

List of welfare indicators and methods of assessment for rabbits on-farm

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1. Introduction

This deliverable combines a list of welfare indicators and methods of assessment relative to on-farm rabbits' welfare. As no specific European legislation is yet available, the legal requirements of the directive 98/58/EC that apply to rabbits 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 ones according to their knowledge and the available scientific data. Among the different welfare indicators, the animal-based Indicators (ABI) are prioritized but Resource-Based (RBI) and Management-Based indicators (MBI) are also provided. These indicators and methods of assessment are evaluated according to their validity, feasibility and reliability (see definitions below) in order to deliver to Competent Authorities useful information for official controls. Indicators and methods of assessment described in this deliverable will be thereafter (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 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 (= method): a form of evaluation of the indicators that might be used in the frame of the verification of the legal requirements.

Validity: The extent to which an indicator is meaningful in terms of providing information on animal welfare.

Reliability: The extent to which results are largely the same when the same observer repeats assessments after receiving reasonable training or the agreement between two or more observers after they have received reasonable 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).

Gap of knowledge: lack of technical and scientific information about the validity, reliability or feasibility of the indicators or its method.

1.2. Methodology used

In this document, for each legal requirement, the corresponding ABI, RBI or MBI are identified, and their method of assessment described and evaluated according to the validity, reliability and feasibility. This information is summarized in tables where their validity, reliability and feasibility are scored according to information found in the scientific literature and the expert knowledge. We choose a rating method with three levels, as follow in table 1 below.

Table 1: Methodology of indicators' validity, feasibility, and reliability notation

	X (low)	XX (moderate)	XXX (high)
Validity	<ul style="list-style-type: none"> Literature shows low correlation between animal welfare and the indicator/method <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of poor level of validity 	<ul style="list-style-type: none"> Literature shows moderate correlation between animal welfare and the indicator/method <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of moderate level of validity 	<ul style="list-style-type: none"> Literature shows high correlation (with causality link) between animal welfare and the indicator/method. <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of high level of validity
Reliability	<ul style="list-style-type: none"> Literature shows low reliability <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of poor level of reliability 	<ul style="list-style-type: none"> Literature shows moderate reliability <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of moderate level of reliability 	<ul style="list-style-type: none"> Literature shows high reliability <p>And/or</p> <ul style="list-style-type: none"> Expert opinion with experience of high level of reliability
Feasibility	<ul style="list-style-type: none"> Material needed: High cost/low availability material (e.g. gas meter, dust meter) <p>And/or</p> <ul style="list-style-type: none"> <i>Time to be performed:</i> more than 60 min <p>And/or</p> <ul style="list-style-type: none"> <i>Ease to access:</i> difficult access or not possible in more than one type of structure <p>And/or</p> <ul style="list-style-type: none"> <i>Animal manipulation:</i> biological sampling (e.g., blood, swab) 	<ul style="list-style-type: none"> Material needed: moderate cost of the material (e.g., thermometer, hygrometer) <p>And/or</p> <ul style="list-style-type: none"> <i>Time to be performed:</i> 30-60 min <p>And/or</p> <ul style="list-style-type: none"> <i>Ease of access:</i> not easy to access (e.g., to upper tiers) or not easy to apply in all farm/slaughterhouses <p>And/or</p> <ul style="list-style-type: none"> <i>Animal manipulation:</i> some animal manipulation with no biological sampling (e.g., check foot pad) 	<ul style="list-style-type: none"> Material needed: no or low-cost material (e.g., tape measurer) <p>And/or</p> <ul style="list-style-type: none"> <i>Time to be performed:</i> less than 30 min <p>And/or</p> <ul style="list-style-type: none"> <i>Ease of access:</i> easy to access and feasible in all kinds of structure <p>And/or</p> <ul style="list-style-type: none"> <i>Animal manipulation:</i> no animal manipulation

1.3. General assessment protocols

Some assessment protocols are quoted often in this document. They are shortly described below.

1.3.1. Welfare assessment protocol for commercially housed rabbits (Wageningen)

This protocol developed by de Jong et al. (2011) is based on the Welfare Quality® framework (Blokhuus et al., 2010). The authors took the first step towards the development of a protocol for assessing welfare on farms, which, however, was not tested or validated under commercial conditions. This

protocol includes appropriate measures for both does and growing rabbits, based on scientific literature and expert opinion. Where possible, animal-based indicators (ABIs) are used but where these are not available then resource-based indicators are proposed. It is suggested that measurements on growing rabbits should be made shortly before the time of slaughter, and for reproducing does at the time of artificial insemination (AI) and at the end of the lactation period.

1.3.2. Welfare Quality protocols for rabbits (IRTA)

Two rabbits' welfare protocols have been proposed by IRTA. One is for does, bucks and kits (Dalmau et al., 2020) and the other one is for growing rabbits (Botelho et al., 2020). Both protocols include details of sampling methods, scoring systems for each indicator and threshold criteria for welfare assessment. All measures of the animal welfare protocol for does, bucks and kits described in this document are assessed in 24 cages for bucks and 51 for does (when possible, 17 in the first week post-partum, 17 around insemination, and 17 post-weaning). If the farm does not contain bucks, it is assessed in 75 cages for does (when possible, 25 of each type). These sampling numbers are usually used, although exceptions exist for some specific indicators. When exceptions are present in an indicator, they will be addressed in the text.

1.3.3. EBENE method (ITAVI, 2018)

French professionals worked on a welfare assessment method named [EBENE \(ITAVI, 2017\)](#). The EBENE project to develop a welfare assessment protocol for the French rabbit industry has proposed measures for does and for growing rabbits, based on the principles and criteria grid established in the Welfare Quality® project. In breeding does, all the measures will be assessed in a total of 45 rabbit does, well distributed and in the entire house. Figure 1 shows how to sample a breeding does house.

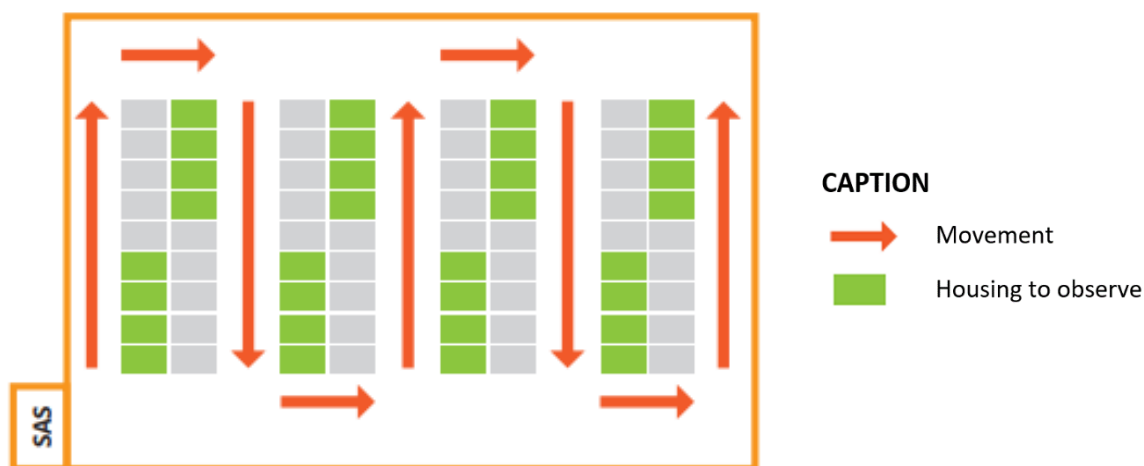


Figure 1: Sampling in a breeding does house (ITAVI, 2018)

In growing rabbits, all the measures will be assessed in approximately a half of the dwellings, taking care not to assess 2 adjacent rows. All rabbits in the same house will be assessed. Figure 2 shows how to sample a growing rabbits house.



Figure 2: Sampling in a growing rabbits house (ITAVI, 2018)

1.3.4. Welfare assessment protocol for rabbits (Italian Ministry of Health)

The Ministry of Health, through the creation of a working group for the welfare of rabbits raised for meat production, published in [2021](#) and officially approved ([CIRCOLARE N. 1/2021 DGSAF](#)) an updated version of the Ministry Guidelines for rabbit farming firstly released on [2014](#) ("Linee di indirizzo per l'allevamento del coniglio" - Italian Ministry of Health, Prot. N°0016200-31/07/2014-DGSAF-COD_UO-P).

The Guidelines contain several recommendations with a strong ethical core and were issued with the aim of filling a legal gap considering that there are no specific rules on the welfare protection of farmed rabbits, apart from the general requirements of Directive 98/58, and to indicate recommended practical procedures.

On 2019-2021, the Guidelines have been updated considering the recommendations of the European Parliament resolution entitled "Minimum protection requirements for the farming of rabbits (2016/2077(INI))" passed in March 2017 together with the important findings related to the welfare of rabbits in different farming systems contained in EFSA's 2020 Scientific Opinion.

Thus, the objective of the revision of the updated Guidelines was mainly to encourage and accelerate the structural change of commercial farms and to direct farmers to production systems that provide better welfare conditions. Moreover, this new draft of the Italian Guidelines is considered of great importance for the drafting of the document to be proposed at the European level, if ever the Commission, following the Parliament resolution, decides to have a specific legislative act for rabbits.

The new Guidelines therefore include a general part with general requirements for all husbandry systems and 3 Annexes: I) technical and structural management of farms, biosafety measures, and health programme, II) additional provisions applicable to furnished cages ("WRSA" cages), III) provisions applicable to park housing systems.

In the Annexes there are also provided measurable indices regarding the size of housing facilities, although EFSA (2020) states that there is still a lack of knowledge about the space requirements necessary to meet the behavioural and physiological needs of all categories of rabbits in an acceptable

manner, and therefore it is not possible to recommend minimum space requirements that ensure acceptable welfare. This was done, not only to speed up the process of adopting specific legal requirements for rabbits, but also to facilitate inspections by the official veterinarians during the official welfare assessments required by the Italian National Animal Welfare Plan.

In fact, directly connected to the preparation of the Guidelines, the second mandate of the group of experts working for the Ministry of Health was to develop a Checklist system for permitting the execution of official controls as well as to perform self-assessment of the welfare level of rabbit farms by vets and breeders. Therefore, the whole Guidelines document was used as the basis for the creation of a real/practical protocol in the form of a checklist for the welfare assessment of meat rabbits, which could be applied by both official and private veterinarians. This protocol is based on [Classyfarm](#), an integrated model already used for cattle, goats, sheep, pigs, and poultry in Italy that identifies measurable indicators for biosecurity, proper use of drugs, and animal welfare. To note that, in analogy with the checklists already available for the other species, a section on Animal Based Indicators (e.g., presence of lesions, mycosis, mastitis, pododermatitis, mortality rate, etc.) has also been included to this checklist for rabbits.

To date, a first final draft of the checklist for official controls has been created, and it is currently under evaluation and revision by the Italian Ministry of Health and other competent authorities for final approval. It is foreseen that it will become in force, and it will be used by beginning 2023.

Therefore, in this document there are indicators that have been provided by IZSLER to EURCAW-Poultry SFA just prior to the final approval and publication of the final official version of the Italian welfare assessment protocol for meat rabbits (Classyfarm).

1.3.5. Other studies

The Italian Ministry of Health funded a pilot study for the on-farm assessment of health and welfare in rabbits kept in different housing systems. The aim of the study was to assess and compare, in farms with different housing systems (conventional and enriched cages, and park systems), the health and welfare conditions of rabbits. To do that they used animal-based indicators and resource and management-based measurements for both reproducing does with their litters at the end of lactation (27-31 days after kindling) and growing rabbits before slaughtering (2-5 days before slaughtering).

At every pre-weaning visit, for a random sample of 75 does (12-15 at their first kindling), the does' health status was individually evaluated, as well as their litters'. The following individual measures related to health were taken: nasal and/or ocular secretion (yes/no), diarrhoea (yes/no), presence of dermatophytosis, mastitis, and ulcerative pododermatitis (yes/no) and their severity (1: minor and limited lesions; 2: extended lesions; 3: deeper, extended and open lesions). In the litters, health measurements made were the followings: total weight, number of rabbits and health status i.e., respiratory and/or digestive pathologies (yes/no), dermatophytosis (yes/no) and kit mortality rate as the average data of the entire productive cycle, directly provided by the farmer.

During the pre-slaughtering assessment, signs of diarrhoea (yes/no), and lesions related to aggression (yes/no and severity) were individually assessed on a random sample of 100 growing rabbits per visit (2 rabbits each × 50 bicellular cages, dual-purpose cage, and enriched cages; 20 rabbits × 5 parks). Mortality was also assessed in growing rabbits as the average data of the entire productive cycle, directly provided by the farmer.

A total of 12 commercial farms (three farms/four housing systems) were visited. First results related to one production cycle/season for the reproducing sector were presented by Zomeño et al. (2019). Then, the protocol was implemented during three productive cycles/seasons (summer, autumn, and winter) throughout one year and the first results of reproducing sector were presented by Pasqualin

et al. (2021). Recently, more results from this project related to the assessment of health and welfare in both reproducing does with their litters and growing rabbits kept in different housing systems were published by Trocino et al. (2022).

In addition to this very recent study, other Authors (Rosell and de la Fuente, 2008; Cerioli et al., 2011; Keating et al, 2012; De Lima et al., 2013; Rosell and De la Fuente, 2013; Olivas et al., 2013; Rosell and De la Fuente, 2018) have previously assessed rabbit welfare as well and have developed different scoring systems to assess their health. Throughout this document, these methods are explained in the different sections.

2. Good feeding

Requirements applicable to rabbits 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. Body condition score (BCS)

Description of the indicator and method of assessment:

The body condition can show rabbits inadequately fed (unbalanced diet, insufficient quantity of feed) or impaired by diseases (EFSA, 2005). In addition, a poor body condition in does can lead to several welfare issues, including for kits (EURCAW Poultry-SFA, 2021).

The body condition score can be assessed, in adult rabbits, visually or by palpation. For example, Bonanno et al. (2008) assess does by palpation of loin and rump regions, for bone protrusions and fullness of muscle. The body condition was then determined as follow:

- Score “0”: If loin is poor
- Score “1”: If loin is intermediate and rump poor
- Score “2”: If loin is intermediate or wide and rump wide

Another notation scale developed by Rosell and de la Fuente (2008) using palpation and estimating the fullness of muscle and fat of the lumbar, sacral, coxal tuberosity and gluteal regions. This larger scale has scores from 1 (emaciated doe) to 9 (doe in obesity), knowing that 5 is the optimum score and 4 and 6 are acceptable according to the authors (Figure 3).

The body condition score could also be assessed visually as in the protocol of Dalmau et al. (2020) on 24 bucks and 34 does (17 around mounting or insemination, and 17 just before weaning if possible) or 50 does (if no bucks reared in the farm inspected) (half around insemination and a half just before

weaning, when possible). Every animal presenting a poor body condition is noted (thinness). A rabbit in poor condition has hips and backbone very prominent. In this protocol, if no lean rabbits are noted, the score is excellent, and it is acceptable if 3% maximum of the rabbits assessed is lean.

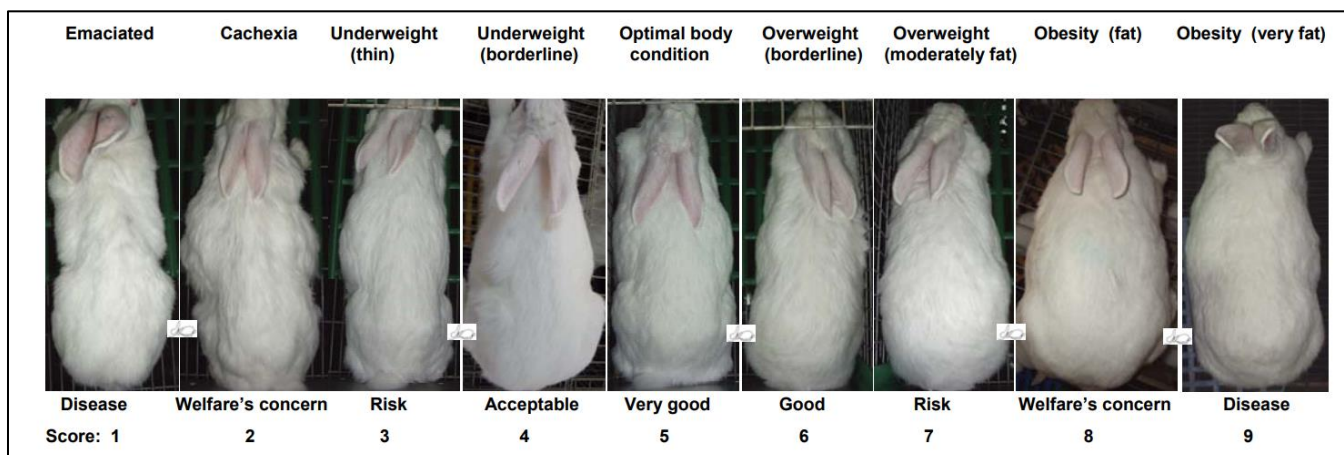


Figure 3: Notation scale of body condition score in does (Rosell and De la Fuente, 2008)

Another similar scoring system is used by the Classyfarm protocol, which is based on the methods (adapted) of Dalmau et al. (2020) and Bonanno et al. (2005). Body Condition Score (BCS) is visually evaluated on at least 50 does, at the time of litter weaning (approximately 30-35 days postpartum) by assigning a score from 0 to 2 based on the degree of muscle fullness of the rump and loin area and the possible presence of bony prominences:

- Score 0 (cachectic/very thin animal): in case of poor muscle coverage and excessive bony prominences
- Score 1 (thin animal): in case of acceptable, but not optimal, muscle coverage and only hinted bone prominences
- Score 2 (normal animal): in case of good muscle coverage and no visible bone prominences.

To calculate the overall score, an animal with BCS=0 should be considered as three animals with BCS=1. In this way, only the percentage of animals with BCS=1, in which animals with BCS=0 were previously included, multiplied by three ($BCS_0 \times 3 + BCS_1$), is considered for the value assignment ("Acceptable," "Optimal"). Between 10 and 30% of animals with BCS= 1 is considered "Acceptable" and "Excellent" if in < 10% of animals.

Evaluation of the method and comment:

These two methods are considered equally reliable. However, validity is higher in the palpation method whereas the feasibility is considered higher with visual assessment.

Body condition Score	Validity	Feasibility	Reliability
With palpation	XXX	XX	XX
Visual assessment	XX	XXX	XX

2.1.2. Small animals

Description of the indicator and method of assessment:

Evaluation of the method and comment:

The diagram shows a sequence of three operations on a 10x3 grid of cells. The first grid has 7 green cells in the first column and 3 gray cells in the second and third columns. The second grid has 10 green cells in the first column and 3 gray cells in the second and third columns. The third grid has 7 green cells in the first column and 3 gray cells in the second and third columns. Orange arrows indicate the flow: a horizontal arrow from the first to the second grid, a vertical arrow from the first to the second grid, and a horizontal arrow from the second to the third grid. A vertical arrow points down from the second grid to the third grid, and a horizontal arrow points from the second grid to the third grid.

Evaluation of the method and comment:

<i>Small rabbits</i>	Validity	Feasibility	Reliability
	XXX	XXX	XXX

2.2.1. State of feeders and drinkers

In the protocol of Dalmau et al. (2020), these 3 indicators are assessed as follow:

- Cleanliness of feeders: Assessed in 24 cages for bucks and 51 for does (when possible, 17 in the first week post-partum, 17 around insemination, and 17 post-weaning). 75 cages for does are assessed in case of absence of bucks in the farm. A dirty feeder is a feeder containing corrupted food, compacted dry food and mold. The score is “excellent” when 100% of feeders are clean, and “acceptable” when it is at least 97% of feeders which are clean.

- **Cleanliness of drinkers:** Assessed in the same cages than for cleanliness of feeders. In the same way as feeders, the score is “excellent” when 100% of drinkers are clean, and “acceptable” when it is at least 97% of drinkers which are clean.
- **Functioning of drinkers:** Assessed in the same cages than for cleanliness of feeders and drinkers. A bad functioning of the drinkers is considered when there is an insufficient flow or if they are dripping. The score is “excellent” when 100% of drinkers have a good water flow, and “acceptable” when at least 97% of drinkers have a good water flow.

Evaluation of the method and comment:

This method is considered valid, feasible and reliable.

<i>State of feeders and drinkers</i>	Validity	Feasibility	Reliability
<i>Cleanliness of feeders</i>	XXX	XXX	XXX
<i>Cleanliness of drinkers</i>	XXX	XXX	XXX
<i>Functioning of drinkers</i>	XXX	XXX	XXX

2.2.2. Number of drinking points per rabbit

Description of the indicator and method of assessment:

In Dalmau et al. (2020), the number of drinkers per rabbits is assessed in 24 cages for bucks and 51 for does (when possible, 17 in the first week post-partum, 17 around insemination, and 17 post-weaning). 75 cages for does are assessed in case of absence of bucks in the farm.

This indicator is scored as “excellent” when there is more than one drinking point per doe or buck, and “acceptable” when there is a ratio of one drinking point per doe of fresh water tested and working.

According to the Classyfarm protocol (water quality, cleanliness and number of feeders and drinking points are evaluated with a single parameter), the presence of one drinking point per cage is considered "Acceptable" and in the case of park housing systems there must be at least two watering points (1 for every 20 rabbits). The "Excellent" value is given to the presence of a higher number of drinking points/cage or park.

Evaluation of the method and comment:

This method is considered valid, feasible and reliable.

<i>Number of drinkers</i>	Validity	Feasibility	Reliability
	XXX	XXX	XXX

2.2.3. Check of the setting of the automated feed and water distribution system (control unit) and emergency supply.

To the authors’ knowledge, there is no standard method for the assessment of this indicator.

2.2.4. Access to food and drinkers in kits

Description of the indicator and method of assessment:

In the protocol of Dalmau et al. (2020), this indicator is checked with the assessment of “access to food” and “height of drinkers” for kits older than 21 days.

- Access to food is assessed by asking the farmer but it also possible to check during the inspection if kits of at least 21 days of age are present. The score is “acceptable” if they have free and easy access to solid food provided to their does, and “not acceptable” if not.
- Height of drinkers is measured in cages of kits older than 21 days of age. This indicator is scored as follow:
 - o Excellent: drinker for kits at 13 cm from the floor or less
 - o Acceptable: drinker for kits between 13 and 23 cm from floor
 - o Not acceptable: any other situation

Evaluation of the method and comment:

Both of these methods are considered valid, feasible and reliable.

<i>Access to food and drinkers in kits</i>	Validity	Feasibility	Reliability
Access to food	XXX	XXX	XXX
Height of drinkers	XXX	XXX	XXX

2.3. Management-based indicators

2.3.1. Diet composition and feeding programme

Description of the indicator and method of assessment:

To be able to meet the nutritional needs of rabbits and to ensure that their feed is appropriate to their body development, physiological state, and production level, it is necessary that, at least each of the basic categories that are in the farm (e.g., fattening, breeding etc.) have a specific feeding program. Such specific program should be written or recorded, or, when not written down, it should be known by the farmer or the staff in charge. As a good practice, it should be kept as stable as possible over time, except in cases of emergency.

In particular, the quantity and quality of fibre contained in the feed should be adequate for maintaining the digestive health of rabbits (digestive transit, caecotrophy and caecal fermentation). Feed should be administered ad libitum, except in special cases (e.g., Epizootic Rabbit Enteropathy prevention in growing rabbits) where feeding restriction is recommended or even necessary.

The Classyfarm protocol evaluates diet composition and feeding program by two separate indicators. The first indicator is considered "Acceptable" if: i) the diet suits to the needs of the animals and for each group of the farm, together with the presence of a feed tag and feed properly stored in suitable environments; ii) if suitable gnawing material (e.g., straw, hay, wood etc.) is provided to the rabbits in a manner that takes into account the design, planning and construction of the housing system (cages or parks). In addition to the above scorings, it is considered "Excellent" if it contains pellets with a diameter of about 3-5 mm and a length of 10-15 mm, together with the presence in the ration of a % of fibre between 14 and 19% of dry matter.

The second indicator is considered "Acceptable" when feed distribution is ad libitum or in case a type of feed restriction (qualitative or quantitative) is provided (e.g., post-weaning quantitative feed restriction of growing rabbits), feed must be administered in the 24h at correct intervals (every 5-8 h, but shorter interval should be preferable) according to a written plan. It is considered "Excellent" if the type of feeding schedule is established based on a health risk assessment done by competent personnel (veterinarian) and if there are systems to control and measure the amount of feed given.

Evaluation of the method and comment

The validity and feasibility of this indicators are high, but reliability is somehow moderate, as it depends on the level of training and experience in evaluating feed quality and composition by the inspector and by farmer compliance.

<i>Diet composition and feeding programme</i>	Validity	Feasibility	Reliability
	XXX	XXX	XX

2.3.2. Water quality controls

Description of the indicator and method of assessment:

Particular attention should also be paid to the microbiological and chemical-physical quality of the water.

The Classyfarm protocol checks, by asking the farmer, if water potability/quality tests are performed on the farm, especially if water comes from a farm well. Water quality controls should be performed at least annually to assign the “Excellent” value of the parameter “quality and provision of water, number of feeders and drinkers”.

Evaluation of the method and comment

Validity is high, with moderate feasibility and reliability.

<i>Water quality controls</i>	Validity	Feasibility	Reliability
	XXX	XX	XX

3. Good housing

Requirements applicable to rabbits 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.”

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. Number of fully stretched lying animals in the pen or at the elevated platform or shelter

Description of the indicator and method of assessment

Proposed by de Jong et al. (2011) as a parameter of comfort around resting, since rabbits prefer to lie fully stretched. It is defined as stretching of the hind-legs and of the body, including full lateral lying on the side (EFSA, 2005). Rabbits lie in this position when they are completely relaxed and in a clean environment, particularly during the light period. This position can also allow thermoregulation, as rabbits stretch out to lose heat by radiation and convection. Therefore, the presence of fully stretched lying animals may indicate adequate space allowance and an environment of adequate quality (in terms of floor type, enrichments, dryness, and hygiene). On the contrary, insufficient space allowance, poor quality of facilities and dirty surfaces, absence of a platform or other resting places, impair comfort around resting (EFSA, 2020). Moreover, rabbits prefer to rest in body contact with other rabbits (for about 50% of the resting time) or lie against protecting structures and/or in hidden places (EFSA, 2005; Cornelissen et al., 2011).

This indicator has been visually applied in 30 “conventional cages” rabbit farms by Dalmau et al. (2020) in the “Animal Welfare Assessment Protocol for Does, Bucks, and Kit Rabbits Reared for Production”, when assessing good housing condition. The sampled animals are those assessed also for “dirtiness” and “free movement”: a total of 34 bucks and 91 does, or 125 does if there were no bucks in the farm. The detection in a fully stretched position of at least the 20% of animals is considered as “Excellent” and of the 10% as “Acceptable. As results of their observations, 80% of the farms assessed (n=24) had at least 20% of the animals fully stretched (this percentage ranging from 20 to 65% of the animals), while the global score for Good Housing was excellent in 63% (n = 19) of the farms. In this contest, such findings could indicate that this ABI is a good parameter of comfort around resting for does and bucks housed in conventional cages.

In the EBENE protocol (ITAVI, 2018), the number of resting animals is evaluated (but it is not specified whether only fully stretched animals should be assessed) and applied in all categories (females and fattening rabbits). However, this protocol specifies that, for fattening rabbits, this indicator should be evaluated at the end of the two minutes required to perform the other evaluations, presumably to favour the adaptation of the animals to the inspectors’ presence (see comments below).

Evaluation of the method and comment

To make this indicator feasible, the rabbits should be visually assessed at the time of the visit. However, among the experts consulted in the work of De Jong et al. (2011), there was no unanimous consensus on the real applicability of such indicator. In fact, these Authors sustain that the main constraint is that the inspectors might disturb and frighten the animals, changing from a relaxed to a frightened position (i.e. jump or move). Therefore, they suggest the need for video recording even if this would make this indicator less feasible due to problems of economic resources and time. Nevertheless, as the authors add, the animals could get used to the novelty after a few minutes. That is probably why in the EBENE protocol it is recommended to wait two minutes before the assessment of this indicator in growers. On the other hand, Botelho et al. (2020) did not consider this parameter suitable for growing rabbits housed in conventional cages, exactly because of the interference with fearfulness when the assessor approached the cage.

To note that animals with more space and more environmental stimuli, such as those housed in parks, may rest less (Dal Bosco et al., 2002; Princz et al. 2008), even when environmental enrichments such as gnawing blocks are present (Birolo et al., 2022). This, combined with the risk that animals may move when the assessors approach the cage, would reduce the possibility of seeing more lying animals, even in the presence of good housing conditions.

In conclusion, this indicator would seem to be more appropriate for the assessment of comfort around resting of rabbits and male rabbits housed in conventional cages than in enriched cages. In fact, although theoretically a valid indicator to assess rabbits' comfort around resting, it could be asserted that this indicator somehow lacks reliability and feasibility.

<i>Number of fully stretched lying animals</i>	Validity	Feasibility	Reliability
Visual assessment	XX	X	X

3.1.2. Simultaneous resting in group housing

This ABI was included in the EFSA report (2020) as a measure of comfort around resting, as suggested by de Jong et al. (2011), probably because rabbits prefer to rest near other lying rabbits in the same "resting area". However, these latter authors did not include "simultaneous resting" as a proposed measure to apply on farm. As a matter of fact, the experts' conclusion was *"If resting space is used as a resource-based measurement, the question remains if in group pens it is necessary that all animals can use the resting area at the same time"* and *"It was also discussed if all animals should be able to rest at the same moment, but there is not enough knowledge about this to reach consensus between experts"*.

Moreover, this parameter is not used in any of the existing protocols for now, mainly because it may be implied by the previous one. In addition, it is not yet clear in assessing this ABI it is necessary to consider only fully stretched or also crouched animals (as foreseen in the EBENE protocol).

In conclusion, it can be assumed that there is a gap of knowledge regarding this proposed indicator.

<i>Simultaneous resting in group housings</i>	Validity	Feasibility	Reliability
	<i>Gap of Knowledge</i>		

3.1.3 Free movement

Description of the indicator and method of assessment

Rabbits should have enough space available for hopping, jumping and turning. Free movement is defined as the capacity of the animal for performing these behaviours (Dalmau et al. 2020). In addition, space allowance and enrichments should allow rabbits natural behaviours such as:

- stand up on their hind legs, lie down and turn on themselves freely,
- fully extend their paws,
- lying down in a relaxed position with extended hind legs,
- jumping and hiding,
- perform normal self-cleaning of the body,
- feeding and drinking *"ad libitum"*,
- perform exploratory behaviours and, if appropriate, nest building and mothering (Italian Ministry of Health, 2021).

For these reasons this indicator was proposed, like most of those in this document, by de Jong et al. (2011) as a parameter of the "ease of movement" criterion within the Good Housing principle. Indeed, it is included in the protocol by Dalmau et al. (2020) and it is assessed on a total of 10 bucks and 40 does checked also for panting and shivering (if there are not bucks in the farm, 50 does are assessed). Each animal should be visually assessed for two minutes. If 100% of the animals are moving, an

“Excellent” rating is given, otherwise, if at least 97% of the animals are moving freely, the score for this parameter is “Acceptable”. In that study, farms that had 97% free of movement animals were 80% (n=24), while the rest 20% (n=6) did not reach the “acceptable” scoring.

In the EBENE protocol (ITAVI, 2018), the movement of breeding and fattening rabbits is assessed (in the latter case by observing them for two min) by recording them; in particular, it is noted whether the animals jump to or from a platform or from a certain point to another point.

Conversely, this parameter was discarded after being tested on growing rabbit's farm due to lack of feasibility by Botelho et al. (2020), probably due to the time requested to assess the indicator itself.

Evaluation of the method and comment

Assessing the “ease of movement” of rabbits should require the definition of standards values which have not yet been scientifically validated. According to de Jong et al. (2011), some of these behaviours are not frequently performed, which makes it difficult to be observed. Since rabbits rest most of their budget time, it could be difficult to see all of them moving in the few observation time during the assessment visit.

In addition, a recent work by Pirrone et al. (2021) showed that hopping behaviour changes whether enrichment is present in the cages or not and depending on the amount and type of enrichment, being higher in non-enriched pens compared to pens with platform or platform + pipes. In addition, most hopping events did not overcome two (75.7% of total events) or three consecutive hops (88.4% of total events). However, as the authors concluded, further data are necessary at different time points to get more knowledge about the behaviour of rabbits under commercial conditions with special reference to hopping behaviours and motivations.

Consequently, to date there is no standardized and scientifically validated methods to correlate the degree of activity of rabbits to restriction of movement, also considering the huge differences existing between the different type of cages. In fact, the parameter used in the EFSA report (2020) to assess restriction of movement, that rabbits should be able to perform at least three consecutive hops, has never been validated and to date there is not enough information regarding the hopping behaviour of these animals.

In conclusion, this indicator could be potentially very useful in a welfare assessment protocol, especially when cage sizes or density of animals cannot be evaluated. However, only in case that valid standard for evaluation would be established and, in this sense, the proposal of Dalmau et al. (2020) at the moment seems to be the most practical one.

<i>Free movement</i>	Validity	Feasibility	Reliability
Visual assessment for does, bucks and kits	X	XX	X
Visual assessment for growing rabbits	X	X	X

3.1.4. Panting (Respiration rate)

Description of the indicator and method of assessment

Rabbits are very sensitive to high temperature (EFSA, 2020). Outside their comfort range (21°-25° C), the compensation behaviours to heat loss could be of three types: change of body position, increase of breathing rate and loss of peripheral temperature, especially ear temperature. If the temperature is high (above 25 °C), the animals stretch out so they can lose as much heat as possible by radiation and convection and stretch ear pinnae and spread it far from the body to expose the surface to the

surroundings to increase heat dissipation (Marai and Rashwan, 2004). Moreover, the only controlled mean of heat loss through evaporation of water (latent heat) for rabbits is the increase of the respiratory frequency, since sweat glands are not functional for these animals and the fur does not favour perspiration (evacuation of water through the skin) (Lebas, 1997). Rabbits' breathing rate could increase rapidly (from 69 to 190 breaths/min) when temperature rises from 10° to $\geq 30^{\circ}$ C (Marai et al., 2002).

De Jong et al. (2011) proposed "respiration rate" as a parameter of thermal comfort. In general, it could be easier to assess an increase in respiratory rate, evaluable through the finding of panting animals, if temperature rises above the optimal range.

In the welfare assessment protocol for does, bucks and kits by Dalmau et al. (2020), an animal is considered as panting when it is breathing with short and quick breaths and with the mouth open. The authors used this indicator to eventually correct the score for environmental temperature: if animals are seen panting, points are subtracted from the thermal comfort score, even if the temperature is within the acceptable range (28°C max), since the effective environmental temperature may differ from several degrees from that measured in the overall barn. In this protocol, 10 bucks and 40 does not assessed for other parameters (if there are not bucks in the farm, 50 does are assessed) are assessed for "panting" (together with "shivering" and "free movement"). Each animal is visually assessed during a time of two min and the result of the assessment is scored as: i) "Excellent", when 0% of animals were found panting; ii) "Acceptable", when up to 4% of animals were found panting; iii) "Not acceptable", when more than 4% of animals were found panting. In their work, none of the animals assessed in any of the farms were found panting when the temperature was within the range (28°C maximum).

In the EBENE protocol, does and growing rabbits are assessed for signs of "thermal discomfort", i.e., fully extended, and hyperventilating animals together with red, expanded ears (see below 3.1.5), are the indicators to assess animals with heat stress.

Nevertheless, Botelho et al. (2020), discarded this indicator after being tested on farm due to lack of feasibility, probably because of the time requested to assess the indicator on a significant number of animals.

Evaluation of the method and comment

There are not enough references to state that, evaluated alone, this indicator can be closely linked to thermal comfort. This makes this indicator poor valid and unreliable. Instead, it is likely that the evaluator can have greater certainty that animals are suffering from high temperatures by combining the finding of rabbits showing increased respiratory rate with other parameters indicative of heat stress (i.e., panting animals lying down, with prominent, red well-expanded ears), as indicated in the EBENE protocol. In our opinion, these indicators should be always correlated also with the environmental temperature, humidity and air quality (e.g., CO₂, NH₃, dustiness, etc.) present at the time of the inspection.

<i>Panting animals</i>	Validity	Feasibility	Reliability
Visually assessed "alone" (Dalmau et al., 2020)	X	XX	X
Visually assessed with other indicator of heat stress/Thermal discomfort (EBENE protocol – ITAVI, 2018)	XX	XX	XX

3.1.5. Red ears

Description of the indicator and method of assessment

This indicator was proposed by de Jong et al. (2011) and listed in the EFSA report (2020) as a possible ABI to assess thermal comfort. The ear lobe plays an important role in thermoregulation of rabbits, since its function is like that of a “car radiator” (Lebas, 1997). Indeed, the ear pinnae contain a complex and dense network of blood vessels and arteriovenous anastomoses that cool the blood through vasodilatation (Morris and Bevan, 1984). Therefore, although there are few references showing that the ears of rabbits under heat stress are intensely red, it can be assumed that the ear vessels during heat stress, being extremely engorged with blood, make the ears appear redder. However, no rabbit welfare assessment protocol uses this indicator, except the EBENE protocol, which includes it in the general assessment of “thermal discomfort.”

Evaluation of the method and comment

This indicator may be of minor importance in the assessment of thermal discomfort, but at the moment there are not enough scientific data, nor a standardized method, to make an objective evaluation of this indicator.

<i>Red ears</i>	Validity	Feasibility	Reliability
Visually assessed with other indicator of thermal discomfort (EBENE protocol – ITAVI, 2018)	<i>Gap of knowledge</i>		

3.1.6. Shivering or huddling animals

Description of the indicator and method of assessment

Adult rabbits exposed to environmental temperatures below $\leq 10^{\circ}\text{C}$ curl up to minimize their total body's surface area exposed to the floor, lower their ear temperature, and fold the ear pinnae to avoid the contact of the internal surface with the air (Marai and Rashwan, 2004). However, rabbits from the age of one month are more resistant to low temperatures, as opposed to 0-12 days old kits which have no fur and cannot modify their body shape by curling up. The only way kits can limit heat loss through convection and radiation is to huddle together with the other kits of the litter and cover themselves with nest material (Lebas, 1997; EFSA 2020). In addition, some farming systems led to more risk of cold stress, such as outdoor or organic systems (EFSA, 2020).

The indicator of “shivering” was assessed by Dalmau et al. (2020) by sampling the same adult rabbits as those evaluated for “panting,” observing each animal for two min and applying the same score method. None of the animals evaluated in the 30 farms were shivering while, as previously mentioned, temperature was inside the optimal range.

As mentioned above, in the EBENE protocol does and growers are assessed for thermal discomfort, which also includes observing animals huddled together or shivering.

In both mentioned protocols, kits are not observed for the assessment of this indicator. Probably because of a question of feasibility, since kits tend to stay for the first weeks of life in the nest, very closely together

Evaluation of the method and comment

Excluding the event in which animals could show shivering or huddling behaviours as consequence of a pathological process (e.g., fever, apathy, lethargy...), it can be stated that this indicator has a high

validity for does, bucks and growing rabbits, but it should obviously always be correlated to the environmental temperature. Observation of the animals for two min increases a bit its reliability but the animals (particularly in the case of growing rabbits housed together in pens) may still become frightened and change position when the evaluator approaches. However, it is improbable to find animals shivering or huddling in modern rabbit farming “indoor” systems. This, combined with the fact that the most susceptible to cold stress (kits) group of animals are not easily assessed, makes this indicator poor feasible and unreliable.

<i>Shivering/huddling animals</i>	Validity	Feasibility	Reliability
Visually assessed (Dalmau et al. 2020; EBENE protocol – ITAVI, 2018)	XX	X	X

3.1.7. Dirty and wet animals (cleanliness of the animals)

Description of the indicator and method of assessment

The state of coat cleanliness is an indirect but reliable indicator of both the management procedures of the farm and the hygienic and sanitary status of facilities and equipment. Properly managed housing rooms allow a high degree of cleanliness of the animals. Dirtiness can impair the animal’s need to rest, causing physical discomfort (cold stress, lesions, pain) (EFSA, 2020) and can also contribute to infections that can lead to pathologies such as mastitis and pododermatitis (EFSA, 2005). This ABI, in addition, provides information on the comfort during resting and on issues arising from:

- the design characteristics of the cages (e.g., type of flooring, presence of platform)
- the amount of environmental “dirtiness” related to the number of rabbits present (stocking density)
- the neglect in the routine management and/or the renewal of equipment/cages, and the possible use of inappropriate materials for cages.

Dalmau et al. (2020) and Botelho et al. (2020) assessed wet and dirty animals separately. In their protocols, a wet animal is considered when the fur is wet in any part of the body. For dirtiness, considering two categories, each animal is scored: i) moderately dirty when from 10 to 30% of the body is dirty; ii) severely dirty when more than 30% of the body is dirty. The animals are only observed and not manipulated. Anyway, the resulting scores are different for each protocol. Dalmau et al. (2020), when assessing wet animals, consider “Excellent” if less than 5% of animals are wet and “Acceptable” if less than 10%. Regarding the dirty animals’ assessment, “Excellent” is scored when up to 2% of animals assessed are moderately dirty and there are no severely dirty animals; otherwise, if up to 4% moderately and 2% severely dirty animals are found, the resulting score for dirtiness is “Acceptable”. In their study, no wet or dirty animals were observed in any of the 30 farms assessed. According to the authors, this result was mainly due to the fact that all assessed farms were equipped with wire-mesh flooring cages, which allow easy passage of manure and urine, and could be easily cleaned and disinfected. General cleanliness of the facilities is also well correlated with the absence of disease, especially those with an oro-fecal transmission.

In the protocol for growing rabbits by Botelho et al. (2020) the score for “wet animals” is “Excellent” if less than 1% of animals are wet and “Acceptable” when less than 2%. For dirty animals, is scored “Excellent” up to 0.5% moderately dirty animals and 0% severely dirty animals; “Acceptable” up to 1% moderate and 0.5% severely dirty animals. Only in three farms wet animals were found, representing less than 2% of the animals assessed. Something similar in the case of dirtiness, since they found only moderate cases in up to 1% of the animals affected.

The forthcoming Classyfarm protocol for farming rabbits of Italian Ministry of Health, which also takes into account the previous Dalmau and Botelho's protocols by using the same categories for moderately and severely dirty animals, assess the overall cleanliness of at least 50 breeding and 100 fattening animals (sampling 4 rabbits/litter from 25 cages), preferably at the end of the fattening period.

Animals are then differently classified according to a 3-grade scale (0-2): i) Grade 0: when animals are perfectly clean with an even, smooth, dry coat; ii) Grade 1: when the coat is 10 to 30% dirty; iii) Grade 2: when dirt covers the coat for more than 30%. When calculating the percentage, an animal with a grade 2 dirtiness should be considered as three animals with grade 1 dirtiness. Then, when the conversion is made, to assign the "Acceptable" judgment, a maximum of 20% animals with dirt grade 1 are tolerated. To assign the "Excellent" judgment, the grade 1 dirtiness must be less than 10% in the animal assessed.

The EBENE protocol assesses dirtiness in reproducing does and growing rabbits. However, in this protocol, dirty animals are also an indicator of diarrhea (Good Health). In fact, animals are assessed for coat soiled with faeces and urine and dirty hindquarters, but if a rabbit has hard droppings on its coat, the protocol does not consider it as dirty.

Evaluation of the method and comment

The indicator of 'dirtiness' can be considered extremely valid in indicating the presence of dirty animals and consequently uncomfortable and not well-managed facilities. In addition, it is quite feasible since it does not require the animals to be handled. However, it is also necessary for the assessors to be well trained in order to identify the areas to assess and to understand what is the correct scoring.

The indicator of "wet animal", evaluating animals when only completely wet, is judged to be of moderate validity, feasibility, and reliability. However, the two indicators could be combined, since this is not a frequent occurrence to find wet animals (Botelho et al., 2020). This would decrease the time taken for assessment and increase feasibility, although it could probably reduce reliability.

<i>Wet and dirty animals (Cleanliness of the animals)</i>	Validity	Feasibility	Reliability
Visually assessed	XXX	XX	XX

3.2. Resource-based indicators

3.2.1 Stocking density

Description of the indicator and method of assessment

Stocking density (space allowance) is the resource-based indicator for ease of movement. The method to assess this indicator is to measure or ask the farmer for cage sizes and correlate the obtained sizes (in cm² or m²) respectively, for space allowance, to the space occupied per animal (cm²/animal) and for stocking density to the number of animals (number of animals/m²) or kg of weight (kg/m^{2t}) according to the animal category.

According to EFSA (2005) a stocking density above 16 animals/m² or 19 animals/m² (based on a final slaughter weight of 2.5 or 2.1 kg respectively) for growing rabbits results in an increased risk of poor welfare. Consequently, an optimal density of 32 kg/m² is recommended, and never more than 40 kg/m² (16 rabbits/m² at 2.5 kg slaughter weight), calculated at the end of the fattening period. Concerning breeding females, the minimum space allowance should be 3500 cm² based on the few studies available but, it is obvious that, during the fifth week of nursing, depending on the weaning age and the litter size, some behaviour could be limited with such space allowance.

Regarding the methods of assessment, Botelho et al. (2020), looking in 32 farms at the stocking density of growing rabbits housed in conventional cages, considered: i) “Excellent” the finding of an average space allowance of 1500 cm² per animal in 90% of the cages; ii) “Acceptable” 500 cm² per animal in 90% of cages. The 500 cm² per animal considered as acceptable in such present protocol is exactly 40 kg/m² for an animal of 2 kg body weight. However, as stated by the authors, in terms of cm²/rabbit, space allowance could change according to the final weight of the rabbit at slaughter age (e.g., if the final slaughter weight is 1.8 kg or 2.2 kg, the space allowance would be respectively 450 cm² or 550 cm² per rabbit); therefore, they suggest to considering for the protocol a change of the parameter to stocking density (kg/m²).

The EBENE protocol (ITAVI, 2018) measures stocking density of growing rabbits in kg/m² and in animal/m² for does.

The Classyfarm protocol for farming rabbits of the Italian Ministry of Health for the veterinary officers apply: i) “Excellent” when growing rabbits are housed with a stocking density equal or lower than 32 kg/m²; ii) “Insufficient” when stocking density is greater than 40 kg/m². Again, in this protocol is underlined the importance to calculate the stocking density value considering the final slaughter weight of the rabbits. This value well correlates with space allowance since young fattening rabbits are allowed to be more active, and to move more freely in the post-weaning period. This protocol does not provide references of stocking density for does but refers to the Annex B of the Italian Ministry guidelines (2021), where recommended minimum space requirements for all categories are given.

Regarding the protocol by Dalmau et al. (2020) for breeding does, bucks and kits, the space allowance is assessed in cm² of free space per animal and it is calculated by assessing the same cages checked for wet and dirty animals and resting mats: “Excellent” is given when there are 90% of cages with at least 3,500 cm² per doe/buck on the farm and “Acceptable” with at least 2,500 cm² per doe/buck.

Evaluation of the method and comment

Calculating the stocking density of animals, in terms of kg/m² for fattening rabbits and space allowance of cm² of surface area per animal for does/bucks, is a valid, feasible and reliable indicator. As stated by EFSA (2020), it is not possible to recommend a minimum space requirement which gives acceptable welfare for all rabbit categories (for does in particular -*author’s note*-), due to the gap of knowledge concerning behavioural and physiological needs for these animals. Therefore, validity for stocking density for does and bucks should be considered as moderate. Nevertheless, it is crucial that legal parameters are identified to provide minimum space requirements for rabbits of all categories. To meet this urgent need, the Italian Ministry Guidelines (2021) and the EURCAW Poultry-SFA (2021), have proposed some minimum parameters for all rabbit categories.

<i>Stocking density</i>	Validity	Feasibility	Reliability
kg/m ² for growing rabbits	XXX	XX	XXX
cm ² per animal for does and bucks	XX	XX	XXX

3.2.2. Height of the cage

Description of the indicator and method of assessment

The height of the cages should allow the rabbits to easily stand up on their hind legs or easily stand with their ears up, and this could be observed in a cage 50 cm (EFSA, 2005). However, the current height of most conventional cages is between 30 and 35 cm. According to the Italian Ministry

Guidelines (2021), cages must not have a height lower than 50 cm for breeders and 40cm for growing rabbits. As proposed by EURCAW Poultry-SFA's review on farm rabbit's welfare (2021), adult rabbits are about 60 cm tall in a standing position thus, in non-open-top systems, they need a height higher than 60 cm to stand up; or at least a part of the housing system with this height (EFSA, 2005).

De Jong et al. (2011) proposed height of the cage as a resource-based indicator of appropriate behaviour whereas both Dalmau et al. (2020) and Botelho et al (2020) use it as an indicator of good housing. In Dalmau and Botelho's protocols "Excellent" is given when in at least 90% of the cages assessed the height of cage is 38 cm and "Acceptable" when height of cage is 32 cm.

Evaluation of the method and comment

Measuring cage height is a valid, feasible and reliable indicator for assessing rabbits' freedom of movement. However, as with animal stocking density/space allowance, there are no legal standards. Thus, there are many differences in cage height between farms (Botelho et. al, 2020; Dalmau et al., 2020), some far below the acceptable limit (only 38 % of farms reached the acceptable limit in the study by Dalmau et al. (2020)). Establishing minimum requirements is therefore essential. It would be desirable to include as an Excellent value the finding of open-top cages (such as elevated pens), which by far allow freedom of movement to a greater extent.

<i>Height of the cage</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020); Botelho et al. (2020)	XXX	XXX	XXX

3.2.3. Quality of facilities

Description of the indicator and method of assessment

To assess "Good Housing" conditions, it is necessary to evaluate the quality of the facilities, whether they can be easily cleaned and disinfected, and cannot harm e.g., due to presence of sharp protrusions, and cause wound (including sore hocks) to the animals. Dalmau et al. (2020) protocol assesses the cleanliness of the cage. This indicator has three scorings: the cage is clean; the cage is partly dirty, when only a part of the cage is affected (including a lot of presence of hair, compacted dry food, and mold); and a dirty cage, when the entire cage is very dirty. In all cases a minimal value is no more than two cages partly dirty. All the other situations are scored as dirty. In Botelho et al. (2020) protocol for growing rabbit's, the assessment of this indicator and the threshold criteria is the same as in Dalmau et al. (2020) protocol of does, bucks and kits. Dalmau et al. (2020) also considers the risk for the animals to be injured by bad maintenance of the cages or other elements in their surroundings. In all cases it is considered a minimal condition to have no cages with risk of injuries. In the growing rabbit's protocol (Botelho et al.,2020), the assessment of this indicator and the threshold criteria is the same as in the protocol of does, bucks and kits.

The presence and condition of resting mat, of an elevated platform and the quality of nesting material can be also assessed with Dalmau et al. (2020). The presence of environmental enrichments is also considered as part of the quality of facilities; however, enrichments are developed in the section 5.2.1. related "Appropriate Behaviours". Moreover, structures that can be easily cleaned is an important requirement but is not directly assessed in the available protocols.

It is very important that cages are provided with at least a plastic mat, in particular when there is a wire mesh floor, and clean, good-quality nesting material (in the case of breeder or dual-band farms). In particular, plastic mats prevent direct contact of the animals with the wire mesh. The mats must be in good conditions, facilitate percolation of manure, and be easy to clean and disinfect.

Nesting material should be dry and of suitable material (e.g., straw) and in the right quantity to preserve the kits' welfare.

As mentioned before, Dalmau's et al. (2020) welfare protocol for reproducing rabbits, kits and bucks evaluates the presence of resting mats (and their condition) and the quality of nesting material. The presence and condition of resting mats is evaluated on the same number of cages to assess height, stocking density and wet animals, dirty animals. An "Excellent" rating is given if 100% of cages have mats, while it is "Acceptable" the finding at least 50% of cages with mats.

The quality of littered floor (cleanliness and dryness of the nest) is visually assessed only in cages with does and kits in the first week after kindling (17 to 25 cages). If the litter is dry in all nests, the rating is "Excellent". A finding of inadequate litter in up of two nests is "Acceptable". In all other situations the rating is "Inadequate".

The EBENE protocol (ITAVI, 2018) also assesses in growing and breeding rabbits the presence of a resting plastic mat.

As opposed to the previous ones, the Classyfarm protocol assesses with a single item for both breeding and growing rabbits the quality of structures i.e., absence of noxious structures and the presence of enrichments, considering the presence of a mat and gnawing material as indispensable to have an "Acceptable" value; while the presence of a platform or park systems as optimal requirements, leading to the "Excellent" rate.

Evaluation of the method and comment

Environmental enrichments can improve the welfare of all rabbits' category (Buijjs et al., 2011; Lang and Hoy, 2011; Szendro and Dalle Zotte, 2011; Martino et al., 2016; Huang et al., 2021; Birolo et al., 2022; EFSA, 2020; Garcia, 2020). Thus, their presence should be valued and rewarded for all animal categories since they promote higher welfare (EURCAW Poultry-SFA, 2021). They are good valid, feasible and reliable indicators. Assessing quality of nesting material (littered floor) is important to guarantee kit's welfare but it could be not easy to assess when kits are in the nest, partially reducing its feasibility.

<i>Environmental enrichment/Quality of facilities</i>	Validity	Feasibility	Reliability
Risk of injuries	XXX	XXX	XXX
Cleanliness of the cage	XXX	XXX	XXX
Presence and quality of resting mat and elevated platform	XXX	XXX	XXX
Quality of littered floor	XXX	XX	XX

3.2.4. Light provision

Description of the indicator and method of assessment

Light quality is another important aspect to consider. Lighting should provide uniform illumination of at least 20 lux at rabbit level, in order to allow the rabbits to have visual contact, to investigate their surroundings visually, to have effective inspection and to show normal levels of activity. Light intensity must not exceed 200 lux, in order to prevent retinal degeneration (a particular risk for albino rabbits). The light/dark regime should follow a 24-h rhythm and include a sufficient period of uninterrupted darkness of about one-third of the day (8 hours) to allow the animals to rest and carry out their nocturnal activity. In case of artificial light only, a twilight transition (30 minutes to two hours) is important. Natural light is preferable in any case.

All the protocols consider quality of light correct (“Acceptable”) when it is possible to check all the animals and if at least 8 h of light and darkness are provided, of adequate intensity. The lighting program can be checked by asking the farmer.

The Classyfarm protocol recommends that light intensity should be verified at time of the visit by appropriate portable instrumentation (luxometer) or, if suitable measuring instruments are not available, enough light that allows the assessor to read a newspaper sheet without effort may be considered suitable. The presence of an automatic timer that regulates light/dark cycles and the twilight period is considered as “Excellent”.

Evaluation of the method and comment

This parameter cannot be evaluated except by direct asking the farmer about the lighting regime adopted and by evaluating the light intensity at the time of the visit. Both assessments should be performed. Evaluation of light intensity can be done empirically or using suitable equipment (luxometer). The luxometer involves an initial cost (low feasibility) but offers a highly valid and reliable assessment.

<i>Light quality</i>	Validity	Feasibility	Reliability
Check for the light regime	XX	XXX	XX
Visual assessment	X	XXX	X
Luxometer	XXX	X	XXX

3.2.5. Temperature and humidity

Description of the indicator and method of assessment

One of the most important climatic components that influences the welfare of farmed animals is the environmental temperature (EFSA, 2020). The effective environmental temperature (i.e., the temperature that animals really feel) depends on several factors such as air speed, external temperature, relative humidity, flooring and cage/pen type, bedding, single or group housing, and the animal's stage of production and health status (Turner et al., 2017). For details on the thermoregulation of rabbits, see Section 3.1.4. A housing environment within 16-26 °C throughout the year and relative humidity within 60-70% will provide thermal comfort to the rabbits (Verga et al., 2007) (Figure 3). Some methods for assessing environmental temperature and humidity are described below.

Temperature data records

In Dalmau et al. (2020) and Botelho et al. (2020), temperature is assessed according to the data records on the farm with two separate parameters: “Temperature” and “Burning hair”. The first, *Temperature*, evaluates data records of the last 3 months. If there are no data, zero points are given as score. If there are any data, “Excellent” is given when the temperatures, maximum and minimum, range from 1 to 28°C, respectively. “Acceptable” is considered when, up to 2 days in the last 3 months, the temperature registered is out of this range and, finally, “Unacceptable” in any other case. The second parameter, *burning hair*, is related to the management practise of burning of hair/fur accumulated on the cages and other housing equipment, in order to improve environmental conditions. Nevertheless, if the temperature is outside of the proposed range during this practice, or the temperature is not registered at all, 20 points will be subtracted from the thermal comfort criterion.

Temperature Humidity Index (THI)

Since there is a close relationship between the ambient temperature and humidity, the relative humidity is a valid tool to measure the severity of thermal discomfort (e.g., heat stress) (Figure 5).

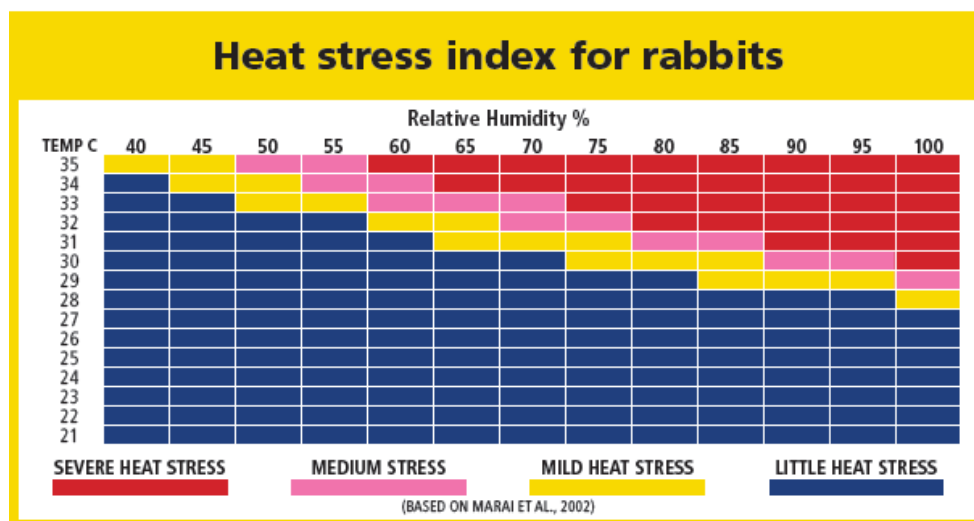


Figure 5: Heat stress Index - Turner et al. 2017

For this reason, a modified 'Temperature-humidity index' (THI) was proposed and adopted for rabbits by Marai et al. (2001) as follows:

$$THI = dbnC - [(0.31 - 0.31 RH) (dbnC - 14.4)]$$

where dbnC = dry bulb temperature in degrees Celsius and RH = relative humidity

Value for THI below 27.8 was taken to indicate an absence of heat stress, while a value over 28.9 was considered to represent severe heat stress. The THI is extensively employed in hot and humid places worldwide to evaluate the effect of HS in rabbit (Oseni and Lukefahr 2014).

Presence of temperature and humidity sensors on the farm and of adequate ventilation systems

The Classyfarm protocol involves checking whether at inspection T° and RH are appropriate for the ethological needs of rabbits and their age. In addition, assessment of the management of microclimatic conditions of the farm through appropriate ventilation systems is considered. In fact, air flow, temperature, and relative humidity are three very closely linked environmental factors that, if well managed, can significantly promote good health and welfare in rabbits (Turner et al. 2017). Therefore, the presence of an automatic detection system of environmental temperature and humidity is considered "Excellent". This could be obtained by using thermo-hygrometer and probes placed at various points of the farm, with the possibility of adjusting the ventilation system automatically according to changes in these parameters. On the other hand, non-systematic detection of these parameters by the farmer is considered "Acceptable", limited to the detection of suitable microclimatic conditions at the time of inspection.

Evaluation of the method and comment

The "Temperature data records" assessment requires the presence of temperature records, which may be even absent in some cases (Dalmau et al., 2020), but it could give a realistic picture of the environmental condition on farm under various conditions. However, it is also important to measure temperature at time of the assessment. The other two assessing methods require the detection of temperature and humidity in real time (with a thermo-hygrometer, for instance) or the consultation of the sensors present in the farm and checking of the ventilation management system. Obviously, the use of sensors reduces feasibility (moderate).

<i>Temperature and Humidity</i>	Validity	Feasibility	Reliability
Temperature data records	XX	XXX	XXX
THI	XXX	XX/XXX*	XXX
T° and RH + ventilation system	XXX	XX/XXX*	XXX

**if a thermal sensor is already present on farm*

3.2.6. Noxious gases concentration

Description of the indicator and method of assessment

High levels of noxious gases, particularly ammonia (NH₃) and carbon dioxide (CO₂), reduce animal welfare and predispose to respiratory diseases and infections such as Pasteurellosis (EFSA, 2005). Proper levels of these gases indicate the presence of good manure management and ventilation. NH₃ should not exceed 25 ppm and CO₂ 5000 ppm (Trocino et al., 2022).

The Classyfarm protocol considers a concentration of NH₃ ≤10 ppm and CO₂ ≤3000 ppm as “Excellent”, a concentration of NH₃ below ≤20 ppm and of CO₂ ≤3000 ppm as “Acceptable”. For the evaluation of these parameters, the perception of olfactory discomfort at the entrance of the barn can help, but to have a valid and reliable detection the use of gas detector is necessary. Trocino et al. (2022) made the measurement at 5 locations in the barn (4 lateral and 1 central).

Evaluation of the method and comment

This is a very good and reliable indicator, however, needing the use of a gas detector, the feasibility is low.

<i>Noxious gases concentration</i>	Validity	Feasibility	Reliability
Gas detector	XXX	X	XXX

3.2.7. Dustiness

Description of the indicator and method of assessment

Environmental dustiness results from a combination of factors, including feed and skin flaking, especially during the moulting period. The presence of an excess of dust in the environment can be responsible for an increase in respiratory pathologies (EFSA, 2005), with irritation of the mucosa, possible inhalation, and related pathogen transmission to the pulmonary alveoli. In addition, the presence of dust, dirt, and hair on the inside and outside of the ventilation system negatively affects the quality and quantity of gas exchange.

Dalmau et al. (2020) and Botelho et al. (2020) use the “dust sheet test” proposed by the Welfare Quality protocol for laying hens (2019). A black surface of ~10 * 15 cm (DINA 4-folds in four pieces) is left during the assessment in the centre of the building housing the rabbits at the same height as their heads. At the end of the visit, the level of dust accumulated is assessed considering three possibilities (Figure 6):

0. No evidence of dust.
1. Minimal evidence of dust (a thin covering of dust).
2. A lot of dust (possible to write on the paper with a finger, or paper not visible).

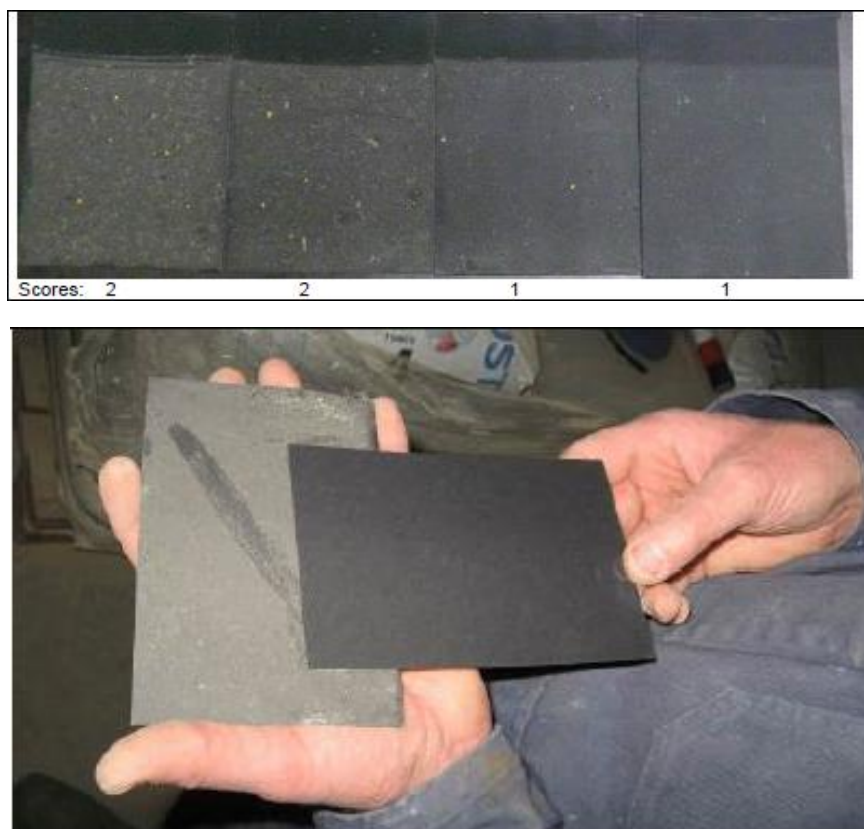


Figure 6: A comparison with a clean sheet could help evaluating the score (Welfare Quality, 2019)

If there is no evidence of dust in the farm, an “Excellent” rating is given; if there is evidence of minimal dust, an “Acceptable” rating is given.

In the Classyfarm protocol, dustiness is not considered a separate indicator, but it is evaluated together with noxious gases. In particular, the execution of the dust sheet test, which follows the same principles, is facultative and integrate the evaluation of presence of dust made by the assessor. When performed the results of the test are put together with NH_3 and CO_2 values to determine a single final evaluation.

Evaluation of the method and comment

This indicator can be judged to be of moderate validity, feasibility and reliability. In fact, there may be some problems in distinguishing between score 1 and 2 and in finding a suitable black sheet for the test.

<i>Dustiness</i>	Validity	Feasibility	Reliability
Dust Sheet test (Dalmau et al. 2020; Botelho et al. 2020)	XX	XX	XX

3.3. Management-based indicators

There are not management-based indicators for this section.

4. Good health

Requirements applicable to rabbits 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. Integument alterations

Wounds can be caused by inadequate equipment (e.g., sharp parts of cages), or by mutilative or aggressive behaviour of other rabbits. Meat rabbits may miss toes, either by biting of the doe or by an inadequate flooring. They may also miss part of the ears by biting of the doe when they are in the nest (de Jong et al., 2011). Meat rabbits' aggression may also cause ear wounds (Princz et al., 2008). Other skin disorders include infections (e.g., dermatophytosis/ringworm), ectoparasites (e.g., mange) seen as abnormal conditions of the skin or coat or excessive rubbing and scratching, hair loss unrelated to nest building behaviour, inflamed scabs or exuding skin (EFSA, 2020).

4.1.1.1. Skin injuries and wounds

Description of the indicator and method of assessment

In the welfare assessment protocol for commercially housed rabbits, de Jong et al. (2011) proposes two measures related with skin injuries and wounds. The first measure, skin injuries, is assessed in breeding does and growing rabbits. This measure assesses the head and ears, body and limbs, genitals or anus, and the tail and their scores are: (0) no wounds; (1) superficial wound, area less than 1 cm²; (2) superficial wound, area larger than 1 cm²; or (3) bleeding wound. Trichophagy is also included in the assessment. The second measure is the number of toes and ear damaged and is only assessed in growing rabbits. Sampling information of these measures appears in section 1.3.1.

The EBENE method in breeding does and fattening rabbits proposed by ITAVI (2018) includes a scoring system for the presence of skin injuries and wounds. This protocol defines injuries/wounds as skin condition (wounds, sore or dry skin and red patches), eye lesions (closed, cornea infected, pus present) and ear lesions (skin excess, infection, abscess on the skin except on the ventral part). Sampling information of this measure appears in section 1.3.3.

The animal welfare protocol for does, bucks, and kits proposed by Dalmau et al. (2020) assesses skin injuries and wounds. This protocol describes a lesion as a fresh scratch or open lesion equal or bigger than 2 cm in any part of the animal and not healed. Any animal with these lesions is assessed as moderately injured. Nevertheless, in case of a lesion of equal or more than 5 cm, the animal is assessed as severely injured. Only one side of the animal is assessed. Ears will not be considered within skin injuries and will be assessed separately (Dalmau, pers. com.). According to Dalmau et al. (2020), a minimal value is no more than 4% of animals with moderate and a 2% with severe skin injuries, while the excellent is stated at no more than 2% for moderate and 0% for severe injured animals. There is another parameter inside this protocol that only considers wounds on the ears. In this case, no distinction for size is made (only considering lesions bigger than 2 cm) and old lesions are distinguished

from fresh ones. Both ears are assessed and the worst of both is considered for scoring the animal (Dalmau, pers. com.). In this case, the minimal value is no more than 4% of animals with moderate injuries and no more than 2% with severe ear injuries, while the excellent is stated at no more than 2% for moderate and 0% for severe injured ears (Dalmau et al., 2020). The assessment of skin injuries and wounds (body and ears) in the welfare protocol for growing rabbits (Botelho et al., 2020) is the same as in the protocol of does, bucks and kits. The difference is the categories' definition. For wounds on the body, a minimum value is no more than 1% of animals with moderate and 0.4% with severe skin injuries, while the excellent is stated at no more than 0.4% for moderate lesions and 0% for severe injured animals. For wounds on the ears, a minimum value is no more than 5% of animals with moderate and 1% with severe injuries on the ears, while the excellent is stated at no more than 2% for moderate lesions and 0% for severe injured ears. Sampling information of these measures appear in section 1.3.2.

The Classyfarm protocol uses a Dalmau et al. (2020) modified scoring system to assess skin injuries and wounds. In this protocol, a minimal value (classified as acceptable) is scored when less than 20% of rabbits checked (at least 50 breeding and 100 fattening animals at the end of the cycle preferably) have some of these skin conditions (abscesses, wounds, ulcers, multiple excoriations and furunculosis). The optimal value is a good fur quality without any evident injury. It is considered non-conformity when more than 20% of rabbits checked (at least 50 breeding and 100 fattening animals at the end of the cycle preferably (4 rabbits/nest*25)) have some of the skin conditions mentioned above.

The protocol of Trocino et al. (2022) considers the presence of injuries associated with aggressions and their severity in growing rabbits.

Evaluation of the method and comment

According to De Jong et al. (2011), scientific literature and expert opinion from different countries were used to select the final parameters related to the absence of injuries. The parameter toes damaged was discarded in the protocol of Botelho et al. (2020), during the first tests on farms, as it requires the animals to be caught and this was stressful for the animals and reduced the feasibility of the protocol.

To test the repeatability of skin injuries and wounds of the EBENE method (ITAVI, 2018), two assessors carried out the assessment at the same time on the same rabbits without talking to each other (inter-assessor repeatability); and the same assessors performed the same assessment on two consecutive days on the same houses (intra-assessor repeatability). Wounds on the body were highly repeatable for fattening rabbits, but not repeatable for breeding does. According to Warin et al. (2021), this measure may not be repeatable (intra-assessor repeatability) because of isolation or humane killing of injured does between the 2 assessments.

Dalmau et al. (2020) and Botelho et al. (2020) only considered lesions of 2 cm or bigger. This is an important point to contemplate because rabbits have a high prevalence of lesions of less than 1 cm, especially in the ears (Rauterberg et al., 2019). However, these small lesions are difficult to assess in commercial conditions due to the light conditions of some farms and the angle of vision of the animals in the cages. As this protocol avoids catching the animals to reduce the stress associated with human contact, including these small lesions without catching the rabbits would dramatically reduce inter-observer repeatability. Thus, only lesions clearly visible for any auditor (at least 2 cm in size) are considered. This means that although the assessment of wounds showed a good capacity of discrimination between farms, the protocol does not consider all the wounds that rabbits might have, but rather only a portion. For this reason, validity is moderate.

Trocino et al. (2022) protocol is a review work of different papers of rabbits (EFSA, 2005; Verga et al., 2007; Cerioli et al., 2011; de Jong et al., 2011). This measure has been assessed in four different housing systems, so feasibility is high.

<i>Skin injuries and wounds score</i>	Validity	Feasibility	Reliability
De Jong et al. (2011)	XX	XX	XX
ITAVI (2018)	XX	XX	XX
Classyfarm (2022)	XX	XX	XX
Dalmau et al. (2020)	XX	XXX	XXX
Botelho et al. (2020)	XX	XXX	XXX
Trocino et al. (2022)	XX	XXX	XX

4.1.1.2 Hairless areas

Description of the indicator and method of assessment

Dalmau et al. (2020) protocol assesses hairless areas only in bucks (in a total of 24 animals). It is considered when there is an area of equal or more than 2 cm without hair. For bucks, a minimal value is no more than 13% of animals with hairless areas, while the excellent is stated at 0%. More than 13% of animals with hairless areas is not acceptable. Botelho et al. (2020) assessment of hairless areas in the animal welfare protocol for growing rabbits is the same as in the protocol of does, bucks and kit. In this protocol, a minimum acceptable value is no more than 1% of animals with hairless areas, while the excellent is stated at no more than 0.2%. Sampling information of these measures appears in section 1.3.2.

Evaluation of the method and comment

According to Botelho (2020), the assessment of this measure in 32 farms of growing rabbits (20 Spanish and 12 Portuguese) was different between the two auditors (one assessed Spanish farms and the other one assessed Portugal farms). While only 10% of the farms from auditor one had animals with hairless lesions, 50% of the farms from observer two had this problem. Although problems of reliability should not be discarded for this measure, differences in the health status of the farms could explain these differences.

<i>Hairless areas score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX

4.1.1.3. Mange

Description of the indicator and method of assessment

Rosell and de la Fuente (2008) assessed mange as presence or absence (1 or 0). This indicator can be also assessed using Dalmau et al. (2020) protocol. In all cases, the minimal acceptable value is a 0% of animals affected. In Botelho et al. (2020) protocol, the assessment of mange is the same as in the protocol of does, bucks and kits, and the minimum acceptable value is also a 0% of animals affected. Sampling information of these measure appear in section 1.3.2.

Evaluation of the method and comment

According to the expert opinion, mange is considered a measure of high repeatability, validity, and feasibility.

<i>Mange score</i>	Validity	Feasibility	Reliability
Rosell and de la Fuente (2008)	XXX	XXX	XXX
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX

4.1.1.4. Dermatophytosis

Description of the indicator and method of assessment

Ceroli et al. (2011) assessed the presence of fungi by taking 10 coat samples (from ear and hair) for each category (35 and 60 day old for growing rabbits and does). This method uses a 2-point scale: (0) presence of fungi and (1) absence of fungi. Isolation of fungi was done by using two selective media: Dermatophyte Selective Medium (DTM) and Sabouraud, incubated in both cases for 5 days at room temperature.

Dermatophytosis (Figure 7) can be also assessed according to the Classyfarm protocol. The assessor should observe the presence of diffuse fungal lesions (presence of alopecic areas with intact or scale/crust-covered skin) on not less than 50 breeders and 100 fattening animals (sampling at least 4 rabbits/litter for at least 25 cages). Fungal lesions between 10 and 20% on the animals assessed is considered « Acceptable » and « Excellent » when they are found on <10% of the animals.



Figure 7: Rabbit with dermatophytosis (Classyfarm)

The welfare assessment protocols for does, bucks and kits (Dalmau et al., 2020) and growing rabbits (Botelho et al., 2020) have a measure to jointly assess dermatophytosis, dermatitis and abscesses. These three conditions are assessed as presence or absence. Dalmau et al. (2020) considered a minimal value is no more than 10% of animals affected, while the excellent is stated at no more than 4%. Botelho et al. (2020) considered that a minimum value is no more than 0.5% of animals affected, while the excellent is stated at 0%. An exception is considered for dermatophytosis, which in both protocols must be a 0%. Sampling information of these measures appear in section 1.3.2.

The protocol proposed by Trocino et al. (2022) considers the presence of dermatophytosis in does and kits. Sampling information of these measures appear in section 1.3.4.

Evaluation of the method and comment

The detection of fungi lesions proposed by Ceroli et al. (2011) has a certain invasive nature, as it requires animal manipulation to extract hair sample. For this reason, feasibility is low.

According to Botelho (2020), the detection of this parameter in 32 farms of growing rabbits from Spain and Portugal was different between the two auditors who assessed the farms. While only 20% of the farms from auditor one had animals with dermatophytosis, dermatitis and abscesses, 66% of the farms from observer two had this problem. Although problems of reliability should not be discarded for this measure, differences in the health status of the farms could explain these differences.

The protocol of Trocino et al. (2022) has been developed as a review work of different rabbit (EFSA, 2005; Verga et al., 2007; de Jong et al., 2011; Cerioli et al., 2011) papers. This measure has been assessed in four different hosing systems, so feasibility is high.

<i>Dermatophytosis score</i>	Validity	Feasibility	Reliability
Cerioli et al. (2011)	XXX	X	XXX
Classyfarm (2022)	XXX	XXX	XXX
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX
Trocino et al. (2022)	XXX	XXX	XXX

4.1.2. Pododermatitis

Pododermatitis (or sore hocks) is a chronic multifactorial skin disease that appears mainly on the plantar surface of the hind legs. This presumably progressive disease can cause pain leading to poor welfare (Ruchti et al., 2019). Some of the suggested risk factors for pododermatitis are directly linked to the animals themselves such as breed, age, body weight or claw length (Rommers and Meijerhof, 1996). Other risk factors are related to the rabbits' environment, such as high temperatures, humidity (Lebas et al., 1986 in Rommers and Meijerhof, 1998), floor type (wire mesh flooring without either plastic mats or plastic platforms) and floor bedding (litter on either full floors or on plastic slatted floors) (EFSA, 2005; EFSA, 2020).

Description of the indicator and method of assessment

Rosell and de la Fuente (2008) proposed that pododermatitis can be assessed as presence/absence (1/0). Another scale exists according to Cerioli et al. (2011), which consists of the following categories: (0) relevant and painful thickening, presence of bleeding ulcers; (1) relevant thickening of the skin at more than one leg; (2) simply thickening of the skin; (3) absence of lesions. The final score corresponds to the mean value calculated from 10 primiparous, 10 pluriparous and 10 empty does respectively, and having determined the arithmetic mean within each group.

Jong et al. (2011) developed a method to assess pododermatitis in accordance with the one by Drescher and Schlender-Bobbis (1996). In this case, the scoring method uses 5 classes: (0) healthy foot pad; (1) no hairs, callus formed, area smaller than 2,5 cm²; (2) no hairs, callus formed, area larger than 2.5 cm²; (3) callus open, cracks formed; (4) wounds. Sampling information of these measures appear in section 1.3.1.

Rosell and de la Fuente (2013) proposed that a rabbit has sore hocks when a plantar or volar lesion is present on at least one limb, even the first stage (Figure 8). In this protocol, hyperkeratosis is not considered as a lesion. These authors also differentiated sore hocks in the plantar region of the hind limbs or in the volar region of the front limbs from digital dermatitis and other cutaneous manifestations, due to footpad pseudomonosis, ringworm or sarcoptic mange.

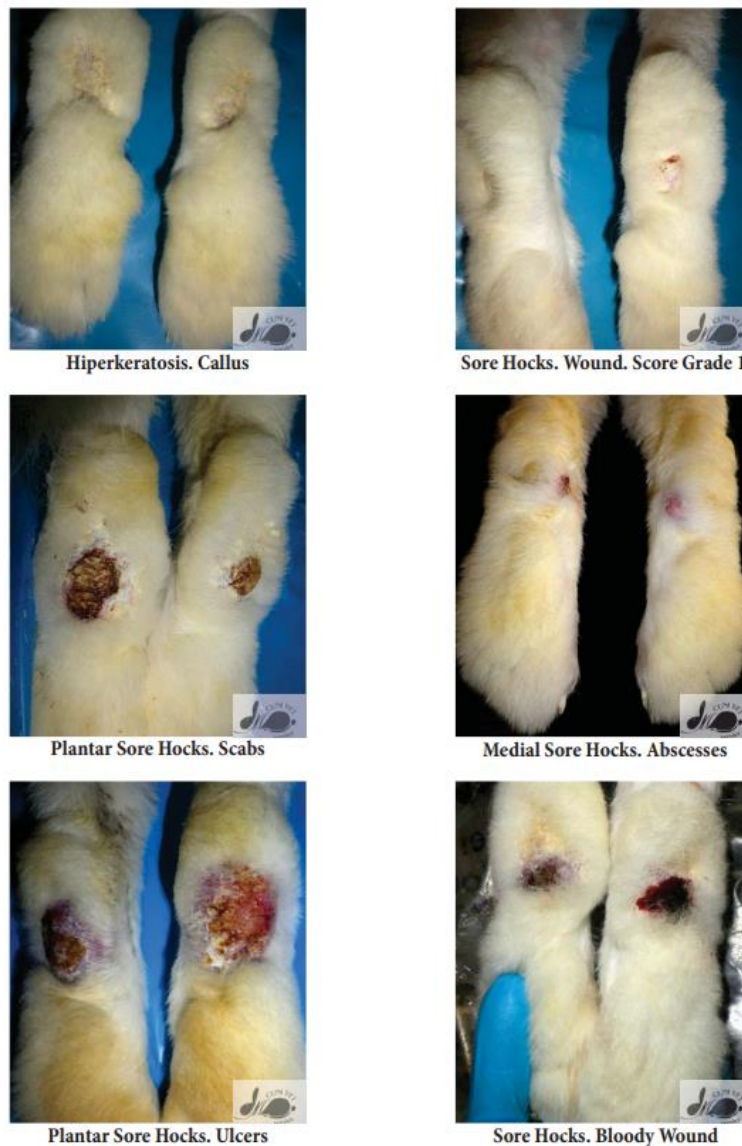


Figure 8: Ulcerative pododermatitis in breeding rabbits (source: Rosell and de la Fuente, 2013)

Olivas et al. 2013 defines a scoring system for pododermatitis in rabbits. This classification is a 5-point scoring system which describes the different stages of pododermatitis: (0) foot without any type of lesion, well furred footpad; (1) hyperkeratosis. Small lesions, skin with absence of chaps or dry chaps, without any ulcer, wound or blood; (2) hyperkeratosis and skin with dried chaps, which may be starting to open, and spots appear, without any type of ulcer, and absence of blood. Moreover, any lesion scored as long or large is included in this category, regardless of the presence of chaps; (3) typical chaps, wounds opened, medium or small ulcers (related to the size of the whole lesion) and with presence of blood (regardless it is dry or not); (4) open chaps and wounds, medium and large ulcers, with presence of blood and putrid or exudative aspect (Figure 9).

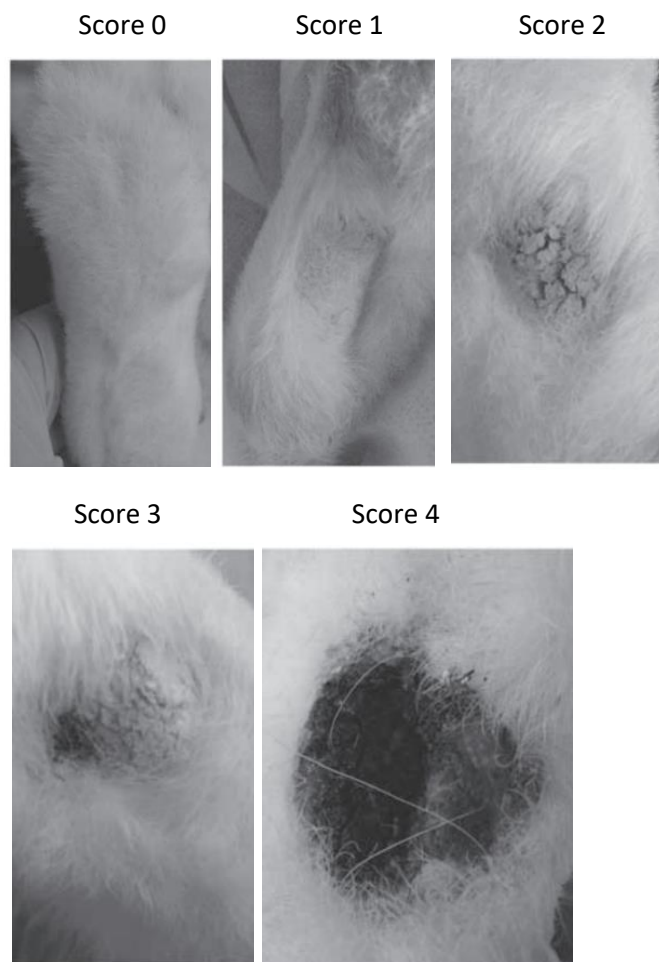


Figure 9: Pododermatitis score (source: Olivas et al., 2013)

EBENE method (ITAVI, 2018) also considers breeding does. In this protocol, pododermatitis is defined as hyperkeratosis with lesion/blood on the food pad. Sampling information of these measures appear in section 1.3.3.

According to the Classyfarm protocol, the frequency of animals with pododermatitis and its severity is assessed in at least 50 breeders, according to the following scoring scale (0-2):

Score 0: Absence of lesions and calluses or otherwise up to <5% of the surface area with hair loss

Score 1: Presence of visible calluses (hinted or clearly visible, but without solution of continuity) in at least one foot

Score 2: Presence of painful and ulcerated calluses (sores) in at least one foot

One animal with a score 2 is equivalent to three animals with score 1. After the conversion is made, it is considered “Acceptable” to have with score 1 between 20% and 30% animals and “Excellent” in less than 20% of animals.



Figure 10: Sore hocks scoring scheme (source Classyfarm). Score 1 (up) and 2 (bottom)

Pododermatitis can be also scored with Dalmau et al. (2020) protocol. This measure considers three cases: no problem, when the feet are fine; moderate problems, if there is no hair, with a callus formed, and the area affected is longer than 2 cm; and severe problems if there is an open lesion. In this protocol, a minimal value is no more than 65% with moderate problems and 8% of animals with a severe problem of pododermatitis, while the excellent is no more than 50% with a moderate and 5% with a severe problem of pododermatitis. Sampling information of these measures appear in section 1.3.2.

The protocol developed by Trocino et al. (2022) considers the presence of ulcerative pododermatitis and their severity in does (1: minor and limited lesions; 2: extended lesions; and 3: deeper, extended, and open lesions). Sampling information of these measures appear in section 1.3.4.

Evaluation of the method and comment

Pododermatitis measure has moderate feasibility as it requires to catch the animal to assess plantar surface of the hind legs.

To test the repeatability of pododermatitis of the EBENE method (ITAVI, 2018), two assessors carried out the assessment at the same time on the same rabbits without talking to each other (inter-assessor repeatability); and the same assessors performed the same assessment on two consecutive days on the same houses (intra-assessor repeatability). Pododermatitis is highly repeatable.

<i>Pododermatitis score</i>	Validity	Feasibility	Reliability
Rosell and de la Fuente ((2008)	XXX	XX	XXX
Cerioli et al. (2011)	XXX	XX	XXX
De Jong et al. (2011)	XXX	XX	XXX
EBENE Protocol (ITAVI, 2018)	XXX	XX	XXX
Classyfarm (2022)	XXX	XX	XXX
Dalmau et al. (2020)	XXX	XX	XXX
Trocino et al. (2022)	XXX	XX	XXX

4.1.3. Mortality

Description of the indicator and method of assessment

Mortality provides a global overview of the health status (de Jong et al, 2011). On farms in Europe, the monthly mortality risks in adult rabbits are 2–4% according to Azard (2007) in France, Rosell and Pérez (2005) in Spain and Portugal, and Xiccato and Trocino (2007) in Italy. The main sanitary cause of the death in female rabbits are respiratory conditions, and the second leading cause of death is related to the digestive system (Rosell and de la Fuente., 2016). The main reasons for juvenile mortality in rabbits after weaning are digestive disorders accompanied by abdominal distension and diarrhoea (Rashwan and Marai, 2000).

The Classyfarm protocol assesses mortality in growing rabbits in 3 categories according to days of live: (1) 0-35 days: pre-weaning mortality index; (2) 35-60 days: post-weaning mortality index (frequently enteric forms); (3) >60 days: post-weaning mortality index (frequently respiratory forms). For all the records, the presence of a farm mortality log per cycle is a prerequisite. It considers the average mortality of the last 5 cycles. For category 1 (0-35 days), a minimal value (classified as acceptable) is between 8-12% of mortality, while the excellent value is less than 8%. It is considered not acceptable the absence of mortality data or recording more than 12% of mortality. For category 2 (35-60 days) and 3 (> 60 days), a minimal value of mortality (classified as acceptable) is between 5-6% and 2-4% respectively, while the excellent value is less than 5% and 2% respectively. It is considered not acceptable the absence of mortality data or recording a mortality more than 10% (35-60 days) and 4% (>60 days).

Dalmau et al. (2020) protocol assesses mortality, according to the records of the farm in the last 3 months. Mortality considers only adult does and bucks' deaths in the farm and not culled by the farmer. In this protocol, a minimal value is no more than 5% of mortality in the last 3 months, while the excellent is stated at no more than 3%.

Botelho et al. (2020) protocol also assesses mortality according to the records of the farm in the last 3 months. Mortality considers only growing rabbits' deaths in the farm from weaning until the end of the cycle (culled animals are not considered here). In this protocol, a minimal value is no more than 8 % of mortality in the last 3 months, while the excellent is stated at no more than 5%.

The protocol developed Trocino et al. (2022) considers kit mortality and growing rabbits' mortality. It describes mortality as the average data of the entire productive cycle (provided by the farmer).

Evaluation of the method and comment

Mortality is assessed according to the records of the farm for at least one productive cycle (Trocino et al., 2022), the previous three months (Dalmau et al., 2020 and Botelho et al., 2020) and the previous 5 cycles (Classyfarm). Therefore, it is an indicator with a high validity, reliability, and feasibility.

<i>Mortality score</i>	Validity	Feasibility	Reliability
Classyfarm (2022)	XXX	XXX	XXX
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX
Trocino et al. (2022)	XXX	XXX	XXX

4.1.4. Culling rate

Culling of rabbits is important when animals are ill or injured to such an extent that treatment is no longer feasible, and rabbits are not fit for transport. Then, they must be killed on the farm. The farmer should also always be alert to the first signs of a disease outbreak. The methods used to kill rabbits on

the farm should cause the death without delay, and they should be performed by a person skilled in the techniques of killing (EFSA, 2005). On farms in Europe, the monthly culling risks are 5–9%, according to Azard (2006) in France, Rosell and Pérez (2005) in Spain and Portugal, and Trocino and Xiccato (2006) in Italy. Culling and reason of culling should be registered separately from mortality caused by diseases etc. (de Jong et al, 2011).

Description of the indicator and method of assessment

Dalmau et al. (2020) protocol assesses culling rate according to the records of the farm in the last 3 months. Culling rate considers the percentage of reproducing animals euthanized on the farm. In all cases, a minimal value is considered when the culling animals are up to 5% in the last 3 months and the excellent value when culling rate is equal or higher than mortalities.

Botelho et al. (2020) assesses culling rate according to the records of the farm in the last 3 months. In this case, culling rate considers only growing rabbits from weaning until the end of the production cycle. In all cases, a minimal value is considered when the culling animals are at least the 20% of the levels of mortality in the farm (i.e., mortality 5%, culling at least 1%), and the excellent category is considered when culling is at least 40% of the mortality rate.

Evaluation of the method and comment

Culling rates are assessed according to the records of the farm for at least the previous three months (Dalmau et al., 2020 and Botelho et al., 2020). Therefore, it is an indicator with a high validity, reliability, and feasibility.

<i>Culling rate score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX

4.1.5. Respiratory disorders

Respiratory disorders are very relevant in breeding rabbits, with welfare consequences that include pain and death. The affected animals have impaired function of the lungs or airways, which can be seen as sneezing, nasal discharge (snuffles, observed also as wet spots on the paws), laboured breathing or chronic sneezing (EFSA, 2020).

4.1.5.1. Nasal secretion

Description of the indicator and method of assessment

According to Rosell and de la Fuente (2008), nasal discharge can be assessed as presence/absence (1/0). De Jong et al (2011) describes a scoring system for dirty/wet nose that was developed by Peeters (1989). This measure is defined as nasal discharge (snot) present or absent around the nose or at the forepaws. Sampling information of this measure appears in section 1.3.1.

The EBENE method developed by ITAVI (2018) defines nasal discharge as important nasal secretions, especially visible at the forelegs. Sampling information of these measures appear in section 1.3.3.

Dalmau et al. (2020) protocol assesses nasal discharge scoring as the presence or absence of the problem. In this protocol, a minimal value is no more than 4% of animals with nasal discharge, while the excellent is stated at no more than 2%. The assessment of this indicator developed by Botelho et al. (2020) also considered the presence or absence of the problem. In this protocol, a minimum value is no more than 5% of animals with nasal discharge, while the excellent is stated at no more than 1%. Sampling information of these measures appears in section 1.3.2.

Ceroli et al. (2011) assessed nasal bacterial infections by taking 22 nasal swaps from 15 does (5 nulliparous, 5 primiparous, 5 multiparous), 3 post-weaned (35 days of age) and 4 growing rabbits (60 days of age). This bacteriological examination can be performed using standard and routine methods for isolation of *Pasteurella multocida*, *Staphylococcus aureus* and *Bordetella sp.* The categories of nasal bacterial infections are: (0) > 5% of the animals assessed with *Bordetella sp.*, *Pasteurella multocida* or *Staphylococcus aureus*; (1) between 1-5%; (2) < 1%.

The protocol developed by Trocino et al., (2022) considers the presence of nasal secretion in does, kits and growing rabbits. Sampling information of these measures appear in section 1.3.4.

Evaluation of the method and comment

The detection of nasal bacterial infections as reported by Ceroli et al. (2011) has a certain invasive nature, as it requires animal manipulation to take nasal swabs from rabbits. For this reason, feasibility is low.

The respiratory tract of rabbits can be irritated by fine dust, so it is expected that nasal discharge allows to assess this condition. According to Botelho et al. (2020), low scores for nasal discharge were observed in farms that had some rests of dust after assessing the dust-sheet test parameter. For this reason, validity of this measures is moderate.

To test the repeatability of nasal discharge of the EBENE method (ITAVI, 2018), two assessors carried out the assessment at the same time on the same rabbits without talking to each other (inter-assessor repeatability); and the same assessors performed the same assessment on two consecutive days on the same houses (intra-assessor repeatability). Nasal discharge has a moderate reliability.

<i>Nasal discharge score</i>	Validity	Feasibility	Reliability
Rosell and de la Fuente (2008)	XX	XXX	XX
De Jong et al. (2011)	XX	XXX	XX
Ceroli et al. (2011)	XXX	X	XXX
EBENE Protocol (ITAVI, 2018)	XX	XXX	XX
Dalmau et al. (2020)	XX	XXX	XX
Botelho et al. (2020)	XX	XXX	XX
Trocino et al. (2022)	XX	XXX	XX

4.1.5.2. Ocular secretion

Description of the indicator and method of assessment

Dalmau et al. (2020) protocol assesses ocular discharge, scoring the presence or absence of signs of conjunctivitis, which are considered as the presence of ocular discharge. In this protocol, a minimal value is no more than 4% of animals with ocular discharge, while the excellent is stated at no more than 2%. The assessment of this indicator used by Botelho et al. (2020) also considered the presence or absence of the problem. In this protocol, a minimum value is no more than 2% of animals with ocular discharge, while the excellent is stated at no more than 0.8%. Sampling information of these measure appears in section 1.3.2.

The protocol developed by Trocino et al., (2022) considers the presence of ocular secretion in does, kits and growing rabbits. Sampling information of these measure appears in section 1.3.4.

Evaluation of the method and comment

The respiratory tract of rabbits can be irritated by fine dust, so it is expected that ocular discharge allows to assess this condition. Botelho et al. (2020) stated that lower scores for ocular discharge were

observed in farms that had some rests of dust after assessing the dust-sheet test parameter. For this reason, validity of this measures is moderate.

<i>Ocular discharge score</i>	Validity	Feasibility	Reliability
De Jong et al. (2011)	XX	XXX	XXX
Dalmau et al. (2020)	XX	XXX	XXX
Botelho et al. (2020)	XX	XXX	XXX
Trocino et al. (2022)	XX	XXX	XXX

4.1.5.3. Coughing and sneezing

Description of the indicator and method of assessment

De Jong et al. (2011) stated that coughing and sneezing can be assessed by observing the rabbits for five minutes and noting the number of coughs or sneezes. These signs can also be assessed following Dalmau et al. (2020) protocol. This measure is assessed in a total of 10 bucks and 40 does that were not assessed for other indicators (if there are no bucks in the farm, 50 does are assessed). Each animal is assessed during 2 min, and the presence or absence of coughing or sneezing during this period is considered. For coughing and sneezing a minimal value is no more than 3% of animals coughing or sneezing, while the excellent is stated at 0%.

Botelho et al. (2020) protocol assesses this parameter from 10 cages or 40 individuals, and the animals were checked for 2 minutes in each cage. The assessment of this indicator is the same as in Dalmau et al. (2020) protocol of does, bucks and kits. In Botelho et al. (2020) growing rabbit's protocol, a minimal value is no more than 0.5% of animals coughing or sneezing, while the excellent is stated at 0% when housed individually (Dalmau, pers. com.). When group housed, a minimal value is no more than 2 cages with less than 3 events in 2 minutes and 1 cage with 3, while the excellent is stated with no more than 1 cage with less than 3 events in 2 minutes. Sampling information of these measures appear in section 1.3.2.

Evaluation of the method and comment

The link between these parameters and the ambiance may be difficult to prove. In addition, is complicated to determine the number of cough and sneeze which indicates the presence of a problem. For these reasons, validity of coughing and sneezing is moderate.

<i>Coughing and sneezing score</i>	Validity	Feasibility	Reliability
De Jong et al. (2011)	XX	XXX	XXX
Dalmau et al. (2020)	XX	XXX	XXX
Botelho et al. (2020)	XX	XXX	XXX

4.1.6. Gastrointestinal disorders

EFSA (2020) reported that digestive diseases are probably one of the main hazards for the welfare of rabbits. These can range from slight problems (transitory low feed intake, light diarrhoea) to acute and painful ones (no feed intake, weight loss, acute diarrhoea or ceacal impaction, intestinal inflammation, gastric or intestinal dilatation or swelling, mucus excretion, etc.). Although these problems usually affect young rabbits in the post-weaning period, digestive disorders are the main cause of mortality during the growing period. A possible clinical sign of digestive disorders in rabbits, in addition to body condition, is the presence of liquid manure around the anus or a firm abdomen.

4.1.6.1. Enteropathy

Description of the indicator and method of assessment

Dalmau et al. (2020) protocol assesses enteropathy by palpation of the abdomen and is considered present when this is hard. A minimal value is no more than 2% of animals affected, while the excellent is stated at 0%. Sampling information of these measures appear in section 1.3.2.

Evaluation of the method and comment

The method to assess enteropathy in adult rabbits with the protocol of Dalmau et al. (2020) has moderate feasibility as the animals need to be caught and turned over to palpate the abdomen. Moreover, in accordance with Botelho et al. (2021), the detection of this parameter demonstrated to be low, as in most of the cases the animal dies very quickly after the appearance of clinical signs.

<i>Enteropathy score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	X	XX	XX

4.1.6.2. Diarrhoea

Description of the indicator and method of assessment

According to Cerioli et al. (2011), rectal bacterial infections can be assessed by taking 22 rectal swaps from 15 does (5 nulliparous, 5 primiparous, 5 multiparous), 3 post-weaned (35 days of age) and 4 growing rabbits (60 days of age). This bacteriological examination is performed using standard and routine methods for isolation of *Clostridium spp.* and *E. coli*. The categories of rectal bacterial infections are: (0) presence > 10% pathogen bacteria; (1) presence 5-10% pathogen bacteria; (2) < 5% pathogen bacteria.

Dalmau et al. (2020) protocol assesses diarrhoea as the presence of liquid faeces around the anus of the animal. In this protocol, a minimal value is no more than 4% of animals affected, while the excellent is stated at 0%. Sampling information of these measures appear in section 1.3.2.

The protocol developed by Trocino et al., 2022 considers the presence of diarrhoea in does, kits and growing rabbits. Sampling information of these measures appear in section 1.3.4.

Evaluation of the method and comment

The detection of rectal bacterial infections as reported by Cerioli et al. (2011) has a certain invasive nature, as it requires animal manipulation to take rectal swabs from rabbits. For this reason, feasibility is low.

The method to assess diarrhoea in adult rabbits using the protocols of Dalmau et al. (2020) and Trocino et al. (2022) has moderate feasibility as the animals need to be caught and turned over to check the anus. Moreover, Botelho et al. (2021) demonstrated the detection of this parameter to be low, as in most of the cases the animal dies very quickly after the appearance of clinical signs.

<i>Diarrhoea score</i>	Validity	Feasibility	Reliability
Cerioli et al (2011)	XXX	X	XXX
Dalmau et al. (2020)	X	XX	XXX
Trocino et al. (2022)	X	XX	XXX

4.1.7. Torticollis

Description of the indicator and method of assessment

Torticollis (or head tilt) refers to the neck muscles' contraction which keeps the head in a tilted position. This condition can be seen with some frequency among rabbits and can be caused by an inflammation of the inner or middle ear or by a vestibular disease, which can be a consequence of an

infection (e.g., *Pasteurella multocida* and *Encephalitozoon cuniculi*), a stroke, neoplasia, trauma, toxins, metabolic disease, or heat stroke (House Rabbit Society team, 2011). Depending on the severity of the condition, it can affect the ability of the rabbit to remain upright, to close the “down” eye (the one facing the floor) and to eat and drink (House Rabbit Society team, 2022).

The presence of torticollis can be scored following the EBENE protocol (ITAVI, 2018). In this case, torticollis is defined as abnormal position of the head and problems for keeping the balance. It is assessed in both breeding does and fattening rabbits. Sampling information of these measures appear in section 1.3.3.

Dalmau et al. (2020) protocol present another scale to assess torticollis. For this condition, three conditions are considered: absence, when the neck is perfect; moderate problem, when the animal has a neck torsion but can eat and drink with no difficulties; and severe problem, when the neck torsion makes access to food and water difficult for the animal. In this protocol, a minimal value is no more than 4% of animals with moderate and a 2% with severe neck torsions, while the excellent is stated at no more than 2% for moderate and 0% for severe cases. In Botelho et al. (2020) protocol, the assessment of this indicator is the same as in the protocol of does, bucks and kits. The difference is the categories' definition. In growing rabbits, a minimum value is no more than 0.5% of animals with moderate and 0.2% with severe neck torsions, while the excellent is stated at no more than 0.2% for moderate and 0% for severe cases. Sampling information of this measure appears in section 1.3.2.

Evaluation of the method and comment

Botelho et al. (2020) reported that the detection of this parameter in 32 farms of growing rabbits from Spain and Portugal was different between the two auditors who assessed the farms. One of them found this problem only in one farm (5%), while the second one in five (42%). Although problems of reliability should not be discarded for this measure, differences in the health status of the farms could explain these differences.

According to Warin et al. (2021), that used the EBENE method (ITAVI, 2018), torticollis measure is highly repeatable when compare the assessment of two auditors at the same time (inter-assessor repeatability), and the evaluation of the same auditor on two consecutive days on the same farms (intra-assessor repeatability).

<i>Torticollis score</i>	Validity	Feasibility	Reliability
ITAVI (2018)	XXX	XXX	XXX
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX

4.1.8. Mastitis

Description of the indicator and method of assessment

EFSA (2020) reported that in rabbit does, mastitis is usually associated with *S. aureus* (which is also commonly involved in pododermatitis). Mastitis is very painful and is the most important gross pathological cause of culling in adult rabbit does. It can occur at any time during lactation or during the dry period. Acute mastitis (or “blue breast”) is apparent from one or more warm, reddened and swollen mammary glands which can change in colour. It can be lethal or may lead to chronic mammary gland changes after recovery. Furthermore, chronic (or purulent or suppurative) mastitis manifests as the thickening of the skin, the development of a hardened mass and the formation of abscesses of 1–12 cm in diameter that can develop into chronic lesions.

Rosell and de la Fuente (2008) assessed mastitis as presence/absence (1/0). Cerioli et al. (2011) scored this parameter by using the following categories: (0) acute or chronic generalized mastitis; (1) evidence of localized foci of mastitis; no lesions or signs; (2) presence of one nodule at palpation; (3) no lesions or signs. The final score corresponds to the mean value calculated after having controlled 10 primiparous, 10 pluriparous and 10 empty does respectively and having determined the arithmetic mean within each group.

ITAVI (2018) developed another scale in the EBENE method. This protocol defines mastitis as the congestion of the udder, sometimes with crusts or abscesses, hot, hard, and red udder. Sampling information of this measure appears in section 1.3.3.

Rosell and de la Fuente (2018) indicated that mastitis can also be assessed in lactating does (10-15% of primiparous does) by visual examination and palpation of intramammary swelling, indurations, abscesses, or penetrating wounds of the mammary tissue. Antialgic postures can be associated with chronic and acute mastitis (Figure 11). The assessment of lactating does should be done outside of the cage.



Chronic mastitis



Acute mastitis
("blue breast")



Mastitis: abnormal-antialgic posture, a
clinical sign in a diseased doe

Figure 11: Images of clinical mastitis (source: Rosell de la Fuente, 2018)

According to the Classyfarm protocol, since acute mastitis usually leads to rapid mortality and is therefore unlikely to be detected during routine visits, the most detectable forms are chronic mastitis. Therefore, the frequency of detectable chronic mastitis on the day of the visit, and its severity, should be assessed in at least 50 females, and scored according to a 3-grade scale (0-2):

- 0: absence of signs and lesions (healthy animal);
- 1: presence on palpation of one or a few non-ulcerated nodules (mild mastitis) (Figure 12);
- 2: presence of many nodules of which one or more are ulcerated (severe diffuse mastitis) (Figure 12).

When calculating the percentage, one animal scored 2 should be considered as two animals scored 1. Thus, when conversion is made, it is “Acceptable” the presence from 10% to 40% of animals scored 1 and “Excellent” in less than 10% of animals.

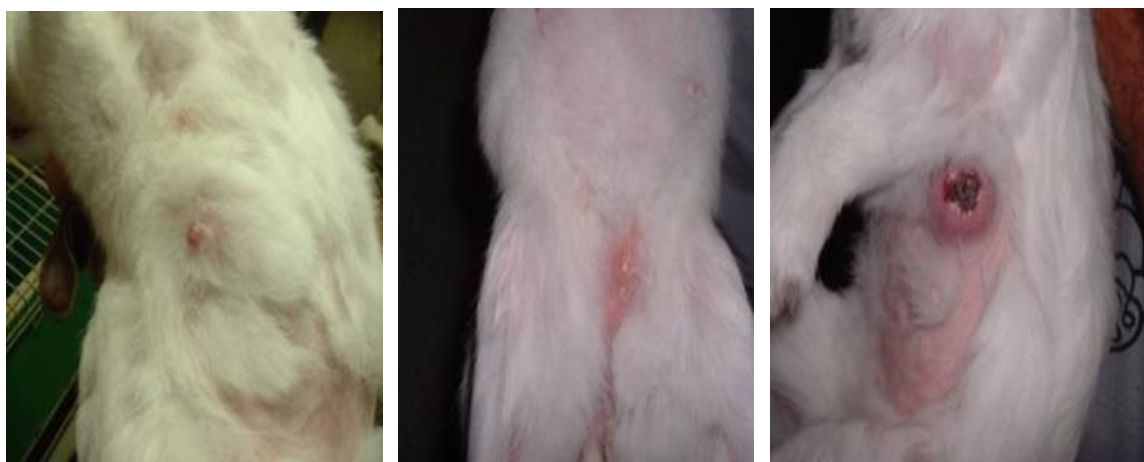


Figure 12: Mastitis scoring scheme (source Classyfarm). From the left: score 0; middle: score 1; on the right: score 2

The protocol developed by Trocino et al. (2022) considers the presence of mastitis in does. Sampling information of this measure appears in section 1.3.4.

Evaluation of the method and comment

Using ITAVI (2018) EBENE method and according to Warin et al. (2021), mastitis measure is highly repeatable when compare the assessment of 2 auditors at the same time (inter-assessor repeatability), and the evaluation of the same auditor on 2 consecutive days on the same houses (intra-assessor repeatability).

<i>Mastitis score</i>	Validity	Feasibility	Reliability
Ceroli et al. (2011)	XXX	XXX	XXX
ITAVI (2018)	XXX	XXX	XXX
Rosell and de la Fuente (2008)	XXX	XXX	XXX
Classyfarm (2022)	XXX	XXX	XXX
Trocino et al. (2022)	XXX	XXX	XXX

4.1.9. Fallen ears

Description of the indicator and method of assessment

Da Silva et al. (2022) described the fallen ears condition as ears drooped downward and anteroventrally from the base. In normal conditions, rabbits can move their ears in a variety of ways showing emotion. However, illness can impact the way that a rabbit moves them. A suddenly drooping ear is typically a sign of infection because it affects the muscles or is a sign of pain, or due to the lack of energy to make them stand erect. Furthermore, fallen ears can be a signal of overheating in the Flemish Giant rabbit. As some breeds have this phenotype as standard, this parameter is not considered for certain breeds with fallen ears, such as beliers (Dalmau et al., 2020).

Fallen ears is assessed with Dalmau et al. (2020) protocol. This indicator is considered just as the absence or presence of the problem, and only the worse of the two ears is considered. In this protocol,

a minimal value is no more than 4% of animals with fallen ears, while the excellent is stated at no more than 2%. For the protocol proposed by Botelho et al., 2020, the assessment of this indicator is the same as in the protocol of does, bucks and kits. In this protocol, a minimal value is no more than 1.2% of animals with fallen ears, while the excellent is stated at no more than 0.6%. Sampling information of this measure appears in section 1.3.2.

Evaluation of the method and comment

According to expert opinion, this measure can be difficult to evaluate for inexperienced assessors. Rabbits presenting one or both down ears can raise them when moving around the cage. Thus, given that the results of this measure can vary depending on the time of evaluation, its repeatability is moderate.

<i>Fallen ears score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XXX	XX
Botelho et al. (2020)	XXX	XXX	XX

4.1.10. Gait score

Description of the indicator and method of assessment

According to De Jong et al. (2011), the gait can be assessed to identify problems of locomotion and lame rabbits if enough space is available. Common causes of lameness in rabbits include fractures, luxation, traumatic injury/sprains, osteoarthritis, septic arthritis, splay leg/hip dysplasia, pododermatitis, spinal disease, neoplasia, and osteomyelitis (Keeble, 2006).

De Jong et al. (2011) proposed to assess the number of lame rabbits by taking the rabbit out of the cage and let it run over a certain distance, or by gently pushing the rabbits in the cage with a hand and scoring if any lame rabbits are observed (only if the cage is large enough).

Dalmau et al. (2020) assessed gait score considering three categories: no problem, if the animal does not have any difficulty in moving; moderate problem, if the animal has any difficulty in moving; and severe problem if the animal has several difficulties (no use of one leg or minimum weight bearing). In this protocol, a minimal value is no more than 4% of animals with moderate and a 2% with severe lameness, while the excellent is stated at no more than 2% for moderate and 0% for severe cases of lameness in animals. In Botelho et al. (2020) protocol, the assessment of this indicator is the same as in the protocol of Dalmau et al. (2020). The difference is the categories' definition. For growing rabbits, a minimal value is no more than 1% of animals with moderate and 0.4% with severe lameness, while the excellent is stated at no more than 0.4% for moderate and 0% for severe cases of lameness in animals. Sampling information of this measure appears in section 1.3.2.

Evaluation of the method and comment

Gait score measure is an indicator with an intermediate level of feasibility as it requires to move the rabbit inside the cage with a hand to assess lameness. If the cage is not large enough it can be difficult to make the rabbit move within it and, becoming difficult to correctly assess this parameter.

<i>Gait score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XX	XXX
Botelho et al. (2020)	XXX	XX	XXX

4.1.11. Body temperature

Description of the indicator and method of assessment

Clinical thermometers have been used to monitor body temperature in rabbits (Jaén-Téllez et al. 2020). Body temperature of rabbits can also be measured with infrared thermography (IRT). The use of infrared thermography (IRT) is a useful and novel technique for identifying changes in temperature emissivity from different parts of the body (Kunc and Knizkova, 2012).

De Lima et al. (2013) reported a work done to ascertain the possibility of usage of IRT in monitoring animal's body surface temperature under diverse ambience. The authors found out that IRT could be a good tool to assess heat stress in animals housed on typical rabbit houses. Jaén-Téllez et al. (2020) stated that body temperature with IRT in rabbit could best be taken from the ear and eyes.

Evaluation of the method and comment

Taking the body temperature by clinical thermometers has disadvantages in that contact must be maintained with the animals to take readings, which create fear in rabbits, so feasibility of the measure is moderate.

Infrared thermography has been in use to measure body temperature in rabbits; however, this technique requires high-cost equipment and for this reason, feasibility is low.




<i>Body temperature score</i>	Validity	Feasibility	Reliability
Clinical thermometer	XXX	XX	XXX
IRT (De Lima et al. 2013)	XXX	X	XXX




4.1.12. Pain




Description of the indicator and method of assessment

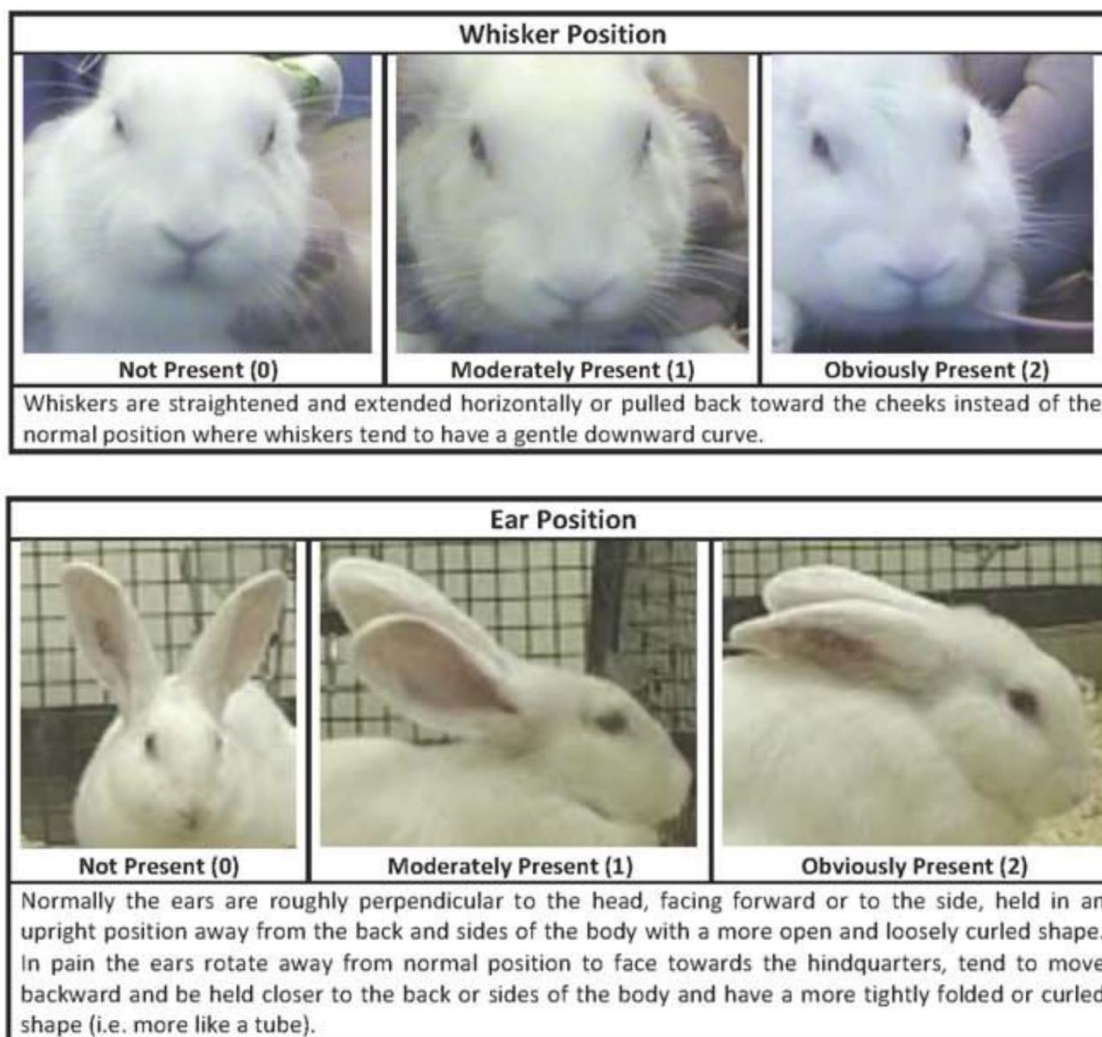
In rabbit production, most causes of acute and chronic pain are generally identified by behavioural and postural changes. Main causes of pain include several health conditions such as respiratory, enteric, and reproductive diseases, as well as pododermatitis. Other causes of pain are poor group housing conditions because of high levels of aggression and injury; poor artificial insemination technique; poor handling of animals, and some management procedures like ear tattooing or tagging, which is commonly applied to all reproductive does on the farm (EFSA, 2020).

As reported by EFSA (2020), rabbits may squeal loudly if in severe pain or distress, and they may grind the teeth, in case of chronic pain. Moreover, the use of the facial expression as an indicator of pain has been validated in rabbits (Keating et al., 2012). The Rabbit Grimace Scale assesses five different facial action units (orbital tightening, cheek flattening, nose shape, whisker position, and ear position) to create an overall score that increases when rabbits experience pain. Each facial action unit is scored according to whether it is not present (score of 0), moderately present (score 1) and obviously present (score of 2) (Figure 13).

Orbital Tightening		
		
Not Present (0)	Moderately Present (1)	Obviously Present (2)
<p>The eyelid is partially or completely closed. The globes themselves may also be drawn in toward the head so that they protrude less. If the eye closure reduces the visibility of the eye by more than half, it would be scored as '2' or 'obviously present'.</p>		

Cheek Flattening		
		
Not Present (0)	Moderately Present (1)	Obviously Present (2)
<p>Contraction around the muzzle so that the whisker pads are pressed against the side of the face. The side contour of the face and nose is angular and the rounded appearance of the cheeks to either side of the nose is lost.</p>		

Nose Shape		
		
Not Present (0)	Moderately Present (1)	Obviously Present (2)
<p>The nares (nostril slits) are drawn vertically creating a more pointed nose that resembles a 'V' more than a 'U'. The tip of the nose may also be tucked under towards the chin exaggerating this appearance.</p>		



Evaluation of the method and comment

Currently, there is no literature, protocols or studies using squeal loudly and grind the teeth indicators. The assessment of facial expression by the Rabbit Grimace Scale has been shown to correctly identify rabbits experiencing acute pain and may be a helpful tool when evaluating other husbandry or experimental procedures. According to Keating et al. (2012), the Rabbit Grimace scale has high reliability. However, this indicator has not been used in a welfare assessment during an official inspection yet. Then, there are gaps of knowledge on the feasibility and reliability for this indicator.

<i>Pain</i>	Validity	Feasibility	Reliability
Squeal loudly (EFSA, 2020)		Gaps of knowledge	
Grind the teeth (EFSA, 2020)		Gaps of knowledge	
Facial expression (Keating et al., 2012)	XXX	Gaps of knowledge	

4.2. Resource-based indicators

4.2.2. Biosecurity facilities

Description of the indicator and method of assessment

Infirmity and quarantine procedures, i.e., dedicated areas for ill animals and for entering animals, respectively, should be present and used in rabbit farms (EFSA, 2020).

According to the Classyfarm protocol, an adequate number of suitable accommodations should be available for the separation of sick or injured animals kept in groups and, where appropriate, for isolation. In the latter case, animals should be able to establish at least visual contact with other animals, if clinical and sanitary conditions permit (e.g., absence of contagious diseases); in other words, farms should be equipped with an "infirmary" environment. Cages used for this purpose should have at least one mat ("Acceptable") or the presence of individual cages of a size that allows the animal to lie down, turn around and jump, and in addition to a mat, other enrichments ("Excellent").

Evaluation of the method and comment

According to the expert opinion, the presence of an infirmary is considered a measure of high repeatability, validity, and feasibility. It is necessary to check this area on farm. If this information is collected from the animal unit manager, validity could be moderate considering it could be falsified.

<i>Presence of a dedicated infirmary score</i>	Validity	Feasibility	Reliability
Classyfarm (2022)	XXX	XXX	XXX

4.3. Management-based indicators

4.3.1. Technical performance

Description of the indicator and method of assessment

According to de Jong et al. (2011), indicators for technical performance are the following ones: percentage of positive palpated does, percentage of abortion, percentage of kindling, number of kits born alive or dead, mortality of kits before weaning, and mortality from weaning to slaughter.

According to Cerioli et al. (2011), reproductive failure and infertility can be assessed by taking 15 vaginal swaps from 15 does (5 nulliparous, 5 primiparous, 5 multiparous).

Technical performance is not directly related to welfare. However, a reduced technical performance may indicate welfare problems (Hoy and Verga, 2006). To use this as an indicator of health, good records by farmers is necessary.

Evaluation of the method and comment

Technical performance parameter was discarded in the protocols of Dalmau et al. (2020) and Botelho et al. (2020) due to different management reproduction among different farms. For this reason, it is difficult to have a standard evaluation method for this parameter (Botelho et al., 2020).

The detection of reproductive failure and infertility as reported by Cerioli et al. (2011) has a certain invasive nature, as it requires animal manipulation to extract biological sample. For this reason, feasibility is low.

<i>Technical performance score</i>	Validity	Feasibility	Reliability
De Jong et al. (2011)	XX	XXX	XXX
Cerioli et al. (2011)	XXX	X	XXX

4.3.2. Replacement

Description of the indicator and method of assessment

For does, the percentage of replacement may be a good indicator of health. Percentage of replacement of does varies between 70-160% per year (Marai et al., 2010). Management procedures may prevent diseases. These could be used in all-in-all-out (Hoy and Verga, 2007), housing breeding material

separately from production rabbits, using day-old rabbits for breeding instead of older rabbits (EFSA, 2005), applying vaccinations (Arts, personal communication), age at first insemination, and the breeding rhythm (intensive, semi-intensive or extensive).

Dalmau et al. (2020) assessed replacement by directly asking this measure to the farmer. In this protocol a minimal “Acceptable” value is no more than 110%, while the “Excellent” is stated at no more than 80%.

Evaluation of the method and comment

Replacement data is collected from the animal unit manager, so feasibility and reliability are high. Validity is moderate considering it could be falsified.

<i>Replacement score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XX	XXX	XXX

4.3.3. Time between parturitions

Description of the indicator and method of assessment

The timing of artificial insemination (AI) after kindling determines the reproductive rhythm and the interval between two consecutive kindling. Rabbit does are receptive and may be inseminated immediately after parturition. Nevertheless, under conventional conditions the most common reproductive rhythms are based on AI at 11–12 days or 17–18 days post-partum, which means an interval of 42 days or 49 days between two kindling. An example of this reproductive rhythm is presented in Figure 14. Longer reproductive rhythms, with AI later than 25 days post-partum, are also applied (EFSA, 2020).

Dalmau et al. (2020) assessed time between parturition by directly asking this measure to the farmer. In this protocol a minimal “Acceptable” value is at least 42 days, while the “Excellent” is stated on at least 49 days.

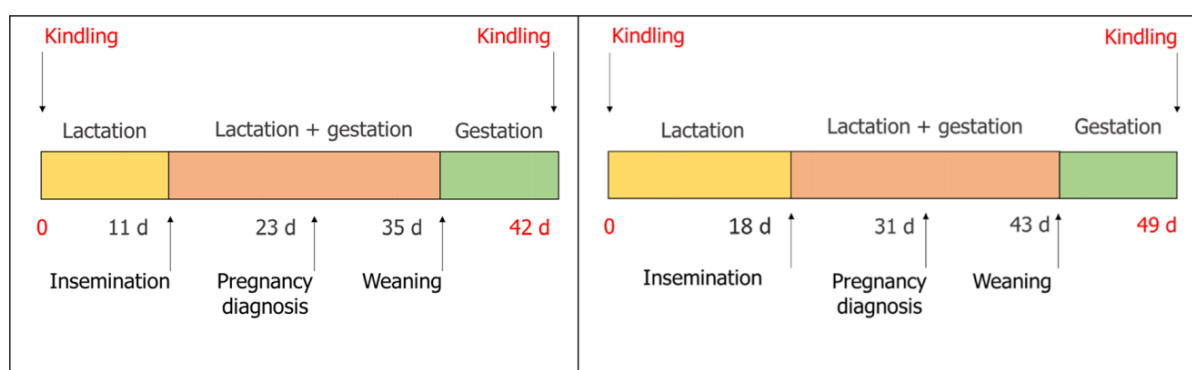


Figure 14: Kindling to kindling interval: 42 days and 49 days, respectively (source: EFSA, 2020)

Evaluation of the method and comment

Time between parturition data is collected from the animal unit manager, so feasibility and reliability are high. Validity is moderate considering it could be falsified.

<i>Time between parturition score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XX	XXX	XXX

4.3.4. Age of weaning

Description of the indicator and method of assessment

In conventional farms, kits are kept with their mother until weaning (EFSA, 2020). A delay of weaning age may help to decrease fattening mortality in poor hygienic conditions (Romero et al., 2009) due to the protective role of rabbit milk against some pathogens (Gallois et al., 2007) and to the higher weight and age at weaning (Lebas 1993).

Dalmau et al. (2020) assessed age of weaning by directly asking this measure to the farmer. In all cases, the minimal value is 35 days old or older.

Evaluation of the method and comment

Age of weaning data is collected from the animal unit manager, so feasibility and reliability are high. Validity is moderate considering it could be falsified.

<i>Age of weaning score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XX	XXX	XXX

4.3.5. Emergency killing methods

Description of the indicator and method of assessment

Council Regulation (EC) No 1099/2009 defines 'emergency killing' as the killing of animals which are injured or have a disease associated with severe pain or suffering, and where there is no other practical possibility to alleviate this pain or suffering. Emergency killing should be carried out when rabbits are in severe pain or suffering. Conditions that will induce severe pain and suffering are e.g., fractures, bone dislocations and open wounds (EFSA, 2020).

Killing methods is assessed by Dalmau et al. (2020) and Botelho et al. (2020) protocols by asking to the manager about the system used. If the day of the visit any animal should be killed, the assessor will be present to check the methodology by using the parameters considered in the next point.

Systems considered as correct are:

- Penetrative captive bolt with pithing.
- Penetrative captive bolt with bleeding.
- Penetrative captive bolt with neck dislocation.
- Electronarcosis with neck dislocation.
- Electronarcosis with bleeding.
- Lethal injection.

In kits, a concussion (blunt on the head) followed by bleeding is accepted.

A minimal value is considered only when performed correctly at farm level. The method can be lethal injection or penetrative percussion on the head followed by pitching, neck dislocation or bleeding, as well as electronarcosis with bleeding and electronarcosis with neck dislocation.

The Classyfarm protocol considers "Acceptable" when killing methods are performed by veterinarian or qualified personnel and/or by the farmer, in the latter case only if there is instruction or training on the subject (e.g., presence of a training course certificate) along with the use of proper and regularly maintained equipment, and "Excellent" when, in addition to the previous requirements, written procedures for proper abatement are provided, detailing responsibilities, equipment and periodic checks to facilitate proper emergency management.

Evaluation of the method and comment

According to expert opinion, killing methods is considered a measure of high repeatability, validity, and feasibility.

<i>Killing methods score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX
Classyfarm (2022)	XXX	XXX	XXX

4.3.6. Mutilation for identification

Description of the indicator and method of assessment

For identification, ear marks (metal or plastic), microchips or tattoos can be used. They are mainly used for identification of the reproductive rabbits (males and females). There are differences among countries about which identifications are allowed. In the Netherlands, ear marks are not allowed. In Spain only tattoos are used, whereas in Switzerland ear marks (metal or plastic) and tattoos are used. When using ear marks, it is important that no excessive tissue growth is visible (de Jong et al., 2011).

Dalmau et al. (2020) allows to assess mutilation for identification. This parameter is assessed in bucks and does and it will be asked to the manager and checked in the animals assessed for other purposes. The excellent is stated when is not performed at all.

Evaluation of the method and comment

According to expert opinion, mutilation for identification is considered a measure of high repeatability, validity, and feasibility.

<i>Mutilation for identification score</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XXX	XXX	XXX
Botelho et al. (2020)	XXX	XXX	XXX

4.3.7. Number of farmer daily inspections

Description of the indicator and method of assessment

Health problems could be reduced by using a strict management of housing hygiene combined with daily checking of the animals looking at their health. The Brambell report mention that “all stock should be inspected at least once a day, and preferably twice”. The concept of minimum inspection requirements, or of a tolerable interval between inspections for animals, has been transposed into EU and national legislation (e.g., EU Directive 98/58/EC). In accordance with this Directive, all animals kept in husbandry systems in which their welfare depends on frequent human attention shall be inspected at least once a day. According to Veissier et al. (2008), it is possible to prescribe inspection intervals, but it is also clear that good stockmanship is not only a matter of the frequency with which animals are observed, but the ‘quality’ of the human intervention.

According to the Classyfarm protocol, animals shall be visually inspected at least once a day (“Acceptable”). It is considered “Excellent” when two or more inspections/day are made, and observations are recorded in a paper or digital logbook. For the visual inspection, it must be borne in mind that the healthy rabbit has an activity appropriate to its age, sex, breed or type, clean bright eyes, good posture, clean healthy skin and fur, undamaged feet, normal gait, and that immobility in rabbits may indicate pain or fright. The condition of the droppings, feed and water consumption, growth of rabbits and cleanliness of nest sites in use should also be checked. A source of light strong enough to see clearly each animal shall be available during inspection. Such inspections shall be done in the less disturbing manner.

Evaluation of the method and comment

Number of farmer daily inspections is collected from the animal unit manager, so feasibility and reliability are high. Validity is moderate considering it could be falsified.

Number of farmer daily inspections	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XX	XXX	XXX
Classyfarm (2022)	XX	XXX	XXX

5. Appropriate behaviour

Requirements applicable to rabbits in the legislation:

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. Negative social behaviour

Description of the indicator and method of assessment:

Negative social behaviour, aggressions, can be part of normal social behaviour of rabbits in particular during the establishment of a hierarchy in a new group. However, it can also be a sign of an oversized group causing bad welfare. During assessment, social behaviours could be difficult to detect or, rarely observed because it is not performed often enough (de Jong, 2011). Then, injuries, wound or scratches are indicators of negative social behaviour, i.e., aggression of conspecifics.

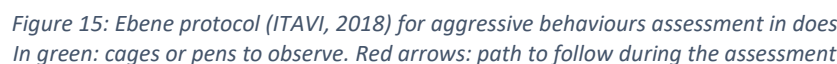
Two methods are used to assess negative social behaviour, a direct one with the observations of bites toward conspecifics or an indirect one with the count of injuries and wounds. For the latter, see section 4.1.1.1.

Direct-Observation of aggressive behaviours

In the protocol of Dalmau et al. (2020), 10 bucks and 40 does (or 50 does if no bucks are housed in the farm) are observed for negative social behaviour during 2 minutes (per cage). Negative social behaviour is when a doe or a buck is biting another one, including kits in the same cage of any conspecific in other adjoining cages. In this protocol, there are two categories of results:

- "Excellent" when no animal has bitten other animals;
- "Not acceptable" when one animal has been seen biting another animal.

In the EBENE Protocol (ITAVI, 2018), aggressive behaviours in does in maternity (threw itself on the wire mesh) and in growing rabbits (fights between rabbits, bites) are assessed on 50 does well distributed in the room (Figure 15) and on every growing rabbit in the cages and pens observed (Figure 16). For growing rabbits, the assessment lasts two minutes per cage/pen and each occurrence of these behaviours are noted. For does, the presence of aggressive behaviours (among other behaviours) is noted with a scan (only one time) when the observer is in front of the previous cage (if the observer is in front of the cage, does have been observed stopping any activity).



The following ranking has been set by expert opinion. The observation of behaviours could be more difficult than counting wounds and injuries. And, if aggressive behaviours are not observed in the moment or in two minutes observations, it does not imply the complete absence of aggressiveness between animals. These two types of methods, direct and indirect, may however give information on the level of animal welfare. Nevertheless, spending two minutes per several cages observing the animals could be difficult to set during an official veterinary inspection. The validity of the Ebene protocol for does concerning this indicator seems to be low since the assessment is really quick (one scan before walking in front of the cage). However, as it is less time-consuming, the feasibility is higher.

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Ebene protocol (ITAVI) for growing rabbits	XX	X	XX
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5.1.2. Positive Social behaviour

Description of the indicator and method of assessment:

The assessment of positive social behaviour was only found in the Ebene protocol (ITAVI, 2018) via the assessment of mutual grooming. However, other social positive behaviours are part of the normal behaviour pattern of rabbits such as body contact, nose-body contact, sniffing and nose-nose contact (Lehmann, 1991 in De Jong et al. 2011).

As in 5.1.1., the protocol differs between reproducing does and growing rabbits. For growing rabbits, the assessor observes all the animals in each selected cages/pens (Figure 16) for two minutes and note each time mutual grooming is observed. For does, 50 animals are observed in the cages selected (Figure 15). Mutual grooming between females, in group housed does is noted, if observed, when the observer is in front of the previous cage (avoiding disturbance of the assessed does).

Evaluation of the method and comment:

According to expert opinion, the validity of this indicator is supposed to be higher in growing rabbits than in does, with this protocol, because of the difference of time of observation (does are only observed once whereas growing rabbits are observed during two minutes per cage/pen). About the reliability, spending two minutes per several cages observing growing rabbits' groups could be difficult to set during an official veterinary inspection, decreasing the feasibility of this indicator according to expert opinion. As, does observations are less time consuming, the feasibility is considered high for a veterinary inspection. Nevertheless, social behaviour (negative and positive) is an indicator difficult to use because these behaviours are difficult to observe during assessment as not performed often (de Jong, 2011).

<i>Mutual grooming</i>	Validity	Feasibility	Reliability
For does	X	XX	XX
For growing rabbits	XX	X	XX

5.1.3. Abnormal behaviour

Description of the indicator and method of assessment:

Stereotypic behaviours are defined as abnormal behaviour repeated obsessively without apparent aim (Dalmau et al., 2020). In rabbits, over-grooming, head shaking, swaying, wall pawing, wire gnawing, scratching, or biting the cage are examples of stereotypic behaviours. However, it is the frequency of the behaviour that make it a stereotypic behaviour and not only the type of behaviour per se.

In rabbits' welfare assessment protocols, abnormal behaviours are assessed with the same methodology as negative social behaviour. For example, in Dalmau et al. (2020), 10 bucks and 40 does (or 50 does if no bucks are housed in the farm) are observed during 2 minutes (per cage). The result is "Excellent" if 0% of observed animals showed stereotypic behaviour and is "Acceptable" if 0 to 4% of the animals expressed abnormal behaviours.

In the Ebene protocol (ITAVI, 2018), as for negative social behaviours, the protocol is slightly different between reproducing does and growing rabbits. In this protocol, the stereotypic behaviours are defined as "eating continuously the wire mesh and scratching the housing environment for more than

3 seconds". For growing rabbits, the assessor observes all the animals in each selected cages/pens (Figure 16) for two minutes and note each time a stereotypic behaviour is expressed. For does, 50 animals are observed in the cages selected (Figure 15). The presence or absence of stereotypes is noted before passing ahead the assessed doe to avoid disturbance.

Evaluation of the method and comment:

The following ranking has been set by expert opinion. As in 5.1.1., observation during two minutes per several cages could be difficult to set during an official veterinary inspection. And, if stereotypic behaviours are not observed on the moment or in two minutes observations, it does not imply the complete absence of abnormal behaviours. Indeed, the authors in Dalmau et al (2020), indicated that the methodology of two minutes of observation per animal had been previously tested with positive results (observation of stereotypes), it may need some adjustments to increase its sensitivity. The validity of the Ebene protocol (ITAVI, 2018) for does concerning this indicator seems to be lower since the assessment is really quick (one scan before walking in front of the cage). However, as it less time consuming, the feasibility is high.

<i>Abnormal behaviour</i>	Validity	Feasibility	Reliability
Dalmau et al. (2020)	XX	X	XX
Ebene protocol (ITAVI) for does	X	XX	XX
Ebene protocol (ITAVI) for growing rabbits	XX	X	XX

5.1.4. Nervousness

Description of the indicator and method of assessment:

The assessment of nervousness of does and growing rabbits has only been found in the Ebene protocol (ITAVI, 2018). It is determined with the observation of these behaviours: tapping with paws, turn around repeatedly, freezing (stay still), retreat movement, escape to the bottom of the cage/pen, ears laid back, hunched back.

As in 5.1.1., the protocol differs between reproducing does and growing rabbits. For growing rabbits, the assessor observes all the animals in each selected cages/pens (Figure 16) for two minutes and note each time a nervousness behaviour (as described above) is expressed. For does, 50 animals are observed in the cages selected (Figure 15). The presence or absence of nervousness is noted before passing ahead the assessed doe to avoid disturbance.

Evaluation of the method and comment:

The following ranking has been set by expert opinion. The validity of this indicator to assess animals' welfare is supposed to be low because it is susceptible to be affected by the presence of an unknown observer. However, although less accurate when used it on its own, it could be interesting to use it in complement to other behavioural indicators. About the reliability, spending two minutes per several cages observing growing rabbits' groups could be difficult to set during an official veterinary inspection, decreasing the feasibility of this indicator according to expert opinion.

<i>Nervousness</i>	Validity	Feasibility	Reliability
For does	X	XX	XX
For growing rabbits	X	X	XX

5.1.5. Self-Grooming behaviour

Description of the indicator and method of assessment:

The observation of self-grooming behaviour of does and growing rabbits has only been found in the Ebene protocol (ITAVI, 2018).

As in 5.1.1., the protocol differ between reproducing does and growing rabbits. For growing rabbits, the assessor observes all the animals in each selected cages/pens (Figure 16) for two minutes and note each time self-grooming behaviours are expressed. For does, 50 animals are observed in the cages selected (Figure 15). The presence or absence of self-grooming behaviours is noted before passing ahead the assessed doe to avoid disturbance.

Evaluation of the method and comment:

The following ranking has been set by expert opinion. There is a gap of knowledge on the validity of this indicator to assess rabbits' welfare. Although less accurate when used it on its own, it could be interesting to use it in complement to other behavioural indicators. About the reliability, spending two minutes per several cages observing growing rabbits' groups could be difficult to set during an official veterinary inspection, decreasing the feasibility of this indicator according to expert opinion.

<i>Grooming behaviour</i>	Validity	Feasibility	Reliability
For does	Gaps of knowledge	XX	XX
For growing rabbits		X	XX

5.1.6. Good relationship with human

Description of the indicator and method of assessment:

A good relationship between human and rabbits prevents fear in the rabbits' life and is valuable for welfare. To reduce the fear of humans, it is recommended to handle the rabbits, particularly during the sensitive periods of the first week of life and near the time of nursing (EFSA, 2005). The relationship with humans can be evaluated with the assessment of the fear of humans. To this end, several tests exist such as the handling test, the human approach test (in pens with group-housed rabbits, with a single rabbit in a test cage), the contact test (hand against a cage and number of contacts evaluated) or the tonic immobility test (e.g. (de Jong, 2011)). However, the tonic immobility test is not valid and feasible in farms to measure fear of humans (in particular because of problems of standardisation between farms and interpretation) (Zomeño et al., 2019), this is why the method of the tonic immobility test will not be described in this document.

In the protocol of Dalmau et al. (2020), the human approach test is assessed on 10 bucks and 40 does (50 does if no bucks on the farm). For 30 seconds, the assessor stays in front of the cage touching the frontal area of the cage with a short stick (no more than 10 cm long). A new stick is used for each rabbit. Three possible results:

- "Confident": the animal touches or sniffs the stick;
- "Interested": the animal shows some interest in the stick and approaches to at least 10 cm from the stick;
- "Not interested or fearful": any other situation.

The final outcome is:

- "Excellent" if at least 20% of the animals assessed touched the stick and 40% did not but were interested;

- “Acceptable” if at least 10% of the animals assessed touched the stick and 20% did not but were interested.

Evaluation of the method and comment:

The following ranking has been set by expert opinion. This test seems feasible on-farm even if it requires at least 25 minutes of inspector’s time and 50 sticks. The scoring system is simple enough to be supposed reliable. However, as the rabbit has to approach a stick, this test could assess the fear of a novel object and/or curiosity more than the fear of humans.

<i>Good relationship with humans</i>	Validity	Feasibility	Reliability
Human approach test (Dalmau et al. 2020)	X	XX	XXX

5.2. Resource-based indicators

5.2.1. Presence of enrichments

Description of the indicator and method of assessment:

Enrichment materials is provided in the rabbits’ housing environment to fulfil their natural behaviour such as gnawing, digging, scratching, hiding, and jumping. These materials are elevated platforms, shelters, litter, or eatable substrate (wood...).

Other important enrichments, particularly for group rabbit farming, are:

- separate compartment/chamber that provides additional space and isolation possibilities
- tunnel/tube that provides the chance to isolate and rest in groups;
- visual barrier, to limit hierarchy competitions between rabbits.

Gnawing materials

Gnawing behaviour is part of normal behaviour repertoire of rabbits. Gnawing material must be available to enable them to engage in exploratory behaviour and perform gnawing behaviour. When rabbits cannot express this behaviour, it can result in negative such as oral stereotypies and conspecific aggressions. Gnawing objects can be natural (wooden beam, pressed hay bale/brick, "long-fibre" food) or artificial materials (e.g., small metal chain or the wood/brick fixed on the cage) but some of them are more efficient to fulfil gnawing needs than others: straw, hay or soft wood (Rommers and Jong, 2010 in (de Jong, 2011)). In any case they should be easy to clean and not cause injury or health problems. Litter material can also stimulate digging behaviours (exploring by scratches the substrate) which can only be expressed on deep littered floors or in outdoor runs. Gnawing materials should be available for all the animals (growing rabbits, reproducing adults), at all age and in a sufficient quantity to avoid competition in group-housing rabbits (EURCAW Poultry-SFA, 2021).

In the protocol of Dalmau et al. (2020), gnawing materials, such as cubes of dried hay or wood sticks, are assessed by checking their presence or absence in 34 bucks and 91 does (or 125 does if there are no bucks). The result is “Excellent” if 100% of cages/pens assessed are with gnawing material, and “Acceptable” if at least 50% of them have gnawing materials.

The Classyfarm protocol assesses with a single item for both breeding and growing rabbits the quality of structures i.e., absence of noxious structures and the presence of enrichments, considering the presence of a mat and gnawing material as indispensable to have an “Acceptable” value; while the presence of a platform or park systems as optimal requirements, leading to the “Excellent” rate.

Nesting materials

Enrichment used as nesting materials by does is essential to promote nest building behaviour and improve survival and growth of the kits (de Jong, 2011). Abnormal behaviours (gnawing and digging wire) may appear in case of a lack of suitable nesting materials (RDA, 1997 in de Jong, 2011). Nesting materials used could be as varied as rabbit hair, hay straw, shredded paper or wood shaving (Dalmau et al., 2020).

In the Dalmau protocol (2020), nesting materials are assessed, when possible, in 10 does 24h prior to the date expected for kindling. Provision of a sufficient quantity of dry and clean nesting material is checked. The scoring is as follow:

- “Excellent”: Nesting material in 100% of the cases;
- “Acceptable”: Up to 1 doe without nesting material;
- “Not acceptable”: Any other case.

Elevated platforms

Providing accessible elevated platforms increases the space allowance, allows growing rabbits to withdraw conspecifics, and does to withdraw kits (when the young have left the nest), to rest and to perform active behaviour (de Jong, 2011). Elevated platforms are also important for the expression of jumping and hiding behaviours (under the platform which play also a role of shelter) and to reduce fear, restlessness, excessive grooming and wire gnawing (Hansen and Berthelsen, 2000). The surface of the platforms should allow rabbits to sit, stretch lying and perform comfort behaviours (de Jong, 2011). The design of the platform must facilitate their access and use by the animals. The elevated platform should also be high enough to allow rabbits to hide underneath. However, since its presence could cause an increase in the soiling of the cage environment, more attention must be taken to preserve the hygiene of such furnished cages.

In the protocol of Dalmau (2020), the presence of elevated platforms is assessed in 17 to 25 cages but only in cages with kits older than 21 days. The result is “excellent” when 100% of assessed cages have platforms and “acceptable” if only 50% (at least) of the cages have platforms. However, the presence of elevated platforms can also be assessed by presence/absence notation in every category of animals (*authors’ note*).

Evaluation of the method and comment:

Environmental enrichments can improve the welfare of all rabbits’ category (Birolo et al., 2022; Buijjs et al., 2011; Lang and Hoy, 2011; Szendro and Dalle Zotte, 2011; Martino et al., 2016; Huang et al., 2021; EFSA, 2020; Garcia, 2020). Thus, their presence should be valued and rewarded for all animal categories since they promote higher welfare (EURCAW Poultry-SFA, 2021). They are valid, feasible and reliable indicators.

<i>Presence of enrichments</i>	Validity	Feasibility	Reliability
Enrichment materials	XXX	XXX	XXX
Nesting materials	XXX	XXX	XXX
Elevated platforms	XXX	XXX	XXX

5.2.2. Height of the system (in non-open-top systems)

See section 3.2.2.

5.2.3. Space allowance

See section 3.2.1.

5.2.4. Free movement

See section 3.1.3.

5.3. Management-based indicators

5.3.3. Access of does to the nest

Description of the indicator and method of assessment:

Most of the farmers use controlled lactation to manage nursing in their does. Controlled lactation is to open the nest, allowing the does to visit her kits, just for a few minutes once a day (Dalmau et al., 2020). The aim of controlled lactation is to approach does' behaviour in natural conditions where, after kindling, does leave the nest and come back once a day only to suckle their kits for a few minutes (Trocino and Xiccato, 2006). Controlled lactation would reduce kits mortality due to crushing and increase kits weight homogeneity (Coureaud, 1998 in Dalmau et al., 2020).

In the protocol of Dalmau (2020), it is the time of accessing the nest which is assessed, evaluating the regularity giving to the doe to access to the nest every day at the same hour. This parameter is checked by asking the farmer or eventually by observation during the audit if possible. The scoring is as follow:

- Excellent: less than one hour of difference day to day;
- Acceptable: between one to two hours of difference day to day;
- Not acceptable: any other case.

Evaluation of the method and comment:

This indicator is considered valid, feasible and reliable.

Does accessing to the nest	Validity	Feasibility	Reliability
	XXX	XXX	XXX

Prioritisation of future topics to work on during the next period

In 2023 and 2024, the EURCAW-Poultry-SFA will develop indicators factsheets based on the more relevant and useful indicators for rabbits' welfare assessment described in this report.

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