

## **DELIVERABLE**

### **D2.1.1 LIST OF THE RELEVANT INDICATORS FOR THE ASSESSMENT OF THE WELFARE OF LAYING HENS IN ALTERNATIVE REARING SYSTEMS.**

## **Contents**

### **1. Introduction**

**1.1. Activity 2. Animal welfare indicators, methods for the assessment and methods of improvement.**

**1.2. Sub-activity 2.1: Relevant animal welfare indicators**

### **2. Methodology**

**3. List of relevant welfare indicators: Laying hens welfare in alternative housing systems**

### **4. Conclusions**

### **5. References**

## **1. Introduction**

### **1.1. Activity 2. Animal welfare indicators, methods for the assessment and methods of improvement**

**Article 21 (8) (e)** of Regulation **(EU) 2017/625** states that “the Commission shall lay down rules on the cases and conditions where official controls to verify compliance with animal welfare requirements may include the use of specific animal welfare indicators based on measurable performance criteria, and the design of such indicators on the basis of scientific and technical evidence”. The European Union Reference Centre for animal welfare for poultry and other small farmed animals should provide scientific and technological expertise for the development and application of the animal welfare indicators referred to in point (e) of **Article 21(8)** and **Article 96 (b)** and developing or coordinating the development of methods for the assessments of the level of welfare of animals and of methods for the improvement of the welfare of animals (**Article 96 (c)**).

### **1.2. Sub-activity 2.1: Relevant animal welfare indicators**

The set of deliverable is part of the sub-activity 2.1 “relevant animal welfare indicators”, which aims to list the poultry welfare indicators regarding the priority area:

**Priority 1.** Broilers welfare on farm.

**Priority 2.** Laying hens welfare in alternative housing systems.

**Priority 3.** State of consciousness after waterbath stunning of broilers and turkeys.

*This deliverable focuses only on: **Priority 2. Laying hens welfare in alternative housing systems.***

The set of deliverable (one per priority area) will be followed up with future output of the same sub-activity, such as the description of the considered validated indicators among the identified ones and associated methodology and the identification of gaps of knowledge regarding missing/not validated indicators and prioritisation of the future topics to work on during the next period. This deliverable is also the base for sub-activity 2.2 to identify the legal requirements which are more difficult to implement and to propose better indicators and methods of animal welfare assessment. Furthermore, it will help in sub-activity 3.1 to identify the gaps of knowledge regarding indicators to check legal requirements and formulate different topics for scientific and technical studies.

This set of deliverable identifies the legal requirements of the legislation and addresses their corresponding specific indicators for each requirement, classified as animal-based, resource-based and management-based indicators. The indicators have been retrieved from literature review and expert knowledge. Furthermore, the legal requirements without specific corresponding indicators have been identified. The search of missing specific indicators in national guidance and the assessment of validity of the key indicators identified here will be reviewed in the next deliverables (deliverables **D.2.1.2** and **D.2.1.3**). Furthermore, a description of improved methods for the assessment of welfare will be provided (deliverable

**D.2.2.2).** This document is only delivering the indicators that can be directly linked with a specific legal requirement. Broader indicators on animal welfare for each priority area will be delivered in the next working period under the denomination “iceberg indicators”.

**Definition and examples of the terminology used:**

**Legal requirement:** a requisite of the EU legislation to be assessed during the 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 the legal requirement, which can be:

- **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:** a form of evaluation of the indicators to be used in the verification of compliance with legislation.

Example: Examine groups of birds at up to 5 well-distributed locations. If birds are panting, count out 100 birds (do not disturb them and leave them sitting where they are) and estimate how many of the 100 birds are panting.

**Area of concern:** the difficulties of an indicator to be used or implemented.

Example: problem with validity, repeatability or feasibility.

**Gap of knowledge:** lack of technical and scientific information about the indicators.

Example: The large differences of THI values obtained from different equations evidence the limitations of using THI as the unique indicator of thermal stress. Moreover, THI does not take into account the ventilation level, the genotype, age or stocking density.



### **3. List of relevant welfare indicators: Laying hens welfare in alternative housing systems**

**3.1. Legal Requirement:** *“The stocking density must not exceed 9 laying hens per m<sup>2</sup> usable area.”* (Directive 1999/74/EC, Article 4)

According to Directive 1999/74/EC, a usable area is an area at least 30 cm wide with a floor slope not exceeding 14 %, with headroom of at least 45 cm. Nesting areas shall not be regarded as usable areas.

**3.1.1. ABI :** None.

**3.1.2. RBI:**

- Birds per m<sup>2</sup> of usable area.

**3.1.3. MBI :**

- Usable area in official documentation.

**3.2. Legal Requirement:** *“All systems must be equipped in such a way that all laying hens have: (a) either linear feeders providing at least 10 cm per bird or circular feeders providing at least 4 cm per bird”* (Directive 1999/74/EC, Article 4)

**3.2.1. ABI:** None.

**3.2.2. RBI:**

- Feeder length per bird.

**3.2.3. MBI:** None.

**3.3. Legal Requirement:** *“(…) (b) either continuous drinking troughs providing 2.5 cm per hen or circular drinking troughs providing 1 cm per hen. In addition, where nipple drinkers or cups are used, there shall be at least one nipple drinker or cup for every 10 hens. Where drinking points are plumbed in, at least two cups or two nipple drinkers shall be within reach of each hen”* (Directive 1999/74/EC, Article 4)

**3.3.1. ABI:** None.

**3.3.2. RBI:**

- Birds per drinker.

- Cm of drinker per bird. In case of continuous drinking troughs, both sides are taken into account in the calculation of the length.

**3.3.3. MBI:** None.

### 3.4. Legal Requirement:

*"[...] gas concentrations must be kept within limits which are not harmful to the animals"*

*"[...] dust levels must be kept within limits which are not harmful to the animals"*

(Directive 98/58 EC, Annex, Point 10)

#### 3.4.1. ABI:

- Irritation of mucus membranes (e.g. Kristensen 1998 in Kristensen *et al.*, 2000).
- Air sac lesions (e.g. Kristensen 1998 in Kristensen *et al.* 2000; Ritz *et al.*, 2004).
- Keratoconjunctivitis (e.g. Kristensen 1998 in Kristensen *et al.* 2000; Ritz *et al.*, 2004; David *et al.*, 2015b).
- Lungs lesions (David *et al.*, 2015a).

**Area of concern:** These ABIs are not feasible on farm inspection (rather with post mortem analysis) or cannot be specifically linked to ammonia level in air

- Food intake and weight loss (e.g. Kristensen 1998 in Kristensen *et al.* 2000; Ritz *et al.* 2004).

**Area of concern:** Food intake and weight loss are not specific to gas concentrations.

- Register consultation to check the frequency of respiratory pathologies.

**Area of concern:** This indicator is linked to the farmer's rigour to fill out the register.

#### 3.4.2. RBI:

- CO<sub>2</sub> and NH<sub>3</sub> concentrations measurements in air.
- Assessment of the dust level.

#### 3.4.3. MBI: None.

**3.5. Legal Requirement:** *"All buildings shall have light levels sufficient to allow all hens to see one another and be seen clearly, to investigate their surroundings visually and to show normal levels of activity. After the first days of conditioning, the lighting regime shall be such as to prevent health and behavioural problems. Accordingly it must follow a 24-hour rhythm and include an adequate uninterrupted period of darkness lasting, by way of indication, about one third of the day, so that the hens may rest and to avoid problems such as immunodepression and ocular anomalies."* (Directive 1999/74/EC, Annex, point 3)

#### 3.5.1. ABI:

- Feather pecking damages (Featherwel, 2013).

**Area of concern:** Feather pecking could be caused by a lot of different other factors like poor environment, rearing conditions of pullets or dietary factors (e.g. Rodenburg *et al.* 2013) but also to genotype.

- Animal's activity and aggressive behaviour (e.g. Mohammed *et al.* 2010).

**Area of concern:** Animal's activity could also be influenced by other factors such as the environmental disturbance (for example, by the inspector's presence).

- Keel bone damage (KBD) (Harlander-Matauschek *et al.* 2015).

**Area of concern:** KBD is related to multiple factors such as bone fragility due to osteoporosis in laying hens or genetics factors (Harlander-Matauschek *et al.* 2015).

### 3.5.2. RBI:

- Light intensity measurements at animals' level.

### 3.5.3. MBI:

- Lighting program records checking.

**3.6. Legal Requirement:** *"A period of twilight of sufficient duration ought to be provided when the light is dimmed so that the hens may settle down without disturbance or injury."* (Directive 1999/74/EC, Annex, Paragraph 3)

### 3.6.1. ABI:

- Proportion of hens on perches at dark period.

### 3.6.2. RBI: None.

### 3.6.3. MBI:

- Lighting program records checking to see the twilight presence and duration.

**3.7. Legal Requirement:** *"Where there is natural light, light apertures must be arranged in such a way that light is distributed evenly within the accommodation."* (Directive 1999/74/EC, Annex, Paragraph 3)

### 3.7.1. ABI: None.

### 3.7.2. RBI:

- Light evenness.

### 3.7.3. MBI: None.

### 3.8. Legal Requirement:

*"[...] temperature, relative air humidity [...] must be kept within limits which are not harmful to the animals"*

*"Ventilation shall be sufficient to avoid overheating and, where necessary, in combination with heating systems to remove excessive moisture"*

(Directive 98/58 EC, Annex, Point 10)

### 3.8.1. ABI:

- Panting (high effective temperature).

Definition: “Breathing rapidly and in short gasps” (Welfare Quality®, 2009).

- Huddling (low effective temperature).

Definition: “Birds grouping together into tight groups, sitting closely alongside each other, often in ‘clumps’ with areas of empty space in between.” (Welfare Quality®, 2009).

- Shivering (low effective temperature, extreme case).

Definition: “Shaking slightly and uncontrollably” (Strawford *et al.* 2011).

### 3.8.2. RBI:

- Environmental temperature measurements in the barn or recordings in the control panel.

- Humidity measurements in the barn or recordings in the control panel.

- Temperature Humidity Index (THI). THI is calculated with the environmental temperature and the relative humidity and can be used to detect heat stress conditions.

**Gap of knowledge:** there are different formulas to calculate the THI depending on the characteristic of the climatic conditions that animals will be submitted to. The large differences of THI values evidence the limitations of using THI as the unique indicator of heat stress. Moreover, THI does not take into account the ventilation level, the genotype, age or stocking density.

-Ventilation : It can be measured by the combined assessment of gas levels, relative humidity and temperature. There is a close link between ventilation and quality of the rearing environment, so the indicators used could be the same.

### 3.8.3. MBI: None.

**3.9 Legal Requirement:** “At least one nest for every seven hens. If group nests are used, there must be at least 1 m<sup>2</sup> of nest space for a maximum of 120 hens” (Directive 1999/74/EC, Article 4)

According to the Directive 1999/74-EC, a nest is a separate space for egg laying, the floor components of which may not include wire mesh that can come into contact with the birds, for an individual hen or for a group of hens (group nest).

### 3.9.1. ABI: None.

### 3.9.2. RBI:

- Birds per m<sup>2</sup> of nest space.

### 3.9.3. MBI: None.

**3.10. Legal Requirement:** “Adequate perches, without sharp edges and providing at least 15 cm per hen. Perches must not be mounted above the litter and the horizontal distance between perches must be at least 30 cm and the horizontal distance between the perch and the wall must be at least 20 cm” (Directive 1999/74/EC, Article 4)

### 3.10.1. ABI:

- Keel bone damage (KBD).

**Gap of knowledge** : Harlander-Matauschek and colleagues indicate in their study (2015) that perch adequacy could impact the amount of KBD but it is unclear and the cause of KBD is probably multifactorial.

- Foot pad lesions (Welfare Quality®, 2009).

**Area of concern:** KBD and foot pad lesions may as well be linked to other parameters (KBD: for example, bone fragility in laying hens or genetics factors; footpad lesions: hygiene, genotype,...). Thus the specificity as indicators of perch adequacy is low.

- Number of hens perched (day/night).

**Area of concern:** period of the day (light/no light) can affect this indicator.

### 3.10.2. RBI:

- Perches adequacy: height, width, materials, shape, absence of sharp edges.
- Cm of perch per bird.
- Distance between perches and distance between perches and walls.

### 3.10.3. MBI: None.

**3.11. Legal Requirement:** *“At least 250 cm<sup>2</sup> of littered area per hen, the litter occupying at least one third of the ground surface”* (Directive 1999/74/EC, Article 4).

#### 3.11.1. ABI: None.

#### 3.11.2. RBI:

- Surface of littered area per hen (in cm<sup>2</sup>).

#### 3.11.3. MBI: None.

**3.12. Legal Requirement:** *“The floors of installations must be constructed so as to support adequately each of the forward-facing claws of each foot.”* (Directive 1999/74/EC, Article 4)

#### 3.12.1. ABI:

- Foot lesions.
- Numbers of claws supported by the floor.

**Gap of knowledge:** There is no literature on this indicator.

**3.12.2. RBI:**

- Size of open space between slats.

**Gap of knowledge:** There is no literature on this indicator.

**3.12.3. MBI :** None.

**3.13. Legal Requirement:** *“In addition to the provisions laid down in points 1 and 2, (a) if systems of rearing are used where the laying hens can move freely between different levels, (i) there shall be no more than four levels; (ii) the headroom between the levels must be at least 45 cm; (iii) the drinking and feeding facilities must be distributed in such a way as to provide equal access for all hens; (iv) the levels must be so arranged as to prevent droppings falling on the levels below.”* (Directive 1999/74/EC, Article 4)

**3.13.1. ABI:** None.

**3.13.2. RBI:**

- Description and measurements of the levels and furniture: number of levels, height between levels, locations of furniture...
- For (iv): Presence of manure belt under each level or continuous floor.

**3.13.3. MBI:** None.

**3.14. Legal Requirement:** *“Hens must have continuous daytime access to open-air runs. However, this requirement does not prevent a producer from restricting access for a limited period of time in the morning hours in accordance with usual good farming practice, including good animal husbandry practice”* (Commission Delegated Regulation 2017/2168 modifying RE 589/2008, Annex)

**3.14.1. ABI:**

- Presence of hens on the open-air runs during inspection.

**Area of concern:** age of the birds and weather can affect this indicator.

- Indicators about the use of free range: dust-baths clues, hen droppings, destruction of plant cover...

**3.14.2. RBI:** None.

**3.14.3. MBI:**

- Popholes opening time records (and justification for not opening when it happens).

**3.15. Legal Requirement:** *“(b) If laying hens have access to open runs: (i) there must be several popholes giving direct access to the outer area, at least 35 cm high and 40 cm wide and extending along the entire length of the building; in any case, a total opening of 2 m must be available per group of 1 000 hens;”* (Directive 1999/74/EC, Article 4)

**3.15.1. ABI:** None.

**3.15.2. RBI:**

- Number and measurements of popholes.
- Accessibility of popholes: presence/absence of obstructed objects in front of popholes (including wires).

**3.15.3. MBI:** None.

**3.16. Legal Requirement:** *“The maximum stocking density of open-air runs must not be greater than 2 500 hens per hectare of ground available to the hens or one hen per 4 m<sup>2</sup> at all times. However, where at least 10 m<sup>2</sup> per hen is available and where rotation is practised and hens are given even access to the whole area over the flock's life, each paddock used must at any time assure at least 2,5 m<sup>2</sup> per hen”* (Commission Delegated Regulation 2017/2168 modifying RE 589/2008, Annex)

**3.16.1. ABI:** None.

**3.16.2. RBI:**

- Birds per hectare of ground.

**3.16.3. MBI:** None.

**3.17. Legal Requirement:** *“Open-air runs must not extend beyond a radius of 150 m from the nearest pophole of the building. However, an extension of up to 350 m from the nearest pophole of the building is permissible provided that a sufficient number of shelters as referred to in Article 4(1)(3)(b)(ii) of Directive 1999/74/EC are evenly distributed throughout the whole open-air run with at least four shelters per hectare”* (Commission Delegated Regulation 2017/2168 modifying RE 589/2008)

**3.17.1. ABI:** None.

**3.17.2. RBI:**

- Distance between nearest pophole and the end of open run.
- Presence of shelters (natural and artificial) and quantity.

**3.17.3. MBI:** None.

**3.18. Legal Requirement:**

*“(b) If laying hens have access to open runs: (ii) open runs must be: — of an area appropriate to the stocking density and to the nature of the ground, in order to prevent any contamination; — equipped with shelter from inclement weather and predators and, if necessary, appropriate drinking troughs.”* (Directive 1999/74/EC, Article 4)

“Open-air runs to which hens have access must be mainly covered with vegetation and not be used for other purposes except for orchards, woodland and livestock grazing if the latter is authorised by the competent authorities” (Commission Delegated Regulation 2017/2168 modifying RE 589/2008, Annex)

**3.18.1. ABI:** None.

**3.18.2 RBI:**

- Estimated percentage of the range covered (trees, bushes, artificial shelters).

**3.18.3 MBI:** None.

## **4. Conclusions**

### **Conclusions specific to Priority 2 - Laying hens welfare in alternative housing systems:**

- 1) A total of 18 legal requirements have been identified for official control in Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes and Council Directive 1999/74/EC of 19 July 1999 laying down minimum standards for the protection of laying hens.
- 2) Of the 18 legal requirements, only 7 can be assessed using ABIs.
- 3) Those ABIs are also influenced by other factors such as age and genotype. Therefore, the interaction with these factors should be considered during the assessment of these indicators.

## **5. References**

- David B, Moe RO, Michel V, Lund V and Mejdell C. 2015a. Air quality in alternative housing systems may have an impact on laying hen welfare. Part I—Dust. *Animals*, 5(3), 495-511.
- David B, Mejdell C, Michel V, Lund V and Moe RO. 2015b. Air quality in alternative housing systems may have an impact on laying hen welfare. Part II—Ammonia. *Animals*, 5(3), 886-896.
- Featherwel. 2013. Improving feather cover – A guide to reducing the risk of injurious pecking occurring in non-cage laying hens. *University of Bristol*.
- Harlander-Matauschek A, Rodenburg TB, Sandilands V, Tobalske BW and Toscano MJ. 2015. Causes of keel bone damage and their solutions in laying hens. *Worlds Poult Sci J*, 71(3):461-472.
- Kristensen HH, Burgess LR, Demmers TG and Wathes CM. 2000. The preferences of laying hens for different concentrations of atmospheric ammonia. *Appl Anim Behav Sci*, 68(4):307-318.
- Mohammed HH, Grashorn MA and Bessei W. 2010. The effects of lighting conditions on the behaviour of laying hens. *Arch Geflugelkunde*, 74(3):197-202.
- Ritz CW, Fairchild BD and Lacy MP. 2004. Implications of ammonia production and emissions from commercial poultry facilities: A review. *J Appl Poult Res*, 13(4):684-692.
- Rodenburg TB, Van Krimpen MM, De Jong IC, De Haas EN, Kops MS, Riedstra BJ, Nordquist RE, Wagenaar JP, Bestman L and Nicol CJ. 2013. The prevention and control of feather pecking in laying hens: identifying the underlying principles. *Worlds Poult Sci J*, 69(2):361-374.

Strawford M, Watts JM, Crowe T, Classen H and Shand PJ. 2011. The effect of simulated cold weather transport on core body temperature and behavior of broilers. *Poult Sci*, 90:2415–2124.

Welfare Quality®. 2009. Welfare Quality® assessment protocol for poultry (broilers, laying hens, Welfare Quality® Consortium, Lelystad, The Netherlands.