List of welfare indicators to assess turkeys' welfare on-farm

Content

1. Introduction

This deliverable combines a list of welfare indicators and methods of assessment relative to on-farm turkeys' welfare. As no specific European legislation is yet available, the legal requirements of the directive 98/58/EC that apply to turkeys are identified and allocated to four welfare principles: *Good Feeding*, *Good Housing*, *Good Health* and *Appropriate Behaviour*. Welfare indicators and their methods of assessment are developed following a review of the existing scientific literature, and the checklist and guidelines used by official inspectors in Member States. There might be some methods not described in this document, the list is not exhaustive. EURCAW-Poultry-SFA chose the most relevant and valid ones according to its knowledge and the available scientific data. Among the different welfare indicators, the animal-based Indicators (ABI) are prioritized and these indicators and methods of assessment are evaluated according to the available knowledge about their feasibility and reliability in order to deliver to Competent Authorities useful information for official controls. However, Resource-Based (RBI) and Management-Based indicators (MBI) could also be applicable and are also provided but with a short description. EURCAW-Poultry-SFA recommends the use of several specific indicators which used in combination may give a general overview of the flock welfare. Iceberg indicators which are able to reflect major welfare issues within a flock of turkeys, are also described and highlighted in blue in this deliverable. A number of indicators in this report, in particular ABIs, are assessed by the transect method (see definition in 1.1) already validated and used in scientific literature (Marchewka et al., 2015; Ferrante et al., 2019; Marchewka et al., 2019; Hrzenjak et al., 2021) and turkey welfare assessment protocols (AWIN, 2015; ITAVI, 2018). The transect method allows the assessments of several indicators simultaneously in a non-invasive way, without handling the birds, and with a number of animals evaluated is more important that when the animals have to be handled. This makes this method particularly appropriate for inspectors (safer, easier and faster). Indicators and methods of assessment described in this deliverable will be later (in the next Work Programme of the EURCAW-Poultry-SFA) developed in indicator factsheets to facilitate their use during official inspections.

1.1. Definitions

Legal requirement: a provision of the EU legislation to be assessed during official controls.
Example: Directive 98/58 EC, Annex, Paragraph 10: *"Temperature, relative air humidity […] must be kept within limits which are not harmful to the animals"*

Indicator: an occurrence, observation, record or measurement which has a proven relationship with a welfare consequence that can be used in the frame of inspection (legal requirement).

- **Animal-based indicator (ABI)**: a response of an animal or an effect on an animal used to assess its welfare. It can be taken directly on the animal or indirectly and includes the use of animal records.
  Example: huddling as ABI of cold stress and panting as ABI of heat stress.
- **Resource-based indicator (RBI)**: an evaluation of a feature of the environment in which the animal is kept or to which it is exposed.
  Example: Environmental temperature, humidity.
- **Management-based indicator (MBI)**: an evaluation of what the animal unit manager or stockperson does, and which management processes or tools are used.
  Example: Protocol for activation of the ventilation system.

Method for the assessment (= method): Description of the procedure for the assessment of an indicator.

Validity: The extent to which an indicator is meaningful in terms of providing information on animal welfare or has a proven its relationship with a specific welfare consequence.

Reliability: The extent to which results are largely the same when the same observer repeats assessments (intra-observer repeatability) or the agreement between two or more observers (inter-observers repeatability) after training.

Feasibility: Capacity to be applicable to different housing systems and at least have the potential to be applied in the field (on-farm or in slaughterhouse). The feasibility will depend on the material needed (cost, availability), animal handling and observation difficulties (e.g. frequency of occurrence of a behaviour). Sufficient training of the observers is considered essential to every indicator described in this document.

Gap of knowledge: lack of technical and scientific information about an indicator or its method.

Iceberg indicator: indicator reflecting major welfare issues in an integrative manner in order to enable an initial overview of the welfare state.

Transect method: Visual observation of birds while slowly walking through a barn along longitudinal predetermined bands (transects) of equal width according to the house width recording welfare indicators of any bird affected in the zone of observation (AWIN, 2015; Marchewka et al., 2015).

The transect method is used in scientific literature on turkeys indicators (Marchewka et al., 2015; Ferrante et al., 2019; Marchewka et al., 2019; Hrzenjak et al., 2021) and assessment protocol of turkeys' welfare (AWIN, 2015; ITAVI, 2018). With the transect method, the evaluation of several welfare indicators (runts, lame birds, featherless birds…) is done by transect walking into the barn (Figure 1). The assessor walks slowly (one step per second) to prevent disturbing the birds, and record visually the indicators assessed. The number of turkeys observed showing the indicator assessed, is then converted into a percentage of the flock. Vigilance is required with contiguous transects to avoid double counting the same birds. This method has been qualified as highly sensitive according to Ferrante et al. (2019). The transect method is also feasible because it is easy to apply and time saving in comparison with the handling of animals (Marchewka et al., 2015; Ferrante et al., 2019), in particular if several indicators are noted during the transect walk at the same time. The reliability of this method is high for most of the indicators but depending on the study, some of them were not reliable between two observers ("immobility" according to Marchewka et al. 2015, and "back wounds", "tail wounds", "dirtiness", "aggression toward conspecific" and "aggression toward human" according to Ferrante et al. 2019). However, although used several times in the scientific literature, the validity of the transect method still needs to be confirmed. Marchewka et al. 2015 compared this method with the Individual Scoring method (104 randomly-chosen turkeys followed visually in the barn and scored) and with the Load Out Evaluation (40 to 50 birds herded into a corridor and individually evaluated) and differences between the three methods were found depending on the indicators. Thus, the transect method may not give a refined view of the prevalence of the indicators in a flock but is useful to compare welfare levels between barns and farms during veterinary inspections.

Figure 1: Example of transect walks in a turkey barn (©Izsler)

1.2. Indicators and ranking method used

In this document, ABIs are identified, and their method of assessment described and evaluated according to their feasibility. The feasibility is rated following a three levels rating method, according to information found in the scientific literature and the expert knowledge (see table 1).

Table 1: Assessment of feasibility of indicators associated to their methods of assessment

	X (low)	**XX** (moderate)	**XXX** (high)
Feasibility	• Material needed: High cost/low availability material (e.g. gas meter, dust meter) *And/or* • *Ease to access:* difficult access or not possible to apply in all farm/slaughterhouses re *And/or* • *Animal handling:* biological sampling (e.g., blood, swab), analysis in a laboratory to be performed	• Material needed: moderate cost of the material (e.g., thermometer, hygrometer) *And/or* • *Ease of access:* not easy to access (e.g., to upper tiers) or not easy to apply in all farm/slaughterhouses *And/or* • *Animal handling:* some animal handling with no biological sampling (e.g., check foot pad)	• Material needed: no or low-cost material (e.g., tape measurer) *And/or* • *Ease of access:* easy to access and feasible in all kinds of structure *And/or* • *Animal handling:* none

2. Good feeding

Requirements applicable to turkeys in the legislation:

Regulation 98/58 CE, Annex, point 14 *"Animals must be fed a wholesome diet which is appropriate to their age and species and which is fed to them in sufficient quantity to maintain them in good health and satisfy their nutritional needs. No animal shall be provided with food or liquid in a manner, nor shall such food or liquid contain any substance, which may cause unnecessary suffering or injury."*

Regulation 98/58 CE, Annex, point 15 *"All animals must have access to feed at intervals appropriate to their physiological needs."*

Regulation 98/58 CE, Annex, point 16 *"All animals must have access to a suitable water supply or be able to satisfy their fluid intake needs by other means."*

Regulation 98/58 CE, Annex, point 17 *"Feeding and watering equipment must be designed, constructed and placed so that contamination of food and water and the harmful effects of competition between the animals are minimised."*

2.1. Animal-based indicators

2.1.1. Undersized turkeys (runts)

Description of the indicator and method of assessment:

An undersized turkey, or runt, is a bird visibly smaller than the average of the flock, approximately half the size (Figure 2), due to inappropriate nutrition and water consumption or the presence of parasites (AWIN, 2015) or other disorders.

To assess this indicator, the transect method is generally used (see 1.1.). In scientific literature, the percentage of runt birds in assessed flocks goes from 0.01 to 0.99% in males and, from 0.008 to 0.72% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

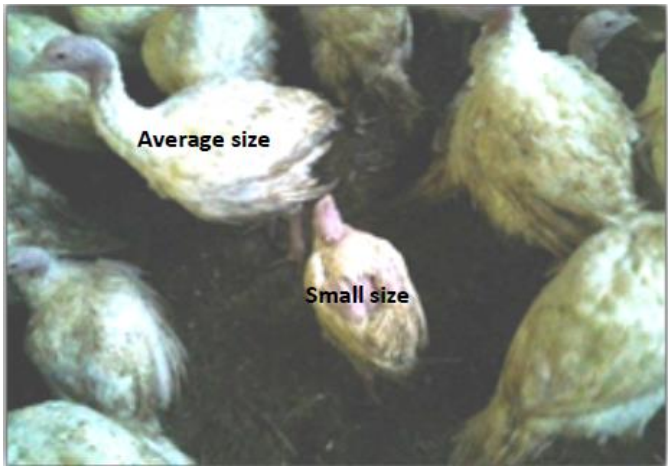


Figure 2: Undersized turkey next to average size turkeys (AWIN, 2015)

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. In addition, two studies comparing the results of two assessors showed a high reliability of the transect method for this indicator (Marchewka et al., 2015; Ferrante et al., 2019).

2.2. Resource-based indicators

2.2.1. State of feeders and drinkers

Description of the indicator and method of assessment:

The state of feeders and drinkers can be checked with 2 parameters: the cleanliness of feeders, and drinkers and the functioning of feeders and drinkers.

To the authors' knowledge, there is no standard method of assessment for this indicator other than walk through the barn and check the state of the equipment.

2.2.2. Number of turkeys per drinking and feeding points

Description of the indicator and method of assessment:

To the authors' knowledge, there is no standard method of assessment for this indicator but to walk through the barn and count the number of drinkers and feeders. The total number of turkeys, initially placed in the barn, must be then divided by the number of drinkers and feeders counted.

According to breeding companies such as Aviagen's management guidelines for commercial turkeys[1] are recommending that one bell-type drinker should be provided per 80-100 birds and one feed pan per 40-60 males or 60-80 females. Feeders should allow at least 2 cm of feeding space per female and 3 cm or feeding space per male. There is no scientific knowledge available about the exact space at feeder requested to avoid competition between birds and free access to feeders.

2.3. Management-based indicators

2.3.1. Diet and feeding programme

Description of the indicator and method of assessment:

The diet has to be adequate for turkeys' physiological needs (especially according to their age).

Primary breeder's management guidelines provide indications for commercial turkey nutrition requirements.

2.3.2. Water quality controls

Description of the indicator and method of assessment:

The water has to be suitable for birds, without any contamination (microbes, droppings, litter, food…).

To the authors' knowledge, there is no standard method of assessment for this indicator but check the state of drinkers by inspecting all of them and checking water quality analysis results and cleaning and disinfection protocols for drinkers.

3. Good housing

Requirements applicable to turkeys in the legislation:

Regulation 98/58 CE, Annex, point 8 *"Materials to be used for the construction of accommodation, and in particular for the construction of pens an equipment with which the animals may come into contact, must not be harmful to the animals and must be capable of being thoroughly cleaned and disinfected."*

Regulation 98/58 CE, Annex, point 9 *"Accommodation and fittings for securing animals shall be constructed and maintained so that there are no sharp edges or protrusions likely to cause injury to the animals."*

Regulation 98/58 CE, Annex, point 10 *"Air circulation, dust levels, temperature, relative air humidity and gas concentrations must be kept within limits which are not harmful to the animals."*

Regulation 98/58 CE, Annex, point 11 *"Animals kept in buildings must not be kept either in permanent darkness or without an appropriate period of rest from artificial lighting. Where the natural light available is insufficient to meet the physiological and ethological needs of the animals, appropriate artificial lighting must be provided."*

[1] https://www.aviagenturkeys.com/uploads/2022/03/17/CL23_V3_Management%20Guidelines%20for%20Growing%20Commercial%20Turkeys_EN.pdf

Regulation 98/58 CE, Annex, point 12 *"Animals not kept in buildings shall where necessary and possible be given protection from adverse weather conditions, predators and risks to their health. »*

3.1. Animal-based indicators

3.1.1. Dirtiness of the animals

Description of the indicator and method of assessment:

Feather dirtiness can have bad consequences for birds' welfare because wet or soiled feathers (with faeces and dirt) lose their protective properties. As fathers are used by birds to be protected from cold, moisture, dirt and skin infections (WelfareQuality®, 2009) dirty plumage can lead to impaired welfare. Feather dirtiness could be correlated with footpad dermatitis, hock burns and lameness but also with the environment of the birds (litter quality for example) (AWIN, 2015). Soiled litter is the main cause of plumage dirtiness and, in case of leg and foot injuries, turkeys tend to be dirtier because of the increasing time spent laying on soiled litter.

Dirtiness is defined as an evident and dark staining of the back, wing and or tail feathers, covering at least 50% of the body area (light discoloration of feathers from dust are not included) (AWIN, 2015)(Figure 3). In the AWIN protocol (2015) and in Marchewka et al. (2015), the evaluation of plumage dirtiness is done by transect in the barn (see 1.1.). In the EBENE protocol (ITAVI, 2018) an estimation of the percentage of dirty turkeys seen in the barn (during a transect where other indicators are noted) is given.

Figure 3: Turkey with dirty feathers (AWIN, 2015)

In scientific literature, the percentage of dirty turkeys in assessed flocks goes from 0.02 to 0.05% in males and, from 0 to 0.02% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Marchewka et al. (2015) showed a high reliability between two observers assessing dirty birds during a transect walk. However, it was not confirmed by Ferrante et al. (2019) who found differences between two assessors. Thus, information and confirmation are still missing to assess the reliability of this indicator and this associated method.

3.1.2. Panting, huddling or shivering as indicators of thermal stress

Description of the indicator and method of assessment:

Turkey poults are more sensitive to cold temperatures than adult turkeys (in good health) which, on the contrary, do not tolerate high temperatures. With the increase in feather coverage and body weight, young birds will be less sensitive to low effective temperatures and more to higher effective temperatures. During the first week of life, the comfort temperature for young birds varies slightly (Table 2). Then, it goes from 31°C at 9 days to 21°C at 44 days of age with a decrease of half a degree every two days (DGAL, 2011).

Table 2: Range of thermoneutrality according to the age of turkey poults (DGAL, 2011)

Turkey poults' age	Thermocomfort zone
0-2 days	33.5 to 34°C
3-4 days	32.5 to 33.5°C
5-6 days	32 to 33°C
7-8 days	31.5 to 32.5°C

Several behaviours related to thermal conditions can be observed and used as indicators of turkey welfare: panting, huddling and, more rarely, shivering. Panting is defined as "breathing rapidly and in short gasps" and is assessing heat stress. Huddling is defined as "Birds grouping together into tight groups, sitting closely alongside each other, often in 'clumps' with areas of empty space in between" (WelfareQuality®, 2019) and is used to assess cold stress. The Welfare Quality protocol exists for broiler chickens and laying hens but not for turkeys, however according to experts' opinion, the broiler chicken protocol can be adapted to turkeys. Both of these behaviours are natural responses to heat and cold stress. However, it is essential to distinguish between panting behaviours due to high temperature and panting that indicates stress and fear, and between birds huddling due to low temperatures.

The Welfare Quality Protocol (2019) for these indicators consists in the estimation of the percentage of birds of the total flock performing panting and huddling behaviours, during flock walks through the barn, at three moments (at the start of the Welfare Quality protocol, halfway through the measurements and at the end of the protocol). In order to adapt this method to inspectors' inspections, the estimations could be done during flock walks at the beginning of the inspection, halfway through the inspection, and at the end. Then, the worst percentage of turkeys that performed panting or huddling behaviours is kept to evaluate the thermal comfort of the birds.

Shivering is defined as "Shaking slightly and uncontrollably" (Strawford et al., 2011). Shivering is rarely observed on farm, but it may happen with very low temperatures. There is a gap of knowledge in literature about the assessment of this indicator rarely used probably because it is not common to see birds shivered on farm. Nevertheless, the Welfare Quality Protocol (2019) method to assess panting and huddling behaviours can be used as for the panting and huddling behaviours assessment.

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility is considered high although time is needed to inspect the birds by transects in the barn, three times during an inspection. There is a gap of knowledge considering the reliability of this indicator.

3.1.3. Loss of Feather

Description of the indicator and method of assessment:

Turkeys with missing feathers could be related to inadequate housing conditions and/or behavioural problems (AWIN, 2015; Marchewka et al., 2015). A featherless turkey has one or more visible extended areas of missing feathers on the body (in particular on the back or on the back and wings) (Figure 4). In turkeys, missing feathers are often combined with back wounds (AWIN, 2015).

Figure 4: Turkey with missing feathers on the back (AWIN, 2015)

In the AWIN protocol (2015), Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of featherless turkeys is done by transect into the barn.

In scientific literature, the percentage of turkeys with missing feathers in assessed flocks goes from 0.03 to 1.04% in males and, from 0.02 to 0.96% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Two studies comparing the results of two assessors showed a high reliability of plumage loss assessment via the transect method (Marchewka et al., 2015; Ferrante et al., 2019).

3.2. Resource-based indicators

3.2.1. Stocking density

Description of the indicator and method of assessment:

There is no legal threshold of stocking density for turkeys in the current European legislation. However, a high stocking density impacts negatively the turkeys' behaviours and health by, for example, increasing litter moisture (thus foot lesions, see 3.2.6. and 4.1.1.), gait deterioration, increasing injurious pecking, decreasing the ability to perform natural behaviour such as exploration, foraging and comfort behaviours, and leading in most extreme cases to poor body mass gain or increased mortality (Marchewka et al., 2013; Erasmus, 2017; Krautwald-Junghanns and Sirovnik, 2022).

Stocking density is a resource-based indicator to assess the space that an animal might have to perform its behavioural needs. The stocking density is assessed by dividing the number of turkeys by the total usable area of the barn, to have the number of birds/m². Then, the kg/m² can be found by multiplying the number of turkeys per square meter by the average weight of turkeys at the moment of the inspection.

3.2.2. Light intensity and lighting programme

Description of the indicator and method of assessment:

The light intensity can be assessed with a lux meter, for example as described for broilers (DGAL/SDSPA/2017-998). Five measures, with a lux meter, at turkey's head level have to be done horizontally, in areas free of shadows (of birds, inspector or farmer). These 5 areas need to be representative of light distribution in the barn. Feeding and drinking areas should be preferred and resting areas avoided. Then, the lowest value is suppressed and the four other measurements are averaged to have the mean light intensity in the barn.

There is no standard method to assess the lighting programme. The light programme has to be check when it is recorded or through the settings of the shed electrical control units.

3.2.3. Temperature and humidity

Description of the indicator and method of assessment:

The thermo-comfort zone in turkeys, as in other poultry species, will depend on birds' age (See 3.1.4.).

Environmental temperature and humidity can be easily measured in the barn with appropriate devices (thermometer and hygrometer). Devices need to be used at turkeys' height to evaluate temperature and/or humidity, in several areas of the barn where values could vary (near the drinkers, near the feeders, in the middle of the barn without any facilities, along the walls, near to popholes…). As temperature may change over the time of the inspection, it can be relevant to assess the temperature at the beginning and at the end of the inspector's visit. The control panel can also be checked.

Another method to assess the environmental temperature and humidity is to use the **T**emperature **H**umidity **I**ndex (THI). THI is calculated with the environmental temperature and the relative humidity and can be used to detect too high or too low effective temperatures. There are several THI formulations, for example: THI = 1.8 x T – (1-RH) × (T-14.3) + 32 (Kibler 1964 in Bouraoui et al., 2002) where T is the dry bulb temperature of indoor air hourly measured (C°) and RH is the relative humidity of indoor air hourly measured (as a fraction of the unit) (Karaman et al., 2007).

3.2.4. Noxious gases concentration

Description of the indicator and method of assessment:

The CO_2 and NH_3 concentrations can be measured in air with specific devices by taking 5 representative measures of CO_2 and NH_3, like for example described by DGAL (2011). Averages of these 5 measures for each gas are then calculated.

CO_2 measures need to be taken at birds' height, away from heating materials, preferably in feeding and drinking areas. When it is possible, the air system has to be taken into account (ventilation system).

NH_3 measures need to be taken at birds' height, away from the building entrance or wet areas (nipple drinkers, water leaks), preferably in feeding areas.

Another method of assessment of ammonia concentrations is the sensorial evaluation. To achieve this, inspectors stay at least 5 minutes in the barn and proceed of a sensorial evaluation of ammonia concentration (i.e., evaluate eyes/nose irritation).

3.2.5. Dustiness

Description of the indicator and method of assessment:

To assess dustiness in poultry barns, the Dust Sheet Test, developed by the Welfare Quality Protocol (2019) for laying hens and broiler chickens, can be used. Other methods exist, however, the EURCAW Poultry-SFA (in 2021) has tested some of them and the dust sheet test was found to be the most reliable method. This is why, it will be developed in this document. In this method, a black A4 size paper is place above bird height on a horizontal surface when first entering the barn. The sheet is removed after 2 hours. The amount of dust accumulated on the sheet is evaluated visually directly or after touching the sheet with a finger. The dust level is classified as follows (Figure 5):

1: No or minimal evidence of dust (sheet has same colour as clean sheet)

2: Isolated specks or a thin layer of dust on sheet is detectable (without comparing with a clean sheet, the test sheet still appears black but there is a slight colour difference between the 2 sheets)

3: Dust covers the sheet, even without comparing with a clean sheet it is clear that the test sheet is no longer black. i.e. (there is a clear difference in colour between clean and test sheets)

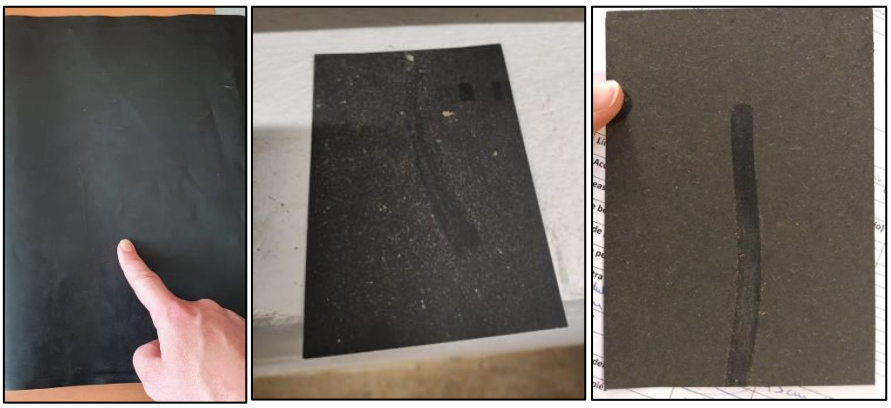


Figure 5: Dust sheet test scoring. Left: score 0; middle: score1; right: score 2

3.2.6. Litter quality

Description of the indicator and method of assessment:

Litter quality is related to several factors such as litter type, stocking density, temperature, humidity (moisture), season, diet and gut health. Litter moisture is generally higher around feeders and drinkers because of the spillage of drinkers but also because birds tend to crowed in these areas and defecate while drinking (Vinco et al., 2018). As in broilers, wet litter in turkeys is a major cause of painful footpad dermatitis and hock burns (Mayne et al., 2007; Krautwald-Junghanns et al., 2011; Wu and Hocking, 2011; Weber Wyneken et al., 2015; Vinco et al., 2018).

Two protocols of litter quality assessments, based on visual scoring, could be easily used by inspectors: the Welfare Quality protocol for broilers (WelfareQuality®, 2009) and the Classyfarm Protocol (Vinco et al., 2018; Vinco et al., 2020).

In the Classyfarm protocol, the litter quality must be assessed in three selected points of approximately 1 square meter at 6-7 meters from the entrance of the shed: one in the middle of the barn, one under the feeder and one under the drinker line. In each evaluation point, the assessor should give a friability score and a wetness score, from 1 to 10 (Table 3). The mean between both values gives the final score

of litter quality of this point. The general litter quality score of the barn is obtained with the mean between the three values identified from the three selected points.

*Table 3: Description of the Classyfarm visual scores for friability and wetness (Vinco et al. 2020). *just started ridges: slightly visible; **small ridges: well visible beneath drinking line; ***larger ridges: well visible, overmatching the drinker rim*

Score	Friability Description	Wetness Description
1	Completely caked	Wet litter, water is appearing by pressure on the litter of the total area
2	80-90 % area caked	Wet litter, water is appearing by pressure on the litter beneath drinkers
3	70-80 % area caked	Wet litter, no water is appearing by pressure on the litter
4	60-70 % area caked	Wet litter dark coloured. Litter can be pressed into ball-shape
5	50-60 % area caked	Wet litter, dark coloured. Larger ridges*** beneath drinkers
6	40 % area caked	Almost dry litter, small ridges** beneath drinkers. Litter between drinkers and feeders is still friable
7	30 % area caked	Almost dry litter, dark coloured beneath drinkers and in other areas light coloured, ridge formation just started* beneath drinkers
8	10 % area caked	Almost dry litter, light coloured, no ridges beneath drinkers
9	Friable litter, small caked Areas	Dry litter, light coloured
10	Friable litter, no caked Areas	Very dry litter (only observed at start)

In the Welfare Quality protocol (2009), the assessor should evaluate four to six different locations in the house (i.e. under drinkers and feeders, along the edges of the house and close to the doorways) and score each location following this scoring system:

0: Completely dry and flaky, i.e. moves easily with the foot

1: Dry but not easy to move with foot

2: Leaves imprint of foot and will form a ball if compacted, but ball does not stay together well

3: Sticks to boots and sticks readily in a ball if compacted

4: Sticks to boots once the cap or compacted crust is broken

3.3. Management-based indicators

There are no management-based indicators.

4. Good health

Requirements applicable to turkeys in the legislation:

Regulation 98/58 CE, Annex, point 4 *« Any animal which appears to be ill or injured must be cared for appropriately without delay and, where an animal does not respond to such care, veterinary advice must be obtained as soon as possible. Where necessary sick or injured animals shall be isolated in suitable accommodation with, where appropriate, dry comfortable bedding."*

Regulation 98/58 CE, Annex, point 19 *"Pending the adoption of specific provisions concerning mutilations in accordance with the procedure laid down in Article 5, and without prejudice to Directive 91/630/EEC, relevant national provisions shall apply in accordance with the general rules of the Treaty."*

4.1. Animal-based indicators

4.1.1. Skin lesions (footpad dermatitis and hock burns)

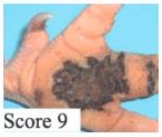
Description of the indicator and method of assessment:

In turkeys, the studies on skin lesions are mainly on footpad dermatitis (FPD) rather than hock burns (HB) or other skin lesions. As the protocol of assessment (sample size, way to handle the birds…) can be the same between FPD and HB with differences in the body part evaluated, this chapter will mainly focus on FPD.

Footpad dermatitis is a common welfare issues in commercially turkeys and broilers, because its prevalence could be high and FPD cause pain to the birds (Weber Wyneken et al., 2015). Allain et al. (2013) showed that 99.9% of feets of 60 turkeys flocks were affected by footpad dermatitis. There are several factors causing FPD (breed, age, diet, sex) but the wet litter is highly correlated with the severity of FPD (Mayne et al., 2007; Krautwald-Junghanns et al., 2011; Wu and Hocking, 2011; Weber Wyneken et al., 2015).

Scoring system of FPD in turkeys are available in scientific literature as in Table 4. Allain et al. (2013) scored the macroscopic aspect of lesions in post-mortem observations on a ten-point scale ranging from "no lesion" (score 0) to the most severe lesion (score 9) according to the type of lesion observed and the percentage of the surface area affected. However, depending on the studies, the sample size will depend. In the Welfare Quality protocol (2009) for broilers, the sample size for assessing FPD is 100 birds (10 birds for ten different locations in the barn).

Tableau 4: Scoring system for footpad dermatitis based on visual observation (Allain et al., 2013)

Type of lesion observed	Surface area affected (% foot)		
	<25 %	[25–50 %]	>50 %
No lesion	 Score 0		
Enlargement of scales and erythema	 Score 1	 Score 2	 Score 3
Hypertrophic and hyperkeratotic scales covered by a yellowish to brownish exudates	 Score 4	 Score 5	 Score 6
Depressed lesion, loss of substance (=ulceration), with or without thick dark, adherent scab	 Score 7	 Score 8	 Score 9

Evaluation of the method and comment:

The reliability of this indicator has not been assessed yet, inducing a gap of knowledge. According to the EURCAW experts' opinion, the feasibility is low because it requires animals handling and manipulations (footpad cleaning), and turkeys' weights could make it quite impracticable on-farm for an inspector. This indicator remaining really important, the assessment should be done on the slaughter line, which will increase the feasibility.

4.1.2. Head wounds

Description of the indicator and method of assessment:

In turkeys, injurious pecking and cannibalism may have several causes, related to stress factors, such as inadequate light (bright), stocking densities (lack of individual space), diet (dietary deficiencies or insufficient feeding), watering and/or barren environment (lack of stimulation and expression of natural behaviours)(AWIN, 2015). Cannibalism leads to body wounds on the head, back and tail/vent (Figure 6).

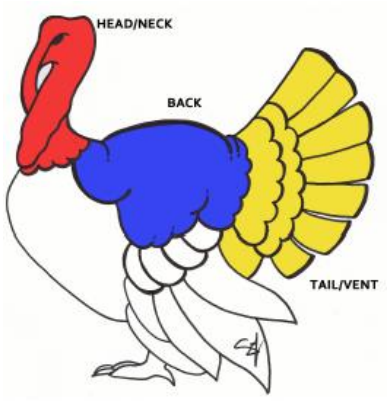


Figure 6: Body areas targeted by conspecifics in case of cannibalism in turkeys (AWIN, 2015)

Head wounds (Figure 7) are defined as visible signs of injuries on the head area related to fresh or older wounds, including the head, beak, snood and neck (in red on Figure 6)(AWIN, 2015; Marchewka et al., 2015).

Figure 7: Examples of head wounds caused by conspecifics pecking (AWIN, 2015)

In the AWIN protocol (2015), in Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of head wounds is done by transect into the barn.

In scientific literature, the percentage of turkeys with head wounds in assessed flocks goes from 0.01 to 0.26% in males and, from 0.01 to 0.11% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Two studies comparing the results of two assessors showed a high reliability of the transect method for this indicator (Marchewka et al., 2015; Ferrante et al., 2019).

4.1.3. Back wounds

Description of the indicator and method of assessment:

See first paragraph of 4.1.2.

Backs wounds (Figure 8) are defined as visible fresh or older wounds, including bleeding wounds, between the end of the neck and the beginning of the tail (in blue on Figure 6)(AWIN, 2015). Wings' wounds can also be included (Marchewka et al., 2015).

Figure 7: Examples of back wounds caused by conspecifics pecking (AWIN, 2015)

In the AWIN protocol (2015), in Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of back wounds is done by transect into the barn.

In scientific literature, the percentage of turkeys with back wounds goes from 0.02 to 0.06 % in males and, from 0.02 to 0.04 % in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Marchewka et al. (2015) showed a high reliability between two observers assessing back wounds during a transect walk. However, it was not confirmed by Ferrante et al. (2019) who found differences between two assessors. Thus, information and confirmation are still missing to rank the reliability of this indicator and this associated method.

4.1.4. Tail wounds

Description of the indicator and method of assessment:

See first paragraph of 4.1.2.

Tail wounds (Figure 9) are defined as visible fresh, older or bleeding wounds on the tail area, or on its sides, the vent is included when it is visible (in yellow on Figure 6)(AWIN, 2015; Marchewka et al., 2015).

Figure 9: Examples of tail wounds caused by conspecifics pecking (AWIN, 2015)

In the AWIN protocol (2015), in Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of tail wounds is done by transect into the barn.

In scientific literature, the percentage of turkeys with tail wounds in assessed flocks goes from 0.01 to 0.54% in males and, from 0.02 to 0.18% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Marchewka et al. (2015) showed a high reliability between two observers assessing tail wounds during a transect walk. However, it was not confirmed by Ferrante et al. (2019) who found differences between two assessors. Thus, information and confirmation are still missing to rank the reliability of this indicator and this associated method.

4.1.5. Immobility

Description of the indicator and method of assessment:

Immobile turkeys are birds who do no attempt to move, even when approached at less than 2 meters, encouraged to move (with the hand or a stick) or when other birds move away (AWIN, 2015; ITAVI, 2018) (Figure 10). Birds are only able to move by propping themselves on their wings (Marchewka et al., 2015). The immobility indicates unhealthy turkey, which cannot feed of drink anymore. It can be related to genetics or environment factors (AWIN, 2015). An immobile bird should be isolated from the others in an infirmary and culled if no recovery is possible.

Figure 10: Immobile turkey resting in an unnatural position with the legs extended to the front (AWIN, 2015)

In the AWIN protocol (2015), in Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of immobile turkeys is done by transect into the barn.

In scientific literature, the percentage immobile turkeys in assessed flocks goes from 0.03 to 0.07% in males and, from 0.004 to 0.08% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it and requires no material or animal handling. Ferrante et al. (2019) showed a high reliability between two observers assessing immobile birds during a transect walk. However, it was not found by Marchewka et al. (2015) who found differences between two assessors. Thus, information and confirmation are still missing to rank the reliability of this indicator and this associated method.

4.1.6. Lameness

Description of the indicator and method of assessment:

A lame turkey walks with difficulty, with one or both legs (steep, non-functional) not placed firmly on the ground, eventually by propping itself up on its wings (AWIN, 2015; ITAVI, 2018) (Figure 11). Birds could also have shaky leg syndrome (Marchewka et al., 2015). Lameness can be related to genetics and environment factors or diseases.

Figure 11: Lame turkey try to moves away from the assessor but stops to rest after some steps (AWIN, 2015)

In the AWIN protocol (2015), in Marchewka et al. (2015) and in the EBENE protocol (ITAVI, 2018), the assessment of lame turkeys is done by transect into the barn.

In scientific literature, the percentage of lame turkeys in assessed flocks goes from 0.01 to 2.27% in males and, from 0.02 to 1.25% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Two studies comparing the results of two assessors showed a high reliability of the transect method for this indicator (Marchewka et al., 2015; Ferrante et al., 2019).

4.1.7. Sick turkeys

Description of the indicator and method of assessment:

Sick turkeys are birds which show clear signs of impaired health as a small and pale snood and/or red and watery eyes. They are usually found in a resting position (Figure 12A), and/or with a pale/yellowish body colour and/or with the pendulous crop hanging in front of the breast (Figure 12B), and/or missing or deformed body parts and/or unarranged feathering (AWIN, 2015; Marchewka et al., 2015).

Figure 12: sick turkey in an abnormal resting position (A) and turkey with a pendulous crop (B) (AWIN, 2015)

In the AWIN protocol (2015) and in Marchewka et al. (2015), the assessment of sick turkeys is done by transect into the barn.

In scientific literature, the percentage of sick turkeys in assessed flocks goes from 0.02 to 0.03% in males and, from 0 to 0.02% in females (Ferrante et al., 2019; Hrzenjak et al., 2021).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Two studies comparing the results of two assessors showed a high reliability of the transect method for this indicator (Marchewka et al., 2015; Ferrante et al., 2019).

4.1.8. Terminally ill

Description of the indicator and method of assessment:

A terminally ill turkey is defined as a bird severely ill or with large wounds, without any possibility of cure and which will generally die. Terminally ill turkeys are lied on the ground with heads resting on the ground or back, usually with half closed eyes with feeble breath (Figure 13) (AWIN, 2015; Marchewka et al., 2015).

Figure 13: A terminally ill turkey lied on the ground (AWIN, 2015)

In the AWIN protocol (2015) and in Marchewka et al. (2015), the assessment of terminally ill turkeys is done by transect into the barn.

In scientific literature, the percentage of terminally ill turkeys in assessed flocks is 0.02% in males and 0.02% in females (Ferrante et al., 2019).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Ferrante et al. (2019) compared the results of two assessors during a transect walk and they both have similar result for this indicator, indicating a high reliability.

4.1.9. Number of dead turkeys

Description of the indicator and method of assessment:

The number of dead turkeys could be assessed during the inspector's transect done inside the barn to assess several indicators (AWIN, 2015; Marchewka et al. 2015).

Evaluation of the indicator, assessed by the transect method and comment:

According to the EURCAW experts' opinion, the feasibility of this method of assessment is high because it requires no material or animal handling. Two studies comparing the results of two assessors showed a high reliability of the transect method for this indicator (Marchewka et al., 2015; Ferrante et al., 2019).

4.2. Resource-based indicators

4.2.1. Presence of a dedicated infirmary

Description of the indicator and method of assessment:

Turkeys that are injured with the possibility of recovery or under treatment should be placed in a dedicated pen ("infirmary").

There is no standard method for this indicator but to check if an extra space, isolated from the rest of the pen and providing clean litter and easily accessible feed and water, is available.

4.3. Management-based indicators

4.3.1. Emergency culling methods

Description of the indicator and method of assessment:

Producers should have emergency culling procedures/methods for birds found suffering. There is no standard method of assessment for this indicator but to check the presence of standard operating procedures (SOPs) or ask the producer his way to proceed.

5. Appropriate behaviour

Regulation 98/58 CE, Annex, point 7 .*"The freedom of movement of an animal, having regard to its species and in accordance with established experience and scientific knowledge, must not be restricted in such a way as to cause it unnecessary suffering or injury. Where an animal is continuously or regularly tethered or confined, it must be given the space appropriate to its physiological and ethological needs in accordance with established experience and scientific knowledge."*

5.1. Animal-based indicators

5.1.1. Aggressiveness

Description of the indicator and method of assessment:

In turkeys, aggressiveness is expressed by aggressive behaviours toward flock mates such as chasing, and pecking. These attacks toward other turkeys include also fights and leaps onto another turkey (AWIN, 2015; Marchewka et al., 2015). Aggressive pecking should not be confounded with normal pecking behaviour useful to the establishment of hierarchy ("peck order"). Aggressive behaviours are favoured in cases of high stocking density or insufficient individual space to express natural behaviours (AWIN, 2015).

In the AWIN protocol (2015) and in Marchewka et al. (2015), the assessment of aggressive behaviours is done by transect into the barn. In scientific literature, with the transect method, the percentage of aggression toward flock mates in assessed flocks goes from 0 to 0.004% in males and, from 0 to 0.001% in females (Ferrante et al., 2019; Hrzenjak et al., 2021), therefore these behaviours are very difficult to see and assess.

In the Ebene protocol (ITAVI, 2018), the assessor should observe 3 different areas of 4m² during 5 minutes (5 minutes per area) and note the occurrence of several type of behaviours, aggression (towards one or several conspecifics, in particular towards the head and neck) included.

Evaluation of the method and comment:

According to EURCAW expert's opinion, the feasibility for this indicator is high with the transect method (AWIN and Marchewka et al., 2015) because the assessment is done during a transect walk as with previous indicators described in this document (no material or animal handling). For both methods, the reliability is estimated to be low according to EURCAW experts' opinion, because the result could be influenced by the training of the observer who needs to be able to distinguish aggressive behaviours from other social interactions and by the time of the day the observation is done as it may impact slightly the occurrence of behaviours observed. In addition, since this behaviour is very brief and rare, and therefore very difficult to observed, it is not very feasible and useful for assessing if turkey behaviour is appropriate.

5.1.2. Expression of positive behaviours

Description of the indicator and method of assessment:

In the Ebene protocol (ITAVI, 2018), the assessor observed 3 different areas of 4m² during 5 minutes (5 minutes per area) and noted the occurrence of several type of behaviours such as dustbathing, foraging, preening, leg or wing stretching and interactions with conspecifics (mutual preening, non-aggressive pecking, play behaviours). These behaviours are here categorised as positive behaviours since they correspond to the satisfaction of behavioural needs.

Evaluation of the method and comment:

According to EURCAW experts' opinion, the feasibility of this method is considered moderate demanding more time than observations during a transect walk, and the reliability is considered moderate because of the possible inter-individual variations. Training is necessary to reduce inter-individual variability. Additionally, expression of these behaviours may vary through the time of the day the observation is done, which may impact slightly the occurrence of behaviours observed, therefore the timing for these observations needs to be standardized.

5.1.3. Featherless

See 3.1.3.

5.1.4. Head wounds

See 4.1.2.

5.1.5. Back wounds

See 4.1.3.

5.1.6. Tail wounds

See 4.1.4.

5.2. Resource-based indicators

5.2.1. Presence of enrichments

Description of the indicator and method of assessment:

Environmental enrichments allow turkeys to express natural behaviours by making their environment more stimulant. Several type of environmental enrichments can be interesting in turkeys' barn: elevated platforms with ramps, perches, bales of substrate (straw for example), pecking objects, panels, barriers, natural light, access to covered verandas, suspended objects (strings, plastic bottles

and jugs…), dustbathing substrates or food distribution in the litter to stimulate foraging behaviours. These various enrichments stimulate behaviours such as pecking, perching, foraging, hiding and dustbathing.

There is no standard method to assess the presence or absence, nor the quality or relevance, of enrichments in turkeys. However, the presence of enrichments and proof of use can be observed during the inspector visit.

5.2.2. Stocking density

See 3.2.1.

5.3. Management-based indicators

There are no management-based indicators.

6. Conclusion

The majority of ABIs described in this document are assessed with the transect method. The transect method, being quite easy to perform, is highly adapted to veterinary inspections in the frame of on-farm welfare assessment. Indeed, although the transect method does not allow to assess with accuracy the prevalence of an indicator in a flock, it is convenient to use to compare the welfare level of different turkey flocks. However, none of these indicators is self-sufficient to evaluate the welfare of a turkey flock and only the use of a combination of indicators (that will reflect the different welfare domains) could give information on the overall welfare level. However, most ABIs assessed with the transect method are scored by presence/absence but no precise scoring scales are available to distinguish the severity of the welfare impact. More research is needed on these scoring scales for these indicators. Finally, it is important to note that other welfare indicators are available on post-mortem assessment at slaughter (e.g. breast blister, FPD…) and can be useful to monitor turkey welfare.

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