. Stocking density

In an Italian study on 32 goat farms the space allowance was 2 m^2 per adult animal, which is the same as recommended by Sevi et al. (2009). Different countries might have different space recommendations, according to breed and type of housing. In Norway, no regulations regarding space allowance for small ruminants are outlined. In a Norwegian study, however, the mean area per goat measured at 30 dairy goat farms was 1 m^2, ranging from 0.6-2.1 m^2 (Muri et al. 2016).

In TechCare we use the same judgement for stocking density in goats as used in AWIN for ewes without lambs:

- Good = at least 1.5 m^2 per adult goat
- Adequate = more than 1 m^2 but less than 1.5 m^2 per adult goat
- Poor = less than 1 m^2 per adult goat.

b) Handled measure

Housing environment and bedding quality is assessed at the animal level by various proxy measures of: heat and cold stress, shag cleanliness, udder dirtiness, leg injuries, hoof overgrowth, ocular discharge, coughing a.s.o. NB. Competition, and respiratory distress/infection are also relevant to this assessment and are given later in this welfare assessment list.

1. Animal-based indicators of housing environment

Thermal stress (heat and cold)

Temperatures above +5 ^oC is recommended for goats (Sevi et al. 2009), and the optimal temperature range suggested for goats kept indoors is 10° to 18°C (Toussaint (1997). Thermal stress may affect health, welfare and production in goats. The presence of heat stress signs is associated with high temperature/humidity index. Heat stress may reduce feed intake and production efficiency. Although goats are frequently described as rustic or highly adaptable animals, they may suffer from low temperatures, especially if combined with wind and rain. In Norway the air temperature during winter might sink below zero in cold housing systems.

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Heat stress signs: focus on the respiration of the goats. Goats suffering from heat stress frequently have an accelerated respiration rate with open-mouth and excessive salivation. Make sure animals with abnormal respiration sounds (e.g. rales, wheezes, stertor or stridor) and coughing are not included as they may be suffering from respiratory disease not related to heat stress.

Cold stress signs: focus on hair coat on the back, postures and movement of the body. Goats suffering from cold frequently have bristling hair on their backs (horripilation) and, in severe cold stress occasions, they shiver and may assume a posture with arched back and head lowered. Make sure animals involved in agonistic interactions are not included, as they frequently raise the hair on their backs.

Thermal stress is visually assessed from outside the pen. Start looking at all the animals in the pen. Record the number of goats with signs of thermal stress.

2. Animal-based measures of bedding quality

Udder cleanliness

The udder must always be clean because it is a gateway to germs/diseases. This indicator should be measured either at the feed fence or in the pen/containment corridor. In both cases, the evaluation can be carried out visually, although in the second case the visual evaluation may be more complicated.
The cleanliness of the udder is evaluated with a score ranging from 0 to 4 (Table 2):

Table 2. Udder cleanliness scoring (after IDELE, outlined for TechCare).

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

Moisture of the coat

The persistence of moisture in the goat's hair, especially deep down, can lead to respiratory problems or a weakening of the immune system. But above all, a warm and humid environment encourages the development of ectoparasitism (Jacquenet & Mage 2004). Finally, in barns, surface moisture in the coat may be due to a poor building environment. Poor ventilation does

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not allow the evacuation of excess humidity, or the evacuation of toxic gases produced by the animals (carbon dioxide and ammonia). Air quality is important; dust suspended in the air, for example, can trigger respiratory or ocular pathologies. The moisture problem in dairy goats might be seen both on the outside of the hair (external) due to wet conditions at pasture and on the surface of the hide (internal) due to condensation and moisture (e.g. urine) from indoor surfaces.

The moisture content of the coat is assessed by touch. For moisture, the observer places his (dry) hand on the back of the goat and moves it along the spine. For internal moisture, the observer spreads the shag with one hand and touches the skin of the goat with the fingers of the other (dry) hand. This assessment is also carried out on the animal's back. The external and internal humidity is rated in two classes (0 = dry and 1 = damp-wet) (Table 3):

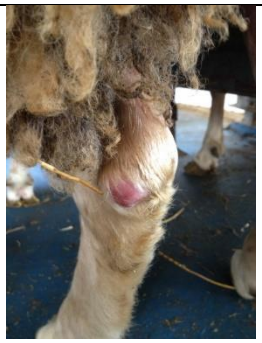
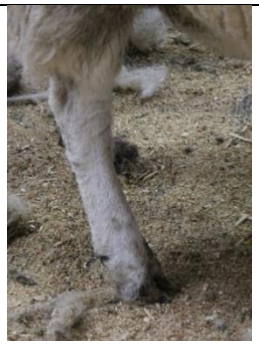
Table 3. Moisture rating of coat (after Gautier 2015).

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

Other animal-based indicators of housing quality

Table 4 shows other types of indicators that may be used to describe housing quality. These measures are copied from the TechCare animal welfare indicator list for dairy sheep, but are as describing for dairy goats (pictures of goats from AWIN 2015).

Table 4. Scores for bodily indicators of housing quality (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

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Hoof overgrowth		Overlong or mishappen feet. Score 1 if at least one claw is overgrown		Hooves show an appropriate length and shape
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

Aggression

Goats have a clear social dominance rank order, and if the rank order is challenged, this might result in aggressive behaviour/fighting. Thus, social instability increases aggression in groups of dairy goats (Andersen et al. 2011). The number of animals and the absence of pasture influence the presence of aggressive behaviour in goats, which is more prevalent in intensive farms compared to semi-intensive. The presence of pasture allows more freedom of movements and the expression of normal social behaviour (Miranda-de la Lama & Mattiello 2010, Tiezzi et al. 2019). A sufficient number of eating places (Jørgensen et al. 2007) and water bowls (Ehrlenbruch et al. 2010) helps to reduce aggressive interactions (see 'Queuing' above).

Aggressive behaviour should be measured in housed animals and is hard to assess for 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). The three first rows are outlined for sheep but may also work for goats.

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Table 5. Ethogram of behaviours indicating competition or aggression in sheep and goats (after TechCare, welfare assessment indicator list for dairy sheep and AWIN 2015).

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	Bites other goats, voluntarily attacks or threatens other goats, butts the belly or head of other goats, with the intention of hurting others. Can be related to dominance, fear or resource protection.

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4. Health in general

a) Unhandled or field measures

1. Nasal discharge

Nasal discharge is defined as any mucous or purulent discharge from the nose, due to inadequate environment or to disease. If discharge is from only one nostril, it may be a sign of nasal disease or lesion; if discharge is from both nostrils, it may be caused by diseases of the lower respiratory tract.

Nasal discharge is visually assessed by the assessor observing the goat from the front. Discharges to be considered should be white or yellowish (mucous or purulent). Serous discharge (transparent and watery like) should not be considered for this assessment. Nasal discharge is observed around the nostrils or hanging from the nose.

Each goat is scored in two levels. Nasal discharge from one nostril is sufficient condition for scoring a goat with presence of nasal discharge (Figure 4).

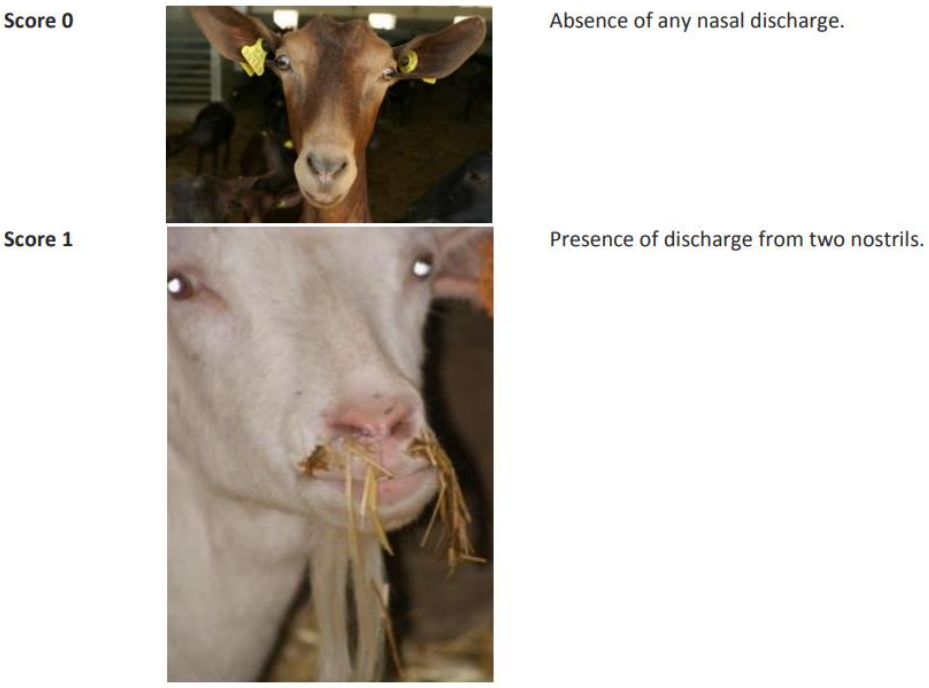

Figure 4. Scores for nasal discharge in goats (after AWIN 2015).

2. Respiratory problems

Due to the variety of responses that can be related to respiratory disease a simple presence/absence score (1/0) to cover the presence of any conditions relating to respiratory infection or distress is suggested (Table 6).

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Table 6. Scores for respiratory condition in goats (after AWIN welfare assessment protocol for sheep).

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

3. Oblivion

Lack of interest in surroundings (withdrawn) (NB this is described as 'oblivion' in the AWIN goat protocol).

A goat which is physically or mentally isolated from the group should be a cause for concern. Vocalizations are indicators of social isolation (Boivin & Braastad 1996, Miranda-de la Lama & Mattiello 2010). Tiezzi et al. (2019) observed a higher number of goats vocalizing in intensive farms, where there were also more goats which were withdrawn.

In goats, being unaware and uninterested or withdrawn is a sign of poor health (e.g. pain caused by lameness, severe disease) or of inability to express a normal social behaviour. Goats are generally herd-living, gregarious and well synchronized animals, so individuals rarely exclude themselves from the group.

Withdrawal is visually assessed from outside the pen. A withdrawn goat generally tries to isolate itself from the group, standing (sometimes lying) immobile for long time, frequently facing the wall or other parts of the housing structure, sometimes with ears down. As to behaviour, it is apathetic, inattentive, absent, depressed, unaffected by external stimuli and shows no interactions with its conspecifics during the whole observation period.

- physical isolation: a goat detaches itself from the rest of the group, especially during synchronized activities (e.g. feeding, resting);
- mental isolation: a goat may be detached, or not, from the group. Even if it is close to the group, it does not take part in synchronized activities and does not react to external stimuli. Due to the high animal density in intensive farms, sometimes goats are not able to physically isolate themselves. Posture, behaviour and localization compared to the rest of the group are the most important items to be considered.

Start observing the animals on arriving at the farm and locate goats that seem either physically or mentally isolated. Check these animals again after 30 minutes – are they maintaining the withdrawn behaviour, then confirm (or not) the identified animals (Figure 5).

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Oblivion		This goat is isolated from the rest of the group during a social activity (feeding time). It is standing immobile, facing the wall.
Oblivion		This goat is trying to isolate itself in a corner. It is standing immobile, facing the wall.
Oblivion		The goat lying in the middle of the picture is trying to isolate itself. It is inactive compared to the rest of the group and shows a mental indifference. The ears are down and the animal shows no reaction to external stimuli, although it is at the core of a group.

Figure 5. Patterns and descriptions of oblivion (or withdrawal) in goats (after AWIN 2015).

The percentage of withdrawn goats in the herd should be recorded and scaled after Tiezzi et al. (2019):

- 1: 1%–2% of animals
- 2: 3%–5% of animals
- 3: >5% of animals

4. Hair coat condition

Hair coat condition is often related to health or nutritional problems or presence of endo- and/or ecto-parasites. Goats with poor hair coat condition usually present low BCS. This condition has been found to be associated with chronic diseases, such as pneumonia, or with mineral imbalances.

Hair coat condition is visually assessed from outside the pen. Start locating the goats with poor hair coat condition, described as: matted, rough, scurfy, uneven, shaggy hair coat, frequently longer than normal. Assess the hair coat condition considering the whole body, with the exception of head and legs below the joints (anatomical knees and elbows). This means that the assessment is possible even if the goat is lying down. Animals may present poor hair coat on

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the whole body or they may only exhibit part of the body with rough hair coat. In both cases they should be classified as having poor hair coat condition. Take into account breed and crossbreed animals because some have naturally long hair, that should not be considered as poor hair coat condition. Hair coat condition cannot be scored during the moulting season. Recordings: Record the number of goats with poor hair coat condition (Figure 6).

Figure 6. Assessment of hair coat condition of goats (after AWIN 2015).

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5. Assessment of social/milking parlour order

a) Unhandled or field measure

Goats 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 dairy goat welfare.

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6. 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 7. 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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7. 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). QBA is included in the welfare assessment protocols for Welfare Quality® for pigs and cattle, and in AWIN for sheep and goats. Battini et al. (2018) confirmed that QBA can clearly discern mood (from agitated/alert to content/relaxed) and the level of activity (from bored to lively) in goats. Furthermore, QBA has been shown to be repeatable and reliable for use in sheep, and is useful in the assessment of for example, parasitism, transport and pain in sheep (e.g. Grant et al. 2020, Maslowska et al. 2020). 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. The animal's behaviour is then scored on a visual analogue scale (VAS) for a number of subjective terms (to capture how the animal is behaving, not what they are doing). For AWIN goats a lists of 13 descriptive terms were developed (Table 11). 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).

The Qualitative Behaviour Assessment (Wemelsfelder 2007) relies on the ability of humans to integrate perceived details of behaviour, posture, and context into the summarization of an animal's style of behaving, or "body language", using descriptors such as "relaxed", "tense", "frustrated" or "content". Such terms have an expressive, emotional connotation, and provide information that is directly relevant to animal welfare and may be a useful addition to information obtained from quantitative indicators.

QBA at group level is visually assessed from outside the pen. The assessment should not be performed on individual animals, but on the group; in the first level assessment the unit is the pen, in the second level is the farm, considering all pens with lactating goats, excluding infirmary, culling, quarantine or maternity pens. Select the suitable observation points and, consequently, the timing of the observations. The selection of these points should reflect the different structures of the pen environment (e.g. deep straw pen, outside field). The number of observation points depends on the complexity of the housing environment. Observation sessions may last from 10 to 20 min, dependent on the number of observation points chosen.

At the end of the observation period, find a quiet spot and score the list of descriptors (Table 8) using the visual analogue scale (VAS). The group will not be scored during the observation, and only one integrative assessment will be made per pen (in the first level) or per farm (in the second level) (integrate the information from each observation point). Each VAS is 125 mm and is defined by its left "minimum" and right "maximum" point. The measure for that descriptor is the distance in mm from the minimum point to the point where the VAS is ticked.

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Table 8. List of behavioural descriptors for goats used when conducting QBA (after AWIN 2015).

Descriptor	Definition
Aggressive	An aggressive goat bites other goats (especially the ears), voluntarily attacks or threatens other goats with the intention of hurting or disturbing them, bitts the belly or the head of other goats. It is intentionally harmful to other goats. The aggressive behaviour can be related to dominance, fear or resource protection.
Agitated	An agitated goat is restless, not at ease, highly susceptible to stimuli, it can move her ears, vocalize, or nervously move around.
Alert	An alert goat is on guard against danger, watchful and ready to react to a potential source of peril (e.g sounds, person, object, animal). It can emit acoustic or visual alarm signals (e.g. sounds, snorts, stamping, ears in upright position, stiff body). It often stands motionless, directing its attention towards the potentially negative stimulus.
Bored	A bored goat is wearied, dull, or is uninterested in the surrounding environment (low reactivity); lack of stimulation; it may be looking for something to do.
Content	A content goat is appeased, gratified, happy, comfortable, at ease, satisfied about its environment, playful. It may jump, play and make noise with objects, climb or try to climb.
Curious	A curious goat is reactive, engaged in exploratory behaviour, positively intrigued by something, attracted by the surrounding environment and by novelties (e.g people, goats in oestrus, objects). It looks around but often concentrates its gaze in a specific direction or towards signal, which attracts its interest.
Fearful	A fearful goat is a scared and shy animal. It may look for shelter or for a way out and crouches down or may tend to hide in the middle of the group. There may be a whole group running around.
Frustrated	A frustrated goat is annoyed and impatient because it is prevented from achieving something (e.g. queuing at the feeding rack or at the water places, passive behaviour).
Irritated	An irritated goat is bothered or annoyed by something (e.g. flies, pruritus, noise, another goat) that can disturb, upset, trouble or exasperate it.
Lively	A lively goat is active, busy and positively engaged in different activities, full of life and expressing energy.
Relaxed	A relaxed goat is at ease in the surrounding environment.
Sociable	A sociable goat is friendly to other goats. It has affiliative (e.g. grooming, sniffing, resting in pairs) and playful contact with other goats.
Suffering	A suffering goat is enduring pain, often with contracted muscles, possibly in antalgic postures. It frequently shows little or no movement or reaction to stimulation and often remains isolated from the group.

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8. 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 9. 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 source**	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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