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To the Minister of Agriculture, Nature and Food Quality

Advice from the Director of the Office for Risk Assessment & Research

On the evaluation of the Animals Act

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Background

The Dutch Animals Act (*Wet dieren*)[1] is one of a number of policy instruments used to safeguard animal welfare and animal and public health in the Netherlands. Its aim is to achieve a simple, transparent and coherent system of rules that dictate how animals are to be treated by humans and manage the risks that animals or animal products could create for humans and other animals. The Animals Act was drafted with the following ambitions in mind[2]:

- To bring together coherent legislation to make it clear to various target groups (animal keepers, veterinarians and traders, etc.) which rules apply to the activities to be carried out by them;
- To protect animals by recognising their intrinsic value and, by doing this, sending out a strong signal that the function animals have for humans can be subordinated to or weighed up against their intrinsic value. There was also a desire to include a provision on the general duty of care, sending out a signal that the social responsibility humans have towards animals goes beyond keeping them in the manner required;
- To protect humans and the environment by drafting rules to ensure that animals and animal products are safe for humans and also limit and avoid the unwanted emissions of substances into the environment;
- To balance different interests when drafting regulations. The interests to be balanced are animal health and animal welfare, the individuality and integrity of animals, the protection of human health and safety, the protection of the environment in relation to the use of animal feed and veterinary medicinal products and the honesty of trade in animals and animal products.

The Animals Act came into effect in a number of phases from 1 January 2013 up to and including 1 July 2014. Article 10.11. of this Act stipulates that the Act is to be evaluated after five years. In 2019, the Ministry of Agriculture, Nature and Food Quality (Ministry of LNV) launched a project to evaluate the Animals Act and the underlying regulations. The underlying decrees and ministerial regulations include

[1] Animals Act, BWBR0030250.
[2] Explanatory Memorandum, Lower House, 2007-2008 session, 31 389, No. 3. An integrated framework of rules on kept animals and related subjects.

the Animal Keepers Decree (*Besluit houders van dieren*)[3], the Animal Keepers Regulation (*Regeling houders van dieren*)[4] and the Veterinarians Decree (*Besluit diergeneeskundigen*).[5]

The object of the evaluation by the Ministry of LNV is to ascertain whether these ambitions have been achieved and also whether the instruments that the Act provides for are effective if rules are broken.

In recent years, the Office for Risk Assessment & Research (*BuRO*) of the Netherlands Food and Consumer Product Safety Authority (NVWA) has issued a number of recommendations and risk assessments on the subject of animal welfare, among other things. The BuRO also monitors (international) scientific developments in the field of animal welfare. In the current evaluation, the BuRO will establish a link between the animal welfare risks identified in the risk assessments and recommendations on the one hand and the Animals Act on the other hand. By doing this, the BuRO aims to establish whether animal welfare risks can be managed adequately under the current Animals Act and also which modifications it deems necessary.

Approach

See Appendix 1 for the main questions and underlying questions that have emerged from the Ministry of Agriculture, Nature and Food Quality (LNV) action plan for the implementation of the Animal Acts evaluation. The BuRO contribution is based on the questions marked in bold in the appendix.

The BuRO has been guided by the following main question:
Does the Animals Act provide a sufficient basis for the management of animal welfare risks?
This main question has been translated into the following sub-questions:

1. Are the biggest animal welfare risks identified in the risk assessments mitigated by legislation and regulations?
2. Are the basic requirements for good animal welfare - good farm management, care, housing and diet, for example - provided for sufficiently in legislation and regulations?
3. Do the rules ensure that the intrinsic value of animals is taken into consideration when establishing and enforcing rules?
4. Which changes need to be made to the Animals Act to improve and/or safeguard animal welfare better?

The BuRO has the following secondary objective too: to identify any obstacles to its assessment of animal welfare risks. For example, the availability of data and the connection with the Animals Act. This translates into the final sub-question:

5. Is the BuRO able to obtain all of the information necessary to carry out a sound risk assessment?

[3] Animal Keepers Decree, BWBR0035217.
[4] Animal Keepers Regulation, BWBR0035248.
[5] Veterinarians Decree, BWBR0035091.

To answer all of these questions, the BuRO conducted a scientific literature review (see Appendix 3 for the search strategy) and prepared an overview of the risks observed and recommendations from advisory reports and risk assessments published previously. The overview above also includes the corresponding underlying legislation and regulations from the Animals Act. The BuRO contribution was established independently and separately to the evaluation carried out by other parts of the Netherlands Food and Consumer Product Safety Authority (*NVWA*).

Scope

- The BuRO contribution focuses on the risks observed, on recommendations set out in advisory reports published previously and on risk assessments carried out from 2013 to the end of 2019. In this BuRO evaluation, these advisory reports are brought together and combined with the BuRO vision on the Animals Act with animal welfare in mind;
- Given the advisory reports and risk assessments published by the BuRO, this document will focus on the welfare of farm animals;
- The Veterinary Medicines Decree (*Besluit diergeneesmiddelen*) and the Veterinary Medicines Regulation (*Regeling diergeneesmiddelen*) will not be included in this evaluation. This is because a number of European regulations on veterinary medicines were adopted in January 2019, because of which a number of rules on veterinary medicines will be scrapped from and amended in the Animals Act and underlying decrees and regulations in the years ahead;
- Transport-related animal welfare recommendations and risks have not been included in this evaluation. No national standards for specific regulations on the transport of animals have been included in the Animals Act or underlying regulations. The transport of animals falls under European Regulation (EC) No. 1/2005;[6]
- Animal welfare recommendations and risks in respect of the slaughterhouse stage have not been included in this evaluation. No national standards for specific regulations on the slaughterhouse stage (with the exception of the killing of animals without stunning them first) have been included in the Animals Act or underlying regulations. European Regulation (EC) No. 1099/2009[7] applies.

Answers to the questions

Sub-question 1: Are the biggest animal welfare risks identified by the risk assessments mitigated by legislation and regulations?

The Animals Act is a framework that sets out most of the biggest risks to animal welfare. However, there is a lack of detail on how these risks are to be managed. There is also an absence of guidelines in the underlying regulations on the proper management of animal welfare risks and requirements for good animal welfare. For example, many of the risks fall under qualitative goal-oriented regulations (open standards) and there are no specific regulations at all for a number of common

[6]Council Regulation (EC) No. 1/2005 of 22 December 2004 on the protection of animals during transport and related operations and amending Directives 64/432/EEC and 93/119/EC and Regulation (EC) No 1255/97, OJ L 3, 5.1.2005, p. 1–44.
[7]Regulation (EC) No 1099/2009 of the European Parliament and of the Council of 24 September 2009 on the protection of animals at the time of killing (text relevant to EEA), OJ L 303, 18.11.2009, p. 1–30.

farmed animal species. Added to this, the animal welfare field has developed since the legal framework was written and adopted, because of which the framework is no longer suitable.

The majority of the 109 welfare consequences (also referred to as welfare problems) that were assessed in the risk assessments on the red meat, dairy, poultry meat, egg and animal feed supply chain are covered by qualitative goal-oriented regulations (also referred to as open standards) - whether or not directly traceable as such – in legislation and regulations. This involves both the direct identification of welfare consequences and also the underlying hazards and risk factors in the legislation and regulations in question. The following seven welfare consequences identified in the risk assessments carried out in the various chains are not addressed in legislation or regulations:

1. Breeding-related health problems in cattle;
2. The after-effects of beak trimming on meat poultry;
3. The after-effects of beak trimming on laying hens;
4. Skeletal abnormalities in ducks, broilers and grandparent and parent stock;
5. Damage to the plumage of broiler grandparent and parent stock;
6. The smothering of laying hens (caused by them huddling together);
7. A fear of people in laying hens.

According to legislation and regulations, six welfare consequences are permitted under certain conditions. These consequences are the result of the following animal management interventions:

1. The disbudding of cattle, sheep and goats;
2. The killing of cattle, sheep and goats without stunning them first;
3. The grinding of piglets' teeth;
4. The castration of piglets;
5. The tail docking of piglets;
6. The cutting of the back toe of grandparent and parent poultry-rearing stock.

Just one welfare consequence is permitted according to legislation and regulations: limiting the behavioural repertoire of sows by placing them in separate housing shortly before farrowing and during the lactation period. Finally, the 'ear tagging' intervention on cattle, sheep and goats, which causes the 'pain' welfare consequence, is compulsory.

Recurring issues in the chain assessments are the various – often animal-species-specific - welfare consequences that ensue from selection for high productivity. For example, the burning out of laying hens, the limited behavioural repertoire possible for broilers and meat turkeys and skeletal abnormalities in ducks, broilers and parent and grandparent stock. Legislation and regulations often apply to the welfare consequences resulting from this breeding policy. For example, animals that appear to be sick or injured must immediately receive appropriate care. No direct legislation or regulations apply to the underlying risk factor (the hazard), being selection for high productivity, for farm animals in the Netherlands and Europe.

Many of the risks fall under qualitative goal-oriented regulations (open standards). Some standards are clear - for example, the care to be given to sick and wounded animals - while others give animal keepers and enforcement agencies little to go on. For example, one standard states that animals must be given sufficient space for their physiological and ethological needs. But what is "sufficient space"? The physiological and ethological needs that animals have are understood to mean species-specific, natural and social behaviour, including interaction with people and conspecifics.[8] However, this has not been specified in any more detail for each animal species. There is also a lack of specific legislation and regulations on the biggest risks applicable for popular farmed animal species like cattle and sheep in other respects. The standards stipulated in legislation and regulations ought to have a sound scientific basis.

The conversion of qualitative goal-oriented regulations into quantitative goal-oriented regulations would create added value in certain areas. For example, maximum ammonia values and minimum housing-unit dimensions (based on the size of the animal to be accommodated in it). The quantitative goal-oriented regulations could serve as a lower limit, thus safeguarding a minimum level of animal welfare and making the rules clearer for animal keepers and enforcement agencies. Prescriptive regulations could be appropriate in respect of the interventions to be carried out on animals, for example. This would guarantee the use of procedures that cause animals the least stress and pain.

The Animals Act also offers the sector the opportunity to put together good practice guides containing detailed goal-oriented regulations. It has been possible to submit guides of this nature to the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland*) for assessment since 27 November 2019. No such guides have been approved to date (August 2020) (RVO.nl, 2019). Although the sector may also have included several specifics of goal-oriented regulations in private quality systems, this is not the main objective of a quality system. Added to this, the requirements stipulated in a quality system will only apply for the participants in question.

Sub-question 2: Are the basic requirements for good animal welfare - good farm management, care, housing and diet, for example - provided for sufficiently in legislation and regulations?
The basic requirements for good animal welfare are provided for in part but not in full. As such, they are provided for inadequately in legislation and regulations. This is because good animal welfare involves meeting basic requirements, such as sufficient food, water and good health, and also ensuring that animals have positive experiences. Given the absence of the need for animals to have positive experiences in legislation and regulations, the basic requirements for good animal welfare are not covered in full by current legislation and regulations. Added to this, there are no specific rules on farm management by livestock farmers - which has a significant impact on animal welfare - just qualitative goal-oriented regulations.

[8] Explanatory Memorandum, Bulletin of Acts and Decrees 2014, 210, Decree of 5 June 2014, setting out the regulations governing keepers of animals (Animals Keepers Decree).

The Animals Act takes the five freedoms[9] that the Farm Animal Welfare Council (FAWC, 1993) formulated based on the findings of Brambell as the starting point for animal welfare. However, today, the scientific community looks at the ability of animals to adapt, their experiences and also their quality of life when considering animal welfare. Good welfare involves more than the absence of factors that negatively affect welfare. Today, it is widely accepted that good animal welfare involves more than just the absence of negative experiences; it must also include positive experiences (Boissy et al., 2007; Edgar et al., 2013; Mattiello et al., 2019). Good welfare involves an interplay of affective state, natural behaviour and good health. The ability that an animal has to adapt must enable it to cope with negative experiences and the balance of negative and positive experiences it has during its life must be positive. Pain, suffering, fear or lasting harm must be necessary, proportionate and minimal and the way in which animals are kept and cared for must meet the needs that they have. Therefore, positive experiences are important for good welfare. Positive experiences have not been included explicitly in Dutch legislation and regulations yet. If policy, certification and regulations were to focus on positive welfare more, this would have the advantage that positive experiences would cause the number of negative experiences to decrease. After all, it will only be possible for animals to have positive experiences if their basic needs have been met. Instead of demonstrating that the failure to meet the needs animals leads to frustration or stress, it is sufficient to demonstrate that animals experience something as positive (Yeates & Main, 2008). Animal welfare should be assessed on the basis of a combination of solid (animal-based) indicators for both negative and positive experiences.

Animal welfare is determined almost entirely by the actions of human beings. Animal keepers are responsible for providing food, water and housing, for treating sick animals and deciding on group composition. With this in mind, the knowledge, skills, motivation and working conditions of animal carers are important factors for animal welfare (Mellor & Beausoleil, 2015; Mellor, 2016). Although management, care, housing and food are all covered by the Animal Keepers Decree, for most animal species this is provided for in the form of a qualitative goal-oriented regulation (open standard) in Article 1.7. The basic professional competence applicable, such as vital knowledge and skills, have not been elaborated on for the keepers of most animal species. A proficiency certificate is only required for broilers and the commercial keeping of companion animals. There is a lack of regulations and legislation that impose specific requirements on the actions of/management by livestock farmers.

[9] The five freedoms (FAWC, 1993) are:
1 freedom from thirst, hunger and malnutrition;
2 freedom from physical and thermal discomfort;
3 freedom from pain, injury and disease;
4 freedom from fear and chronic stress;
5 freedom to express normal patterns of behaviour.

Sub-question 3: Do the rules ensure that the intrinsic value of animals is taken into consideration when establishing and enforcing rules?

The definition of the term 'intrinsic value' has not been elaborated on in the Animals Act. Meijboom (2012) states that moral values play a role in current thinking about the intrinsic value of animals when used by humans. According to these moral values, animal abuse and discomfort must be avoided, efforts must be made to achieve positive welfare and the well-being and integrity of animals must be respected. This means that, after considering moral values, the decision will sometimes need to be made to refrain from the use of animals and also that preconditions must be created within which animals are able to have the best life possible.

The Animals Act defines 'intrinsic value' as follows:

The Animals Act
Article 1.3. Intrinsic value

1. The intrinsic value of the animal is recognised.

2. Recognition of intrinsic value as referred to in Subsection 1 is understood to mean recognition of the value that animals possess in their own right as sentient beings. In drawing up rules under or pursuant to this Act, and in taking decisions on the basis of these rules, due consideration shall be given to the impact of these rules or decisions on the intrinsic value of the animal, notwithstanding other legitimate interests. In all cases, any violation of the integrity or well-being of animals, beyond what is reasonably necessary, shall be avoided and the care reasonably required by the animals guaranteed.

3. For the purpose of subsection 2, the care reasonably required by animals shall in any event include safeguarding the animals against:
a. thirst, hunger and malnutrition;
b. physical and physiological discomfort;
c. pain, injury and diseases;
d. fear, distress, and chronic stress;
e. limitation of their natural behaviour;

insofar as can be reasonably required.

The term 'intrinsic value' is deliberately not elaborated on because "*an unambiguous interpretation of the definition of intrinsic value is not possible"*. "*In society, views differ about what the intrinsic value of animals entails*."[10]

Based on a recognition of the intrinsic value of animals and the social realisation that humans should be responsible for animals and, as such, take care of them, the general duty of care is set out in Article 1.4 of the Animals Act. The Explanatory Memorandum states: *"This proposed provision seeks to ensure that everyone, whether they be animal keepers, traders, carriers, feed or drug manufacturers or*

[10] Explanatory Memorandum, Lower House, 2007-2008 session, 31 389, No. 3. An integrated framework of rules on kept animals and related subjects.

veterinarians, acknowledges the responsibility they have towards animals and also the inherent, independent value of animals in their actions and that they always act with the above in mind. This might then result in the decision not to carry out a certain action or activity, even though the action or activity in question is permitted. Just because something is possible does not mean that it has to be done." The duty of care clarifies the intrinsic value of animals more and also the need to consider their interests in respect of certain actions. However, the scope of this article in relation to animal welfare risks is not clear yet. This statutory provision has not entered into force yet either.

Because the interpretation of the term 'intrinsic value' has not been elaborated on in full, it is difficult to determine whether the intrinsic value of animals was taken into consideration for most rules when setting them. The article on the duty of care has not entered into force yet either. It should be observed that the definition of the term 'intrinsic value' in the Animals Act does not correspond with the definition used by Meijboom (2012). The latter believes that positive welfare is one of the aspects of the intrinsic value of animals, but this is not covered in legislation and regulations.

However, the consideration of the intrinsic value of animals when setting rules has been elaborated on for a number of rules. For example, in connection with the ban against using mammals that are wild animal species in circuses and other performances and also against the transport of these animals for this purpose.[11] For example, it is stated that: *"The government believes that the impairment of the welfare and integrity of non-domesticated mammals in a circus cannot be justified by the interests of the circuses, trainers and the public, whether this be tradition, economic importance or entertainment, as this significantly impairs the welfare and integrity of these animals and the interests of circuses, trainers, hirers and the public are just limited."*

Where the performance of physical interventions on animals is concerned, the Act takes the 'no, unless' principle[12] as its basis, given the intrinsic value that animals have. However, many interventions are permitted (under certain conditions), on pigs primarily. The Council on Animal Affairs (*RDA*) developed an assessment framework for animal interventions in 2013 (RDA, 2013). It has resulted in the banning of a number of interventions. For example, the use of nose rings on male pigs and the freeze branding of cattle.[13] The interventions currently permitted could be held up against this assessment framework again, to check whether these interventions are still acceptable based on current insights, developments and scientific knowledge.

[11] Explanatory memorandum, Bulletin of Acts and Decrees 2015, 328, Decree of 28 August 2015, amending the Animal Keepers Decree in connection with the ban against using mammals that are wild animal species in circuses and other performances and also against the transport of these animals for this purpose.
[12] Explanatory memorandum, Bulletin of Acts and Decrees 2014, 162, Decree of 16 April 2014, setting out the regulations governing veterinarians (Veterinarians Decree).
[13] Explanatory memorandum, Bulletin of Acts and Decrees 2018, 146, Decree of 26 April 2018, amending the Veterinarians Decree and the Animal Keepers Decree in connection with various animal-welfare related amendments.

Sub-question 4: What changes need to be made to the Animals Act to improve and/or safeguard animal welfare better?

- The definition of animal welfare must be updated to reflect the most recent accepted scientific insights, including positive experiences and the ability of animals to adapt;
- It must be possible to manage the greatest animal welfare risks via reference points in scientifically valid, specific and targeted regulations per animal species;
- Quantitative goal-oriented regulations and prescriptive regulations must reflect the most recent accepted scientific insights;
- The definition of 'intrinsic value' must be elaborated on.

Sub-question 5: Is the BuRO able to obtain all of the information necessary to carry out a sound risk assessment?

The BuRO is not currently able to obtain all of the information it needs to be able to carry out sound risk assessments. This is because too little data is being registered structurally and in a manner that is accessible. A comprehensive risk assessment requires information about the prevalence of welfare consequences and exposure to hazards/risk factors. This information is often not available. For most animal species, the Animals Act only requires data to be recorded on the mortality and treatment of sick animals. Animal keepers are not required to actively provide this data to government. The BuRO does not have access to this data, with the exception of data about broilers. Broiler farmers are required to keep more records, which are of a more detailed nature, including data about mortality and stocking density. This data must be passed on to RVO.nl too. However, there are many other welfare consequences and hazards/risk factors for which livestock owners are under no legal requirement to keep records. Because of this, there is little insight into the current status of animal welfare in the Netherlands. Animal welfare is also difficult to measure due to a lack of data and, as such, difficult to check and enforce as well. If various animal indicators were to be recorded at slaughterhouses and livestock farms, this could give the supply chain feedback about animal welfare and help provide the BuRO with the data it needs to do comprehensive and substantiated risk assessments.

Main question:

Does the Animals Act provide a sufficient basis for the management of animal welfare risks?

According to the latest scientific insights, the current Animals Act and underlying legislation and regulations are currently failing to manage animal welfare risks sufficiently. The Animals Act provides a basis, but many of the subjects covered in it are elaborated on in insufficient detail in the underlying regulations. Animal welfare involves more than the absence of negative experiences. There is a lack of attention in legislation and regulations for the positive experiences of animals and the basic needs specific to each animal species.

Advice

1. Redefine the term 'animal welfare'. Besides the absence of negative aspects (the five freedoms), also include positive aspects ('a life worth living') as important criteria for government action and the setting of rules to protect animals. Also establish the definition of the 'intrinsic value' of animals and elaborate on this definition, so that it can also be used as the starting point for the development of policy, legislation and enforcement;
2. Ensure that Article 1.4 (General duty of care) gains more significance for the protection of animal welfare and then enters into force;
3. Ensure that specific legislation is drafted for the types of animal species kept most in the Netherlands, based on the basic needs that these animals have. This would limit the biggest risks, such as the inability of animals to express natural behaviour. When doing this, draw on the quantitative goal-oriented regulations applicable for each animal species instead of qualitative goal-oriented regulations (open standards). Where scientific standards are available, terms like 'sufficient' and 'adequate' could be replaced by a science-based minimum standard;
4. Also ensure that the existing parts of the Animals Act and underlying legislation and regulations correspond with recent accepted scientific insights. For example, the definition of 'animal welfare' referred to above, the term 'needs of animals'[14] and the amount of roughage fed to veal calves;
5. When evaluating the Animals Act, reconsider whether the intrinsic value and, as such, the integrity, of animals has been safeguarded sufficiently for all permitted interventions and also raise the question of whether there are any new scientific insights or developments that render certain current permitted interventions unnecessary;
6. Elaborate on basic proficiency requirements by setting more specific requirements for the actions, knowledge and skills of and management by animal keepers;
7. During the periodic evaluation of legislation and regulations, focus on any changes necessary and consider scientific (and social) developments.

Yours faithfully,

The Office for Risk Assessment & Research
prof. dr. Antoon Opperhuizen

[14] EU Directive 98/58/EC and the Animal Keepers Decree refer to the physiological and ethological needs of animals. The needs that animals have originate in the brain and are not physiological or ethological. These needs can only be met via a physiological change or certain behaviour. As such, it is better to refer to 'biological needs' or 'needs' (Broom, 2017).

Substantiation

1. Legislation and animal welfare

1.1. The Animals Act

After taking a number of years to draft, the Dutch Animals Act came into force in a number of phases from 1 January 2013 up to and including 1 July 2014; the Explanatory Memorandum was published in 2008. The Animals Act is one of a number of policy instruments used to safeguard animal welfare and animal and public health. Its aim is to achieve a simple, transparent and coherent system of rules that dictate how animals are to be treated by humans and also manage the risks that animals or animal products could create for humans and other animals. Article 10.11. of the Animals Act stipulates that the Act is to be evaluated after five years. This evaluation will also cover the following decrees and regulations that fall under the Animals Act:

- The Animal Feedstuffs Decree (*Besluit diervoeders*) 2012[15] and the Regulation on Feedstuffs (*Regeling diervoeders*) 2012;[16]
- The Animal Products Decree (*Besluit dierlijke producten*) [17] and the Regulation on Animal Products (*Regeling dierlijke producten*);[18]
- The Enforcement and Other Animals Act Matters Decree (*Besluit handhaving en overige zaken Wet dieren*)[19] and the Regulation on Enforcement and Other Animals Act Matters (*Regeling handhaving en overige zaken Wet dieren*);[20]
- The Animals Keepers Decree and Animal Keepers Regulation;
- The Veterinarians Decree (*Besluit diergeneeskundigen*) and Veterinarians Regulation (*Regeling diergeneeskundigen*);[21]
- The exemption regulation on the sale of ungraded eggs (*Vrijstellingsregeling verkoop ongesorteerde eieren*).[22]

1.2. Types of legislation and regulations

The rules set out in the Animals Act and underlying legislation and regulations can be broken down into duty of care obligations, means-oriented regulations and goal-oriented regulations. Besides this, standards may be open or closed and qualitative or quantitative.

1.2.1. *Duty of care obligations*

"Duty of care obligations are general obligations that pertain to the observance of a certain degree of care with a view to the interests to be protected by the legislation in question and may relate to either an act or omission by a party to which the obligation in question applies." (Uylenburg et al., 2010). For example, Article 2.1(6) of the Animals Act: *"Everyone must provide an animal in need with the necessary*

[15] The Animal Feedstuffs Decree 2012, BWBR0032346;
[16] Regulation on Feedstuffs 2012, BWBR0028123;
[17] Animal Products Decree, BWBR0032335;
[18] Regulation on Animal Products, BWBR0032462;
[19] The Enforcement and other Animals Act Matters Decree, BWBR0032334;
[20] Regulation on Enforcement and other Animals Act Matters, BWBR0032523;
[21] Veterinarians Regulation, BWBR0035238;
[22] Exemption regulation on the sale of ungraded eggs, BWBR0035132.

care." Article 1.4 of the Animals Act pertains to the general duty of care. However, it has not entered into effect yet.

1.2.2. Means-oriented regulations

"*Means-oriented regulations stipulate which technical means or technologies the party to which the regulation applies must use with a view to the interests that the legislation in question aims to protect."* (Uylenburg et al., 2010). Two examples of means-oriented regulations are Article 2.65(1c) of the Animal Husbandry Decree - *"Each parent animal will have the following at the very least: a perching rod of at least 7 cm and a minimum clearance of 10 cm under the perching rod and a minimum of 35 cm above it"* - and Article 2.22(4) of the Animal Keepers Decree - "*Piglets must have a solid floor or a floor covered with a rubber mat; the floor space provided must be a minimum of 0.6 m^2 per litter of piglets."*

1.2.3. Goal-oriented regulations

The Animals Act and underlying legislation and regulations consist largely of goal-oriented regulations. ter Borg et al. (2009) define a goal-oriented regulation as follows: *"A regulation that formulates a certain goal. The party to which the regulation applies is free to choose the means used to achieve the goal in question."* The Explanatory Memorandum says the following about goal-oriented regulations: "*Where possible, goal-oriented regulations will be given preference, partly to encourage animal keepers to take responsibility and show initiative. If regulations of this nature are not possible - where the implementation of EU rules is the case, for example - or the risk is too great that rules of this nature could lead to misunderstandings, specific provisions or standards (*means-oriented regulations or quantitative goal-oriented regulations*) will be the preferred choice."* The following is stated in the Explanatory Memorandum too: *"Consideration will always be given first to the question of whether - for example - further goal-oriented regulations could have added value as a follow up to the obligation to provide the animals in question with all due care."*

There are two types of goal-oriented regulations: quantitative and qualitative. A quantitative goal-oriented regulation requires the achievement of a specific and measurable result. The following are examples of quantitative goal-oriented regulations. Article 2.23(1) of the Animal Keepers Decree: *"The light intensity in a housing unit intended for pigs will be a minimum of 40 lux, measured vertically at animal height, for a minimum of 8 hours a day."* and Article 2.65e: *"Animals that are reared to be kept as parent stock must have access to a floor area of at least 666 cm2 per animal."* Qualitative goal-oriented regulations are so-called open standards (ter Borg et al., 2009). Many goal-oriented regulations from the Animals Act and the Animals Keepers Decree are qualitative goal-oriented regulations, because of which they state the goal to be achieved but not the immediate, specific measurable result to be achieved. Examples of qualitative goal-oriented regulations are Article 1.6(2) of the Animal Keepers Decree - *"Animals must be given the space they need to meet their physiological and ethological needs."* – and Article 1.7(c) of the Animal Keepers Decree – *"Anyone who keeps animals will ensure that animals that appear to be ill or injured immediately receive appropriate care".*

1.3. EU regulations on animal welfare

Many pieces of Dutch legislation and regulations on animal welfare originate from the EU. Member states are required to incorporate EU directives into their national legislation and regulations (Veissier et al., 2008). The national legislation of EU countries must be equivalent to EU directives at the very least but may also be stricter. EU directives exist on the subject of farm animals[23], calves[24], pigs[25], broilers[26] and laying hens.[27]

Scientific research and research on public opinion about animal welfare are an important part of the legislation and policy development process in the EU (Broom, 2017). When the European Commission initiates the drafting of legislation on animal welfare, the Directorate-General for Health and Food Safety (DG-SANTE) at the European Commission may consult the EFSA scientific committee about animal health and welfare and a working group will draft a scientific report. These reports are then used as input for European regulations (Veissier et al., 2008). For example, specific EU legislation on veal calves. Research in the 1970s and 1980s revealed serious welfare problems for veal calves. A recommendation by the Council of Europe in 1988 and a scientific report commissioned by the European Commission in 1990 resulted in EU Directive 91/629/EEC[28] in 1991. A number of years later, the EU Scientific Veterinary Committee published a report on the welfare of veal calves. This report led to Directive 97/2/EC[29] and the phasing out of veal crates and inappropriate food (no roughage and food with a very low iron content) for calves. These scientific reports and the ensuing EU directive resulted in an improvement in animal welfare at the time (Broom, 2017).

1.4. Specific legislation and regulations per animal species

Besides the introduction of specific legislation for animal species as a result of EU legislation, the Netherlands also included specific legislation in the Animal Keepers Decree on the parent stock of broilers, meat turkeys, rabbits and minks and regulations on the commercial sale, delivery and keeping of companion animals for shelter or breeding purposes. These rules, with the exception of rules on companion animals, originate from the product boards and were added to the Animals Keepers Decree when the product boards were abolished in 2015.

Broom (2017) observes an inconsistency in EU regulations about the number of animals being kept in the EU and specific regulations about these animal species. Broilers are the farm animal species kept most in the EU. Although specific EU

[23] Directive 98/58/EC of the Council of 20 July 1998 concerning the protection of animals kept for farming purposes, OJ L 221, 8.8.1998, p. 23–27.
[24] Directive 2008/119/EC of the Council of 18 December 2008 laying down minimum standards for the protection of calves, OJ L 10, 15.1.2009, p. 7–13.
[25] Directive 2008/120/EC of the Council of 18 December 2008 laying down minimum standards for the protection of pigs, OJ L 47, 18.2.2009, p. 5–13.
[26] Directive 2007/43/EC of the Council of 28 June 2007 laying down minimum rules for the protection of chickens kept for meat production, OJ L 182, 12.7.2007, p. 19–28.
[27] Directive 1999/74/EC of the Council of 19 July 1999 laying down minimum standards for the protection of laying hens, OJ L 203, 3.8.1999, p. 53–57.
[28] Directive 91/629/EEC of the Council of 19 November 1991 laying down minimum standards for the protection of calves. OJ L 340, 11.12.1991, p. 28–32.
[29] Directive 97/2/EC of the Council of 20 January 1997 amending Directive 91/629/EEC laying down minimum standards for the protection of calves. OJ L 025, 28.01.1997 pp. 0024–0025.

regulations are in place for them, the same does not apply for the second up to and including the sixth animal species kept most (trout, salmon, rabbits, ducks and turkeys), for example. The top 10 in the Netherlands is different (see Table 1).

Table 1. The farm animals kept most in the Netherlands, according to the agricultural census, legislation and EFSA reports.

Animal species	Number of animals 2018 (CBS, 2018)	EU legislation	Dutch legislation	EFSA report or opinion
Laying hens	45.5 million	Yes	Yes	Yes
Broilers	41.8 million	Yes	Yes	Yes
Pigs	12.4 million	Yes	Yes	Yes
Broiler parent stock	8.3 million	No	Yes	Yes
Cattle, excl. veal calves	2.9 million	No	No	Yes
Laying-hen parent stock	1.5 million	No	No	No
Veal calves	1.0 million	Yes	Yes	Yes
Meat ducks	0.9 million	No	No	No
Mink	0.9 million	No	Yes	Yes
Sheep	0.9 million	No	No	Yes

In his report, Broom (2017) makes three recommendations about animal welfare legislation and regulations:

- Housing-related legislation has a greater impact on animal welfare than regulations on short-term risks like transport and interventions do;
- The protection of animals against the biggest animal welfare risks ought to be incorporated into specific legislation and regulations for the animal species in question;
- These specific regulations and legislation must be scientifically based.

The animals being kept most will not necessarily be subject to the biggest welfare risks. A risk assessment will consider the impact (severity x duration) of welfare consequences, the prevalence of welfare consequences and exposure to the hazard in question. Thus, risks with moderate severity but a longer duration, high prevalence or major exposure will affect the welfare of a population of animals more than short-term welfare consequences with the same severity. Therefore, the overall welfare of animals will benefit more if living conditions that do not meet their needs are banned rather than merely regulating interventions, transport or killing methods. Animals spend most of their lives in these husbandry conditions. Examples include rules on the housing used for veal calves, individual cages for sows and the banning of battery cages (Broom, 2017). However, allowance must be made for the effect of the accumulation of relatively small welfare effects; the combination of these effects could still result in a negative balance ultimately. Taken together, a number of minor negative experiences could culminate in a situation in which animals no longer have the ability to adapt. For example, pigs in a non-enriched

environment display more stress-related behaviour and are more susceptible to disease than pigs in an enriched environment are (van Dixhoorn et al., 2016). Due to the combination of stressors (negative experiences), animals are no longer able to adapt and become ill.

For some animals species - cattle, for example - no specific regulations are in place to regulate their environment and housing; just the general, non-specific and non-extensive science-based legislation ensuing from EU Directive 98/58/EC applies in this situation (Broom, 2017). The EFSA has drafted scientific reports and opinions for many of these animal species in the meantime (see Table 1 for an overview). However, these reports have not resulted in specific EU regulations for these animal species yet. For example, reports about dairy cattle (EFSA, 2009b), beef cattle (EFSA, 2012d) and sheep (EFSA, 2014). As an aside to these findings, it should be observed that the introduction of specific legislation will not necessarily guarantee good animal welfare. Specific legislation does not automatically guarantee high levels of compliance. There is sometimes scope for exceptions too. For example, broilers in Europe are still frequently experiencing leg problems and the tails of many pigs are still being docked because of the exceptions allowed for, despite the applicability of specific legislation on both of the above (Broom, 2017).

In the Netherlands, specific legislation and regulations are not in place for all of the animal species used in livestock farming either. Just the general rules on keeping animals for agricultural purposes apply for the 2.9 million cattle, 1.5 million parent stock of laying hens, 0.9 million meat ducks and 0.9 million sheep in the Netherlands. Extra consideration needs to be given to how to use legislation and regulations to manage the welfare risks of meat ducks, which are not protected by specific EU or Dutch legislation; nor is any EFSA report or opinion available. The same applies to the parent stock of laying hens. The advice on risks in the poultry meat chain (*Advies over de risico's van de plumveevleesketen*) states the following about the welfare of meat ducks: *"Many of the welfare problems that broilers have are experienced by ducks too: for instance, skeletal abnormalities, species that grow too quickly and become too heavy and the prevalence of footpad dermatitis. One specific welfare problem for ducks is the absence of natural open water or alternatives to natural open water. Ducks are not able to express their natural grooming behaviour, which requires slightly deeper water at the very least. This results in secondary welfare problems: dirty noses and eyes."* (BuRO, 2018b). Broom (2017) also mentions the lack of open water as a welfare issue for meat ducks, as well as excessive stocking density, poor feather condition and musculoskeletal problems.

1.5. Type of legislation for animal welfare

To achieve the welfare outcome envisaged via legislation, O'Hara & O'Connor (2007) advise as follows about legislation and regulations on the animal welfare of production animals:

- Incorporate minimum welfare requirements, with animals as the starting point, into regulations and also specify the corresponding welfare indicators.[30]

Minimum welfare requirements must focus on the needs of animals and be goal-oriented rather than demand-specific characteristics (means-oriented regulations) for housing and management. In this way, focus is placed on the welfare outcome envisaged for animals rather than on fixed housing requirements and dimensions (O'Hara & O'Connor, 2007). With this in mind, the goal-oriented regulations used in the Animals Act and underlying regulations would seem a suitable legislative instrument to use to safeguard animal welfare.

However, these goal-oriented regulations are elaborated on insufficiently in Dutch legislation and regulations. Also see Section 5 for several examples. Goal-oriented regulations could be elaborated on in a number of ways. One option would be to specify the relevant welfare indicators, preferably to be measured against the animals themselves, in the goal-oriented regulations. In this way, consideration would actually be given to the welfare and experiences of animals and not their environment. By specifying welfare indicators, livestock farmers would be given the opportunity to meet minimum welfare requirements based on their own knowledge and experience.
O'Hara & O'Connor (2007) give an example of how the above has been implemented in legislation and regulations in New Zealand. The New Zealand Animal Welfare Act 1999 states that laying hens must have enough suitable food and water. According to the minimum requirements stipulated in the New Zealand Animal Welfare (Layer Hens) Code of Welfare 2005, this means - among other things - that food is to be provided every day and the feeding method used must have been designed to avoid competition and injuries. The indicators of acceptable welfare named by O'Hara & O'Connor (2007) include the daily inspection of the food available, the absence of competition at the troughs and the possibility for smaller chickens to access troughs too.

These parts of the New Zealand Animal Welfare Act and Code of Welfare are similar to the requirements set out in the Dutch Animals Act and Dutch Animal Keepers Decree. However, the welfare indicators referred to are not specified in Dutch legislation and regulations. One option would be to include these welfare indicators in good practice guides. The Animals Act provides for the drafting of good practice guides that contain recommendations for compliance with legislation and regulations (Article 8.44 of the Animals Act). This may help animal keepers with rules. The legislator provides for the preparation of these guides by the business community or sector organisations themselves: *"After all, the parties concerned will be more inclined to accept the specific interpretation of and elaboration on*

[30] A category or observation, recording or evaluation used to assess animal welfare. The indicator could be animal-based, management-based or environment-based. EFSA, 2012c). Examples include production, mortality, injuries, skin damage and stereotypy, etc.

regulations because they have prepared the guides themselves."[31] Since 27 November 2019, it has been possible to submit good practice guides that elaborate on goal-oriented regulations in the Animals Act to the Netherlands Enterprise Agency for assessment (RVO.nl, 2019). In August 2020, no good practice guides had been officially adopted yet. The sector may also have included several specifics of goal-oriented regulations in private quality systems, but this is not the main objective of a quality system. Added to this, the requirements stipulated in a quality system will only apply for the participants in question.

Work is also under way in Europe to develop welfare indicators to verify compliance with legislation. The European Commission has created EU Reference Centres for Animal Welfare (EURCAW) to improve the enforcement of animal welfare legislation. In October 2018, the EURCAW-Pigs was created, followed by the reference centre for poultry and other small production animals (rabbits, for example) in October 2019 (European Commission, 2020). The EURCAW-Pigs has already developed various factsheets containing indicators for tail biting and housing in farrowing crates, among other things (EURCAW-Pigs, 2020).

2. Sentient beings and the intrinsic value of animals

2.1. Intrinsic value in the Animals Act

Europe recognises that animals are sentient beings: the Treaty of Amsterdam[32], which was signed in 1997 and entered into force in 1999, states that: *"THE HIGH CONTRACTING PARTIES,DESIRING to ensure improved protection and respect for the welfare of animals as sentient beings*". In the Treaty of Lisbon[33], which was signed in 2007, this was amended and incorporated into Article 13: "*In formulating and implementing the Union's agriculture, fisheries, transport, internal market, research and technological development and space policies, the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals, (..)"*. In the Netherlands, this has been incorporated into Article 1.3 of the Animals Act. The term 'intrinsic value' of animals and the five freedoms are an important starting point for the Animals Act. According to Article 1.3 of the Animals Act, the intrinsic value of animals is recognised.

[31] Explanatory Memorandum, Lower House, 2007-2008 session, 31 389, No. 3. An integrated framework of rules on kept animals and related subjects.
[32] Treaty of Amsterdam amending the Treaty on European Union, the Treaties establishing the European Communities and certain related acts, OJ C 340, 10.11.1997, p. 1–144.
[33] Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, Signed in Lisbon, 13 December 2007, OJ C 306, 17.12.2007, p. 1–271.

The Animals Act
Article 1.3. Intrinsic value

1. The intrinsic value of the animal is recognised.

2. Recognition of intrinsic value as referred to in subsection 1 is understood to mean recognition of the value that animals possess in their own right as sentient beings. In drawing up rules under or pursuant to this Act, and in taking decisions on the basis of these rules, due consideration shall be given to the impact of these rules or decisions on the intrinsic value of the animal, notwithstanding other legitimate interests. In all cases, any violation of the integrity or well-being of animals, beyond what is reasonably necessary, shall be avoided and the care reasonably required by the animals guaranteed.

3. For the purpose of subsection 2, the care reasonably required by animals shall in any event include safeguarding the animals against:
a. thirst, hunger and malnutrition;
b. physical and physiological discomfort;
c. pain, injury and diseases;
d. fear, distress, and chronic stress;
e. limitation of their natural behaviour;

insofar as can be reasonably required.

The term 'intrinsic value' is deliberately not elaborated on in the Explanatory Memorandum, because "*an unambiguous interpretation of the definition of intrinsic value is not possible"*. "*In society, views differ about what the intrinsic value of animals entails*."

Based on a recognition of the intrinsic value of animals and the social realisation that humans should be responsible for animals and, as such, take care of them, the general duty of care is set out in Article 1.4 of the Animals Act. The Explanatory Memorandum states: *"This proposed provision seeks to ensure that everyone, whether they be animal keepers, traders, carriers, feed or drug manufacturers or veterinarians, acknowledges the responsibility they have towards animals and also the inherent, independent value of animals in their actions and that they always act with the above in mind. This might then result in the decision not to carry out a certain action or activity, even though the action or activity in question is permitted. Just because something is possible does not mean that it has to be done."* The duty of care clarifies the intrinsic value of animals more and also the need to consider their interests in respect of certain actions. It is a precautionary duty and ensures that everyone is aware of their responsibilities towards animals. The general duty of care must always be taken into consideration, whereas Article 1.3 primarily pertains to rules: *"In drawing up rules under or pursuant to this Act, and in taking decisions on the basis of these rules, due consideration shall be given to the impact of these rules or decisions on the intrinsic value of the animal (..)"*. However, the scope of Article 1.4 in relation to animal welfare risks is not clear yet. This article has not entered into effect yet either.

2.2. Intrinsic value in literature

The recognition of animals as sentient beings and the intrinsic value of animals are moral values that humans give to animals. According to Meijboom (2012), different views exist on the moral value of animals and the justification of their use:

1. Animals only have instrumental value → when using animals, there are no justifications in the interest of animals, only respect for the autonomy of other people;
2. Animals have moral value as sentient beings → animals are able to experience pleasure and pain; justification implies that welfare is maximised when using animals;
3. Animals have an intrinsic value → justification implies respect for individual animals;
4. Animals have inherent dignity → humans and animals are moral equals; justification only necessary if animals are being used as a goal in itself.

When humans use animals, the usefulness and necessity of doing so must be demonstrated and the duty of care to animals must be met. Actions involving animals have consequences for animals and humans are morally responsible for this. If actions are not in the interest of animals, the action should be justified (RDA, 2018).

The view on the intrinsic value of animals (3) overlaps with the view of animals that have moral value because they are sentient beings (2). The view of animals as sentient beings must take the interest of animals into consideration because animals are beings that are able to experience pain and pleasure. The view on intrinsic value pertains to the intrinsic value of animals themselves too. It is important for humans to respect animals. Humans have a duty to animals, not just to ensure their welfare but to respect their integrity (well-being) too (Meijboom, 2012). The justification of the use of animals implies respect for the individual animal and must weigh up the intrinsic value of the animals in question and the value of the goal. The moral dilemmas faced here have no unequivocal reference point. As such, the 'no, unless' principle must be applied when impairing the intrinsic value of animals and the limitations placed on animals must be justified on the basis of the value of the goal (Meijboom, 2012; RDA, 2018).

Figure 1 shows the different views on and duties that humans have towards animals. As regards the view on the intrinsic value of animals, animal abuse and discomfort must be avoided, efforts must be made to achieve their positive welfare and the integrity of animals must be respected. With this in mind, the decision will sometimes need to be made to refrain from the use of animals and preconditions will need to be created within which animals are able to have the best life possible (Meijboom, 2012).

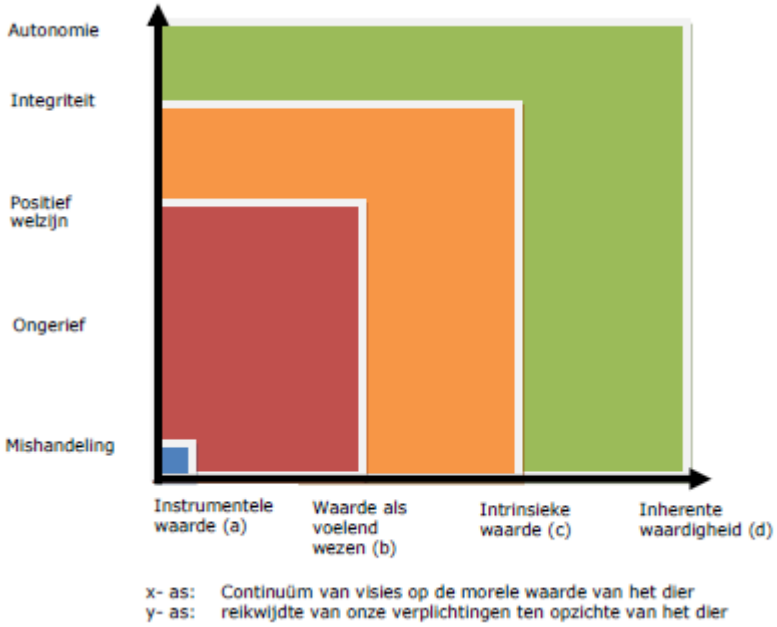

Figure 1. Connection between the continuum of views on the moral value of animals and duties towards animals (from: Meijboom (2012)). [34]

3. Animal welfare: the five freedoms and other animal welfare definitions and concepts

The five freedoms set out in Article 1.3(3) of the Animals Act are important criteria for government action and when setting rules to protect animals in the Netherlands.[35] Thus Dutch legislation defines welfare as the absence of negative welfare. This definition is still frequently used as the starting point for policy at a national and international level and for marketing and quality systems (FAWC, 2009; Ohl & van der Staay, 2012; Mellor & Webster, 2014; Mellor, 2016), but no longer reflects recent scientific developments in respect of animal welfare.

3.1. The five freedoms

The British Animal Welfare Council (FAWC) elaborated on the five freedoms in 1993, based on the requirements for animal welfare formulated by the Brambell committee in 1965 (FAWC, 1993; Ohl & van der Staay, 2012):

1. Freedom from thirst, hunger and malnutrition;
2. Freedom from discomfort;
3. Freedom from pain, injury and disease;
4. Freedom from fear and distress;
5. Freedom to express normal behaviour.

Initial definitions of animal welfare were based primarily on the importance of biological functioning, being good health in particular and also growth, production

[34] On the x-axis Continuum of views on the moral value of the animal: Instrumental value (a), Value as a sentient being (b), Intrinsic value (c), Inherent dignity (d). On the y-axis scope of our duties to animals: Autonomy, Integrity, Positive welfare, Distress and Abuse
[35] Explanatory Memorandum, Lower House, 2007-2008 session, 31 389, No. 3. An integrated framework of rules on kept animals and related subjects.

and reproduction. Attention was limited to negative experiences and their effect on welfare.
Although the five freedoms are presented as freedoms, the truth is that animals can never be entirely free of negative experiences. Therefore, the starting point when formulating the five freedoms was for animals to be 'as free as possible' and the freedoms were formulated more as ambitious or idealised goals (Green & Mellor, 2011; Mellor, 2016). Therefore, the freedoms were of less direct value for the setting of rules, but were a suitable starting point for the subjects to be focused on by livestock farmers and codes of practice designed to improve animal welfare (Mellor & Webster, 2014). For example, to ensure that animals have freedom from thirst, hunger and malnutrition, they must have access to water and a suitable diet, which will enable them to stay healthy and vital (FAWC, 2009). This approach focuses on the biological functioning of animals and not on their experiences (Mellor & Webster, 2014). The first four freedoms focus on the absence of negative welfare. The fifth freedom, being the freedom to express normal behaviour, does provide scope for positive experiences but does not name them explicitly (Yeates & Main, 2008; RDA, 2018; Lawrence et al., 2019). Bracke & Hopster (2006) also see positive experiences as part of normal patterns of behaviour and refer to the 2001 report by the 'future of the livestock farming sector' thinking group: "*The object of the last point (of the five freedoms*) *is for it not to be made impossible for animals to express their normal patterns of behaviour. This translates as the possibility for poultry to roam around, for pigs to root and for cows to graze in pastures."* (Wijffels et al., 2001).

3.2. What is animal welfare?

The five freedoms are an example of how animal welfare has been implemented in the past. There is no uniform definition of the term 'animal welfare'. Over the years, new scientific insights have emerged, because of which the term is changing and will continue to do so in the future. Added to this, definitions are influenced by the moral and ethical standards of society and the determination of what constitutes an acceptable welfare situation is strongly influenced by how much society knows about animal welfare on the one hand and public values on the other hand (Mellor et al., 2009; Green & Mellor, 2011; Ohl & van der Staay, 2012). The term 'animal welfare' is used frequently in society, media and in political circles. From an animal science point of view, animal welfare involves the state of animals and not the ethical duty that people have to take care of animals or something that people attribute to animals (Keeling et al., 2018). In this BuRO evaluation, animal welfare is also approached from the animal-science point of view: the state of animals.

Several examples of scientific definitions of the term 'animal welfare' over the years and its development towards the experiences of animals themselves follow below:

- "*Animal welfare is a state in which animals feel well*" (Wiepkema, 1980);
- "*Animal welfare is a state in which animals are free of pain and suffering*" (Simonsen, 1982);
- *"The term "welfare" refers to the state of an individual in relation to its environment, and this can be measured. Both failure to cope with the environment and difficulty in coping are indicators of poor welfare"* (Broom, 1991);

- *"Animal welfare is the quality of life as it is experienced by the animal itself"* (Bracke et al., 1999);
- *"Positive welfare means that animals have the ability to respond appropriately (i.e. adaptively) to positive and potentially harmful (negative) stimuli".* (Ohl & van der Staay, 2012).

In the Netherlands, knowledge institutions have used similar definitions of animal welfare in recent years:

The Council on Animal Affairs (RDA, 2018):
'Animal welfare is the quality of life as it is experienced by the animal itself' (Bracke et al., 1999). An animal will experience a positive state of well-being if it is free to engage in normal behaviours that are typical of its species and if it is able to respond effectively to the challenges posed by the circumstances in which it finds itself. (Such challenges relate to hunger, thirst and malnutrition (incorrect feed); thermal and physical discomfort; injury and disease; fear and persistent stress stimuli.)

Utrecht University and the Royal Dutch Society for Veterinary Medicine (*Koninklijke Nederlandse Maatschappij voor Diergeneeskunde (KNMvD)*) (Universiteit Utrecht, 2019) comment as follows on the subject of animal welfare:
"An individual animal can be said to be in a good state of welfare if it is capable of adapting to prevailing environmental conditions and in so doing to achieve a state that it experiences as positive."

Wageningen University & Research (Wageningen University & Research, 2019):
"We focus on animal welfare and health. Animals that are not healthy will not feel well. Vice versa, animals that feel comfortable will be stronger, healthier and less susceptible to disease and illness. Animal welfare involves ensuring that animals are able to meet their natural needs as much as possible and have scope for positive emotions, as experienced by the animals themselves."

At an international policy level, welfare is still primarily defined as the absence of negative experiences; positive experiences are not mentioned explicitly:

The Terrestrial Animal Health Code of the World Organisation for Animal Health (OIE) (OIE, 2019):
"*Animal welfare means the physical and mental state of an animal in relation to the conditions in which it lives and dies.*
An animal experiences good welfare if the animal is healthy, comfortable, well nourished, safe, is not suffering from unpleasant states such as pain, fear and distress, and is able to express behaviours that are important for its physical and mental state."

The EFSA (2012b) adopts a similar position:
"Animal welfare: The welfare of an individual is its state as regards its attempts to cope with its environment'.
The welfare of an animal is good if, as indicated by scientific evidence, it is healthy, comfortable,

well-nourished, safe, able to express key aspects of behaviour, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Animal welfare refers to the state of the animal, whereas the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, management, and humane treatment."

The view on and definition of animal welfare used and the corresponding starting points are decisive for the assessment of animal welfare. The following is an example from Fraser (2003;2008): in 1997, a scientific committee from the European Union[36] concluded, based on literature reviews, that the welfare of intensively farmed sows in farrowing crates results in serious welfare problems; the animals are not able to display natural behaviour. However, based largely on the same literature, Australian researchers[37] concluded that both individual housing and group housing could meet the welfare requirements that pigs have. The Australian research based its conclusion on the health and functioning of pigs as indicators of (poor) welfare. No difference was made between individual housing and other housing when applying these parameters. The European researchers included both the affective state of animals, natural behaviour and health in their definition of welfare. Exploratory behaviour and rooting are important for animal welfare due to their link with natural behaviour needs, because of which the European researchers concluded that "some serious welfare problems for sows persist even in the best stall-housing system" (Fraser, 2008).

The examples above show that the starting points and their emphases strongly influence the definition and assessment of animal welfare. A strict definition of animal welfare is vital to ensure its effective and consistent use in precise scientific measurements, legal documents, public statements and discussions (Broom, 2017). The various definitions of 'animal welfare' share a number of key elements and have been subject to a number of important developments over the years. These key elements and the most important developments are described here.

3.3. A number of animal welfare aspects in just one concept

Animal welfare is not a static concept. Fraser (2008) has identified a number of aspects or views on which the concept of animal welfare would appear to be made up (see Figure 2 and below). The reasoning behind this animal welfare concept is based both on scientific evidence and human values. Science and values are difficult to separate entirely where animal welfare is concerned. The concept presented by Fraser (2008) is sometimes presented just a little differently, seeming to focus on the animal or the human view (Figure 2). The concept presented by Fraser is an aspect in itself. It brings together a large number of elements that literature on the subject associates with animal welfare; hence why this concept will be explained in more detail in this document.

[36] Scientific Veterinary Committee, 1997.
[37] Barnett et al., 2001.

According to Fraser (2003;2008), the animal welfare concept is made up of the following three aspects:

- Basic health and functioning → pertains to health, growth and productivity (see Subsection 3.3.1.);
- Natural living → pertains to the possibility for animals to live a reasonably natural life and express normal and species-specific behaviour (see Subsection 3.3.2.);
- Affective state → pertains to emotions and other feelings that are experienced as pleasant or unpleasant (see Subsection 3.3.3.).

These three aspects largely or entirely correspond with the various human views on animal welfare (Fraser et al., 1997; Forkman, 2018; Rault et al., 2020) (see Figure 2):

- The functional view → pertains to good production and health;
- The naturalistic view → it should be as natural as possible;
- The hedonistic view → involves a large number of stimulating and pleasant experiences and as few unpleasant experiences as possible.

These three aspects could also be presented from the perspective of animals more too (Fraser et al., 1997):

- Health → animals must be healthy;
- Natural behaviour → animals must be able to express species-specific behaviour;
- Emotions → animals are able to suffer and have positive experiences.

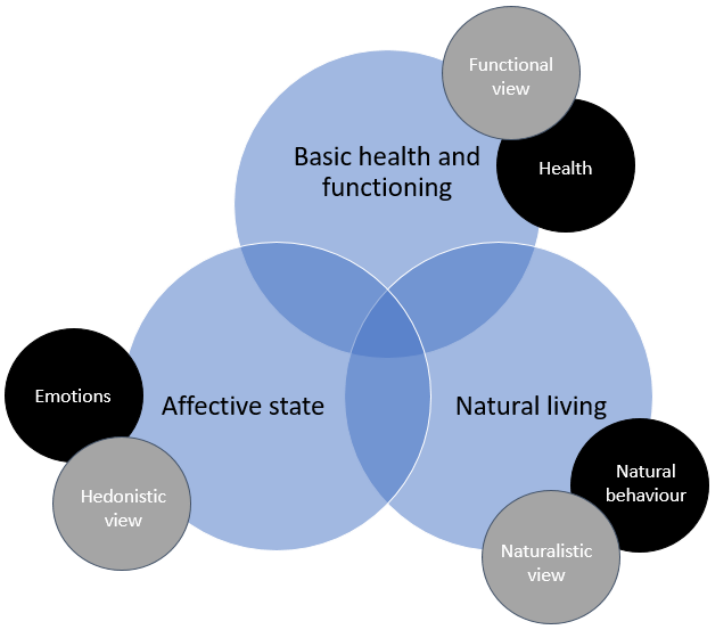

Figure 2. The three aspects of animal welfare according to Fraser (2008). These aspects are sometimes also presented from the human perspective (grey; (Fraser et al., 1997; Forkman, 2018; Rault et al., 2020)) or the animal perspective (black; (Fraser et al., 1997)).

3.3.1. Basic health and functioning

Traditionally, animal welfare aspects were based primarily on the good basic health of animals and their biological functioning (Fraser, 2008). According to this functional view, based on the human perspective, animal welfare is good if animals are healthy and grow, reproduce and produce well (milk or eggs, for example) (Fraser, 2003; O'Hara & O'Connor, 2007; Mellor et al., 2009; Green & Mellor, 2011; Forkman, 2018). The primary concern is good production and the animal health this requires. This view continues to be the most important starting point for many livestock farmers and people who work on livestock farms today (Te Velde et al., 2002; Fraser, 2003;2008; Keeling et al., 2018).

From the perspective of animals, good health is the main priority. Indicators of poor welfare include reduced production, poor health and death (O'Hara & O'Connor, 2007).

3.3.2. Natural living

According to the natural living starting point, animals must live in conditions that are as natural as possible and enable them to express natural behaviour (Fraser, 2003). This natural living or naturalness (Yeates, 2018a) starting point corresponds with the naturalistic view on welfare (Forkman, 2018). From a human perspective, the main priority is for the environment to look as natural as possible and for the 'nature of the animal' to be respected (Fraser, 2008). The natural living starting point is primarily identified as an important aspect of animal welfare by consumers and citizens (and NGOs) (Te Velde et al., 2002; Fraser, 2003; Keeling et al., 2018). The extent to which welfare is affected will depend on how much the way in which animals is kept deviates from their natural lifestyle and the extent to which they have the opportunity to express natural behaviour (Mellor et al., 2009).

From the perspective of animals, the main priority is their ability to express natural behaviour. Natural behaviour, which is also referred to as species-specific behaviour, is behaviour that is characteristic of the animal species in question in natural (or semi-natural) conditions (RDA, 2018). Animals are inclined to express this behaviour in natural conditions because it is pleasant and promotes biological functioning (Bracke & Hopster, 2006). Examples include nesting behaviour, foraging and dust bathing behaviour by chickens (O'Hara & O'Connor, 2007). Where this aspect is concerned, welfare is poor if animals are not able to express this natural behaviour (O'Hara & O'Connor, 2007).

3.3.3. Affective state

Reasoning with the hedonistic view in mind, the affective state starting point focuses on the possibility for animals to suffer and have positive experiences and also to adapt to their surroundings (Fraser, 2003; O'Hara & O'Connor, 2007; Yeates & Main, 2008; Forkman, 2018).
Positive welfare also corresponds with the image that the public has of animal welfare. People generally associate the term 'animal welfare' with efforts to provide animals with opportunities for positive experiences. They assume that humans are not permitted to cause animals pain or suffering (Rault et al., 2020). Rault et al. (2020) show that different views exist within the subject of positive welfare too.

They distinguish between 'hedonistic positive welfare' (the result of wishes and positive experiences of welfare) and the 'positive welfare balance' (the balance between positive and negative experiences). Welfare hedonism can be defined as the view that subjective experience is the only non-instrumental, valuable component of welfare (cited in Robbins et al. (2018)); the main object is for animals to 'feel good' (Sandøe, 2010). Rault et al. (2020) also raise 'eudemonism' for discussion as a view on positive animal welfare. Besides short-term emotions, eudemonism also embraces a longer-lasting state of satisfaction and satisfaction with life, which yields a more holistic than hedonistic view (an accumulation of positive experiences) of positive welfare. For example, an approach based just on the provision of positive experiences (hedonism) - by giving treats - could result in obesity.

In recent years, this starting point for animal welfare has been the subject of increased attention in science and various welfare concepts like the Quality of Life welfare concept and the dynamic welfare concept. Today, many animal welfare scientists opt for a hedonistic approach (Robbins et al., 2018). However, this starting point is not new. Early ethologists believed that the subjective experience of animals was crucial for an understanding of their behaviour (Fraser, 1999).

According to the starting point based on the affective state, welfare is good if: an animal *"adapts with positive emotional experiences and/or without negative experiences during its interactions with other animals, people and the environment"* (Fraser, 2003). The affective state of an animal is linked to its needs, emotions and positive experiences. The subsections below explain this terminology.

3.3.3.1. The needs of animals

The needs of animals in respect of animal welfare are a frequent subject of discussion. For example, as a tool to assess or design housing systems (Bos et al., 2009). Although it is plausible that natural behaviour is an animal need, this is not necessarily the case. A natural behaviour could also be an instrument that is used to meet a need. A need is only really a need if there is also an underlying motivation (intrinsically relevant) for it: in other words, an animal wants to 'work' to meet a need (for example, opening a door to access food) (Bracke et al., 1999; Bracke & Hopster, 2006). Another assumption is that the emotional state alone is intrinsically relevant for animal welfare (Bos et al., 2009). As such, the decision to focus on the needs of animals ties in with the affective state approach proposed (Fraser, 2008) (Subsection 3.3.3.).

The needs of animals consist of two different underlying motivations (also referred to as motivational needs): needs with direct physiological consequences for the underlying motivation, such as hunger and the eating of food (Boissy et al., 2007) and the behavioural needs that animals have to express behaviour independently of their environment or physiological needs. The needs of animals arise in their brains and are not solely of a physiological or ethological nature. The needs of animals are met through a physiological change and/or certain behaviour. With this in mind, Broom (2017) proposes that the term 'biological needs' or 'needs' should be used rather than 'ethological' or 'physiological' needs (Broom, 2017).

Complicating factors where the needs of animals are concerned are the existence of a sliding scale of maximum frustration-maximum need fulfilment (if an animal has just eaten, it will be less motivated to fulfil the need to eat) and competition between needs (the need to eat will be less important if an animal feels that it is under threat from a predator. The need to flee will have priority in this situation) (Bracke et al., 1999).

In the long term, behavioural needs have advantages for animals and their offspring. For example, grooming or sexual behaviour. Animals are rewarded not by the direct effect of this behaviour (reproduction, for example) but by the behaviour itself (mating, for example). Another example is rooting by pigs, which is experienced as a reward that is independent of the actual act of eating of food (if this was not the case, it would be an instrument that was used to meet the need to eat). Behavioural needs depend on biological functioning and may vary from one animal species to another (Bracke et al., 1999; Bracke & Hopster, 2006; Boissy et al., 2007; Broom, 2017).

3.3.3.2. Emotions

From the 1990s onwards, some research started to focus specifically on animal welfare and animal affective neuroscience began to grow in popularity. Research was done on the brain mechanism and emotions of animals, aided by electrodes, for example (Boissy et al., 2007; Fraser, 2009).
Since the mid-1990s, it has been scientifically accepted that animal welfare includes both mental and physical welfare (Green & Mellor, 2011). Bracke et al. (1999) define welfare as: "the quality of life as perceived by the animal itself." The emotional state of an animal is determined by whether or not its needs have been met. Therefore, to assess welfare, it is important to have an overview of the needs that animals have (Bracke et al., 1999). If animals are motivated to express behaviour of this nature but do not have the opportunity to do so, this can lead to stereotypy (repetitive behaviour without a clear purpose; pacing, for example). This behaviour is displayed if an animal is experiencing frustration, a threat or a lack of stimulation. It shows that an animal does not have any control over its situation. Therefore, stereotypy is a sign that the welfare of an animal has been affected (Broom, 1991; O'Hara & O'Connor, 2007; RDA, 2018). Other forms of abnormal behaviour that indicate that welfare has been affected are apathy and even self-injury behaviour (feather damage, for example) (Manteca et al., 2016).

3.3.3.3. Positive experiences

Examples of behaviour that shows that an animal is in a positive state are play, affiliative behaviour[38] and emotional expressions like some vocalisations. This behaviour is self-rewarding; endorphins are released, for example (Boissy et al., 2007; Yeates & Main, 2008). Negative experiences cause animals to become less motivated to display positive behaviour. For example, wounded animals move less, because of which they participate in potentially positive activities less too (Mellor, 2016). Positive experiences are less urgent for the survival of animals but still

[38] When displaying affiliative behaviour, an animal stays in the presence of the other animal, gives food to the other animal, protects the other animal or grooms the other animal, by licking it, for example (Boissy et al., 2007).

improve their quality of life. This positive behaviour is primarily manifested if the essential physiological needs have been met and, as such, are a sign of good welfare (FAWC, 2009).

For positive experiences to be possible, the environment in which animals are kept must give them the opportunity to display this behaviour. For example, animals could be kept in groups, given access to suitable resting places, offered choices and predictability and unpredictability could be balanced (Mellor, 2016). If an unsuitable environment is replaced by a more stimulating environment - via enrichment, for example - the negative experiences animals have had can be compensated for by positive experiences. Frustration and boredom can be converted into exploration and play, for example (Mellor & Webster, 2014; Mellor & Beausoleil, 2015). Positive experiences may also be the result of a behavioural response that successfully improves negative situations or experiences. For example, the smell and taste of food when hungry, a satiated feel after eating or when animals avoid heat by cooling down in water (Mellor & Beausoleil, 2015).

3.3.4. Connection between aspects

Good welfare will not necessarily be achieved by meeting one aspect of animal welfare (affective state, natural living or good health). Animals that are housed outside have more opportunities to display natural behaviour, but may be affected more by parasites and extreme weather conditions. Animals that are isolated in a laboratory may be free of disease but will not display social behaviour. They may display no natural behaviour either (or only to a limited extent). According to the concept developed by Fraser (2008), good animal welfare will only be achieved if all three starting points are taken into consideration (basic health and functioning, natural living and affective state), as shown in the overlap between the circles in Figure 2. However, it should also be observed that the specifics of starting points of this nature within the concept of animal welfare are still evolving, as also evident from the study by Rault et al. (2020), for example.

3.4. The Welfare Quality concept: animals have needs and emotions too

The European Welfare Quality concept elaborates on the five freedoms and includes positive effects in the assessment of animal welfare. This concept was developed with a view to assessing animal welfare in the farming system and has been subdivided into four principles - good feeding, good housing, good health and appropriate behaviour - and a number of questions have been formulated (Botreau et al., 2007):

- Are the animals properly fed and supplied with water?
- Are the animals properly housed?
- Are the animals healthy?
- Does the behaviour of the animals reflect optimised emotional states?

Twelve criteria underlie these four principles (see Table 2). The BuRO draws on the Welfare Quality principles in its risk assessment of animal welfare, which it does primarily to structure welfare consequences and hazards.

Table 2. The Welfare Quality principles and criteria (Jones & Manteca, 2009).

Principles	Criteria
Good feeding	1. Absence of prolonged hunger 2. Absence of prolonged thirst
Good housing	3. Comfort around resting 4. Thermal comfort 5. Ease of movement
Good health	6. Absence of injuries 7. Absence of disease 8. Absence of pain induced by management procedures
Appropriate behaviour	9. Expression of social behaviours 10. Expression of other welfare related behaviours 11. Good human-animal relationships 12. Positive emotional state

The principles and criteria above have been developed into assessment protocols for different animal species. For example, cattle, pigs and poultry (Welfare Quality Network, 2019).

3.5. Ability to adapt, biological reactions to a stressor and the dynamic welfare concept

3.5.1. Ability to adapt

Failure to provide for different aspects of animal welfare can cause animals to experience stress. Animals may or may not have the ability to adapt to this stress. Scientific insights gained in the last 20 years show that negative experiences are necessary to the survival of animals to a limited extent too and form part of the ability animals have to adapt. Negative experiences have a biological function, protecting the overall welfare of animals. Where possible, animals will adapt their behaviour to eliminate this imbalance. For example, thirst ensures that animals seek out and find water (Mellor, 2016). Fear causes animals to avoid hazards or demonstrate certain behaviour after assessing risks (for example, cautiously exploring an environment in which they have previously encountered an enemy (Rodgers et al., 1997)) and is a sign of an ability to adapt and, by doing this, avoid even worse negative welfare. Negative experiences may also be the result of external effects. Examples include fear, panic, frustration, depression and boredom. In captive animals, these negative experiences are often caused by humans, who house animals in threatening, bare, cramped or isolated environments. Human intervention is usually needed to remove the cause of a negative experience of this nature (Mellor, 2016). However, the prevention or limitation of these negative experiences will not automatically result in good welfare but could make welfare neutral at the very most (Mellor, 2016). Animal welfare will have been affected if animals are not able to respond adequately to these negative stimuli by fleeing the threats in question, for example. To achieve good welfare, animals must be able to adapt to changing circumstances and respond adequately (Ohl & van der Staay, 2012).

3.5.2. Biological response to a stressor

When a stressor lasts so long or is so intense that it is beyond the biological adaptability of the animal in question, welfare will be affected and the animal will become distressed. A stress response starts when the central nervous system observes a potential threat (stressor) (see Figure 3 for a schematic representation). This observation and stress response are influenced by various factors, like past experiences, genetics, age and physical state. This is followed by a biological response, which could consist of a behavioural response, a response by the autonomic nervous system, a neuroendocrine response and/or an immune response. The animal will adapt its biological functioning and cause 'the biological costs of stress'. These costs may be negligible in the event of short-term stressors or stressors with a low intensity. However, in the event of long-term stress and/or a high-intensity stressor, physical functioning will be affected and may ultimately lead to illness and poor welfare (Moberg, 2000). Reduced welfare can result in increased susceptibility to illness. In this situation, what starts off as a mild infection could lead to a downward spiral and, ultimately, death. The opposite is possible too; good welfare may make it easier for animals to adapt to a stressor. Welfare has an important and complex connection with pathology (the development and progression of illnesses) (Broom, 2017).

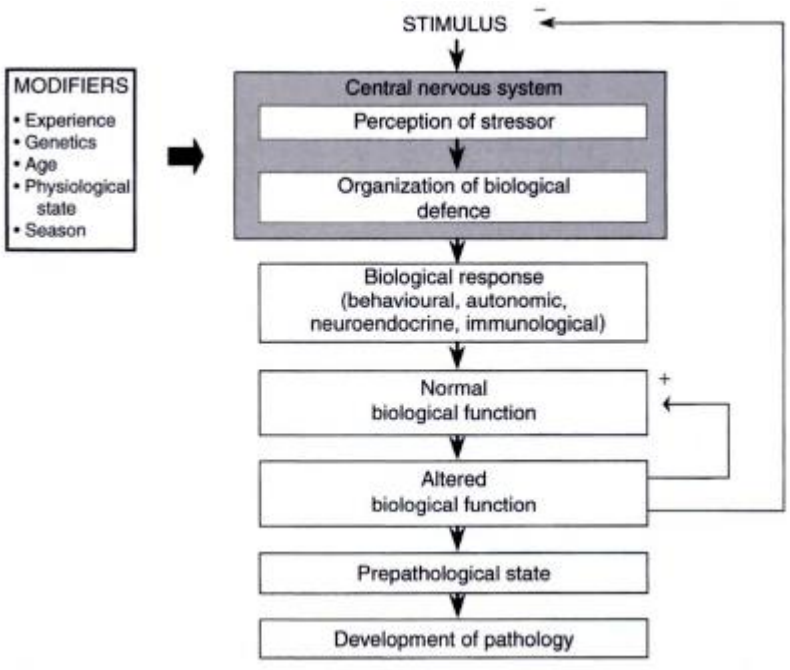

Figure 3. Biological reaction to a stressor, from Moberg (2000).

3.5.3. The dynamic welfare concept

How animals cope with positive and negative experiences and their ability to adapt are elaborated on more in the dynamic welfare concept. Welfare is at risk if animals reach the limits of their ability to adapt. The limits of animal welfare are determined by the limits of the ability that animals have to adapt, which is influenced by internal (physical and psychological health, for example) and external factors (like the environment) (Ohl & van der Staay, 2012; Universiteit Utrecht, 2019). For example,

pigs in enriched housing are more resilient to illness and disease and display less stress-related behaviour than pigs in non-enriched housing are (van Dixhoorn et al., 2016). The limit of this ability to adapt is not stable but determined by various factors, such as age, hormones and the genetic background of the animal (Universiteit Utrecht, 2019).

The dynamic welfare concept can be used to update the five freedoms (Ohl & van der Staay, 2012):
"An individual is in a state of good welfare when it has the freedom to adequately react to:

- *hunger, thirst or incorrect food;*
- *thermal and physical discomfort;*
- *injuries or diseases;*
- *fear and chronic stress and, thus, the freedom to display normal behavioural patterns that allow the animal to adapt to the demands of the prevailing environmental circumstances and enable it to reach a state that it perceives as positive."*

Animal welfare is not poor if an animal is hungry but able to look for and find food and then eat. Welfare will only have been affected if this is not possible in the long term (Ohl & van der Staay, 2012). Ohl & van der Staay (2012) define positive welfare as follows: *"Positive welfare means that animals have the ability to respond appropriately (i.e. adaptively) to positive and potentially harmful (negative) stimuli".*

3.6. Animal welfare in the long term: the Quality of Life concept

Many welfare protocols for the assessment of animal welfare (such as those based on the five freedoms or the Welfare Quality concept) are based on static measurements and not measurements taken over time (Ohl & van der Staay, 2012). When assessing animal welfare, it is possible to consider an acute situation or the long-term situation. In the event of the latter, consideration should be given to whether negative experiences fall within the adaptive capacity of an animal and are compensated by positive experiences (Universiteit Utrecht, 2019). The five freedoms could be used to assess an acute situation, for example. If an animal is not suffering and its basic needs have been met, its welfare will be satisfactory (Mattiello et al., 2019; Universiteit Utrecht, 2019). The five freedoms are less suitable for the assessment of long-term animal welfare. A concept that could be used following on from these positive and negative welfare experiences and the balance between both during the life of the animal is the Quality of Life (QoL) concept (Mellor & Webster, 2014; Mellor, 2016; Yeates, 2018b).

The QoL concept considers the balance between positive and negative experiences, based on which the life of an animal can be assessed as 'a life not worth living', 'a life worth living' and 'a good life' (see Table 3 for examples of each category). If welfare is only regulated on the basis of the absence of negative experiences and parameters that demonstrate poor welfare are considered, the neutral point of balance will be the best situation possible to achieve (Mellor, 2016). On balance, the welfare an animal experiences during its lifetime must be positive. Pain, suffering, fear or lasting harm must be necessary, proportionate and minimal and

the method used to keep and care for animals must meet the needs and certain wishes of the animals in question (FAWC, 2009). To improve welfare and achieve 'a life worth living' status, minimum standards of positive experiences are important. These standards must also be species specific (Mellor, 2016).

Table 3. The Quality of Life scale, according to the Quality of Life concept. The different categories are based on the balance between positive and negative experiences (Mellor, 2016).

Category	Description
A good life	The balance of salient positive and negative experiences is strongly positive. Achieved by full compliance with best practice guides (best practice advice) well above the minimum requirements of codes of practice or welfare.
A life worth living	The balance of salient positive and negative experiences is favourable, but less so. Achieved by full compliance with the minimum requirements of code of practice or welfare that include elements that promote some positive experiences.
Point of balance	The neutral point at which clear positive and negative experiences are equally balanced.
A life worth avoiding	The balance of salient positive and negative experiences is unfavourable, but can be remedied rapidly by veterinary treatment or a change in husbandry practices.
A life not worth living	The balance of salient positive and negative experiences is strongly negative and cannot be remedied rapidly so that euthanasia is the only humane alternative.

3.7. Summary

The scientific consensus today is that animal welfare involves more than just the absence of negative effects: "*It is now widely accepted that good welfare is not simply the absence of negative experiences, but rather is primarily the presence of positive experiences such as pleasure*." (Boissy et al., 2007; Edgar et al., 2013). The absence of negative states like pain and fear will not automatically result in good animal welfare (Mattiello et al., 2019).

Summarising the various animal welfare concepts and definitions above, good animal welfare involves an interplay between affective state, natural behaviour and good health. Negative experiences must lie within the adaptive capacity of animals and the balance between negative and positive experiences during the life of these animal must be positive. Pain, suffering, fear and permanent harm must be necessary, proportionate and minimal and the way in which animals are kept and cared for must meet both their physiological (food, water and shelter, for example)

and ethological needs. All of the above have been incorporated into four Welfare Quality principles and underlying criteria (also see Table 2).

4. Risks that emerged from the supply chain assessments

In recent years, the BuRO has carried out various risk assessments on production chains in which farm animals form part of the chain. These supply chain assessments assess the risks associated with the numerous links in the production chain, from animals on the farm to the product on the consumer's plate. International scientific literature on food safety and animal welfare was gathered for these risk assessments; its relevance for the Dutch production chain was then evaluated and the risks assessed. The first risk assessment of the red meat supply chain was published in 2015, followed by the first risk assessment of the dairy chain in 2017, the first risk assessment of the poultry meat and egg chains in 2018 and the first risk assessment of the food-crop and animal-feed chains in 2019.

The risk assessments that the BuRO[39] carries out are based on the EFSA assessment method (EFSA, 2009a;2012b;2012d). EFSA's methodology is in line with the 'Food Code' (Codex Alimentarius) (FAO/WHO, 1995) and Regulation (EC) No. 178/2002[40]. The risk assessment comprises the following steps:

1. Hazard identification: the threats to animal welfare that have been identified by academic experts and experts in professional practice and which have been described in international scientific literature;
2. Hazard characterisation: the relevance (welfare impact) consisting of the severity and duration of the welfare consequence;
3. Exposure assessment: the likelihood of threats, including the number of animals affected by them. In relation to animal welfare, this is the occurrence of certain conditions, situations and practices that affect the welfare of animals;
4. Risk assessment: the overall assessment of the nature and severity of each threat, and the likelihood/prevalence thereof in the Netherlands.

The welfare consequences identified as such in the various supply chains have been gathered together and categorised in accordance with the Welfare Quality principles and criteria (see Table 2). It has been chosen to primarily take the welfare consequences as the starting point and not the underlying risk factors. Welfare consequences are the effects on animals and, as such, directly impact animal welfare.

See Appendix 2 for an overview of all of the various welfare consequences. The Animals Act and underlying regulations do not include any national standards in respect of welfare consequences in the transport and slaughterhouse stages. These consequences fall under the European Animal Transport Regulation (EC) No. 1/2005

[39] The methodology underlying the assessment of risks is evolving. Different approaches were adopted in the various risk assessments, which covered the risks considered the greatest based on the approach adopted. Given the different approaches used, it is not possible to compare every aspect of the different risk assessments.
[40] Regulation (EC) No. 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1–24.

and European Regulation (EC) No. 1099/2009 on the protection of animals at the time of killing. Therefore, these welfare consequences will be disregarded in this advice.

Hazard characterisation involves scoring the severity and duration of welfare consequences. Taken together, they represent the welfare impact on a scale of 1 to 7. See the table below.

Table 4. Evaluation system for the assessment of the welfare impact. Determined by classifying the severity and duration of a welfare problem (Visser et al., 2015b; Visser et al., 2015c).

	Severity				
Duration	**None**	**Low**	**Moderate**	**Severe**	**Very severe**
Short	1	2	3	4	5
Medium	1	3	4	5	6
Long	1	4	5	6	7

The most important welfare consequences per chain follow in the subsections below.

4.1. The red meat supply chain

A full risk assessment based on the four EFSA steps was not carried out for the red meat supply chain. Instead, this risk assessment focused on identifying welfare consequences and hazards and no impact scores were given for the farm stage. The welfare consequences referred to in the conclusions and recommendations from the Red Meat Supply Chain Risk Assessment (*Risicobeoordeling Roodvleesketen*) (BuRO, 2015) were taken into consideration. The welfare consequences were then categorised in accordance with the Welfare Quality principles and criteria. Welfare consequences in the red meat chain fall under 'good health' or 'normal behaviour'. Welfare consequences in respect of the 'expression of other welfare-related behaviours' are the most common, followed by 'pain due to management procedures' and 'disease' (see Table 8 for an overview). Examples are the separation of cows and calves, tail and ear biting by pigs, the castration of piglets and claw problems in veal calves.

4.2. The dairy supply chain

The welfare consequences set out in the Dairy Supply Chain Risk Assessment Advisory Report (*Advies over de risico's van de zuivelketen*) (BuRO, 2017) were taken into consideration. The diseases named were summarised as viral and bacterial infections and metabolic diseases. The welfare consequences were categorised in accordance with the Welfare Quality principles, as also done in the animal welfare risk assessment in the dairy supply chain (*Risicoanalyse dierenwelzijn zuivelketen*) (Visser et al., 2015b). The BuRO itself categorised the criteria per welfare consequence. The majority of welfare consequences in the dairy chain fall under the 'pain due to management procedures' and 'disease' aspects of the 'good health' principle. Welfare consequences include discomfort from ear tagging or disbudding and viral and bacterial infections (see Table 8 for an

overview). The welfare consequences with the highest impact scores (6 or 7 on a scale of 1 to 7) during the farm stage are shown in Table 5.

Table 5. Welfare consequences in the farm stage with a high impact score (6 or 7 on a scale of 1 to 7) in the dairy chain (Visser et al., 2015b)

Livestock category	Welfare impact
Young livestock - dairy cattle	• Discomfort from endoparasitic infections
Lactating, pregnant or nursing dairy cows	• Too thin • Clinical mastitis • Abomasum dislocation
Lambs	• Discomfort from endoparasitic infections • Discomfort from ectoparasitic infections • Myiasis • Bluetongue • Infection after ear tagging
Lactating, pregnant or nursing dairy sheep	• Too thin • Discomfort from endoparasitic infections • Discomfort from ectoparasitic infections • Myiasis • Bluetongue • Maedi-visna
Goat kids	• Discomfort from endoparasitic infections • Infection after ear tagging
Lactating, pregnant or nursing milk goats	• Too thin • Discomfort from endoparasitic infections • CAE • Para TBC

4.3. The poultry meat supply chain

The welfare consequences set out in the advice on risks in the poultry meat chain (BuRO, 2018b) were taken into consideration. These are welfare consequences with an impact score (severity x duration) of four or more for chickens. The most important welfare consequences for ducks and turkeys are referred to briefly in this advice. The welfare consequences have been categorised in accordance with the Welfare Quality principles, as also done in the risk assessment of animal welfare in the white meat chain (Visser et al., 2015c). The BuRO itself categorised the criteria per welfare consequence.

The majority of welfare consequences in the poultry meat chain fall under 'good health'. Examples of welfare consequences are footpad dermatitis, beak trimming, gastrointestinal problems and respiratory problems (see Table 8 for an overview).

Table 6 shows the high-impact (score 6 or 7) welfare consequences applicable in the farm stage.

Table 6. High-impact (score 6 or 7) welfare consequences applicable in the farm stage in the poultry meat chain (Visser et al., 2015c).

Livestock category	Welfare impact
Grandparent and parent rearing stock	• Skeletal abnormalities • Footpad dermatitis • Discomfort from ectoparasitic infections • Serious infectious respiratory problems • Hopeless suffering • Feather pecking
Grandparent and parent breeding stock	• Skeletal abnormalities • Footpad dermatitis • Discomfort from ectoparasitic infections • Serious infectious respiratory problems • Hopeless suffering • Feather pecking
Hatchery	No welfare consequences with an impact of 6 or 7
Broiler farm	• Skeletal abnormalities • Footpad dermatitis • Discomfort from ectoparasitic infections • Serious infectious respiratory problems • Infectious gastrointestinal problems • Hopeless suffering • Feather pecking • Too heavy
Breeding parent stock - ducks	• Skeletal abnormalities • Footpad dermatitis • Too heavy
Parent breeding stock - ducks	• Skeletal abnormalities • Footpad dermatitis • Too heavy
Duck hatchery	No welfare consequences with an impact of 6 or 7
Meat duck farm	• Skeletal abnormalities • Footpad dermatitis • Too heavy
Turkey hatchery	No welfare consequences with an impact of 6 or 7
Meat turkey farm	• Skeletal abnormalities • Footpad dermatitis • Serious infectious respiratory problems • Hopeless suffering • Feather pecking

4.4. The egg supply chain

The welfare consequences set out in Appendix 5 of the advice on the risks in the egg supply chain (BuRO, 2018a) were taken into consideration. These are welfare consequences with an impact score (severity x duration) of 4 or more. The welfare consequences have been categorised in accordance with the Welfare Quality principles, as also done in the risk assessment of animal welfare in the egg supply chain (Visser et al., 2015a). The BuRO itself categorised the criteria per welfare consequence. The majority of welfare consequences in the egg chain fall under 'good health'. Examples of welfare consequences are beak trimming, gastrointestinal problems and respiratory problems (see Table 8 for an overview). Table 7 shows the high-impact (score 6 or 7) welfare consequences during the farm stage.

Table 7. High-impact (score 6 or 7) welfare consequences during the farm stage in the egg supply chain (Visser et al., 2015a).

Livestock category	Welfare impact
Laying hen hatchery	Disturbed rest
Rearing - organic, free-range/barn and colony housing system	• Toe amputations and toe injuries • Feather pecking
Laying period - free-range/organic, barn, colony housing system	• Keel bone fractures • Bumble foot • Toe amputations and toe injuries • Ectoparasitic infections • Serious infectious respiratory problems • Infectious gastro-intestinal problems • Burning out • Feather pecking • Limited behavioural repertoire (only in the event of a colony housing system)

4.5. The animal feed chain

The document entitled advice on the risks in the feed-crop and animal feed chain (*Advies over de risico's van de keten 'voedergewassen en plantaardig diervoeder'*)(BuRO, 2019) sets out the biggest risks for plant health, animal health and food health. The end of the animal feed chain has been identified as the animal feeds received at Dutch livestock farms or, for farms that mix or blend animal feed themselves, the feed produced at livestock farms. The risks for animal health and animal welfare that arise when giving feed to animals fall outside the scope of this assessment. Therefore, risks that arise earlier in the chain were included. Just welfare consequences and hazards were identified; no impact scores were given. The welfare consequences set out in the main text of the document entitled advice on the risks in the feed-crop and animal feed chain (BuRO, 2019) were taken into consideration, after which the BuRO categorised them in accordance with the Welfare quality principles and criteria. Twelve welfare consequences were identified: copper poisoning, traumatic reticuloperitonitis due to the ingestion of foreign

objects, reduced fertility, acute mortality, birth defects, reduced weight, immunomodulation, botulism, cryptosporidiosis, listeriosis, salmonellosis and abortion. All of the above fall under the 'good health' category.

4.6. Conclusion on welfare consequences

As described in the subsections above and Table 8, most welfare consequences in the various chains relate primarily to 'good health' in general and freedom from disease in particular. A significant number of welfare consequences were caused by 'pain due to management procedures'. Many welfare consequences also related to 'appropriate behaviour', in particular the inability to express species-specific behaviour.

Table 8. Numbers of welfare consequences identified in the red meat, dairy, poultry meat, egg and animal-feed supply chains, categorised in accordance with the Welfare Quality concept.

Welfare Quality principles	Red meat supply chain	Dairy supply chain	Poultry meat supply chain	Egg supply chain	animal feed chain	Final total
Good feeding			**3**	**2**		**5**
Absence of prolonged thirst			1	1		2
Absence of prolonged hunger			2	1		3
Good housing		**1**	**5**	**2**		**8**
Ease of movement			1			1
Comfort around resting			1	2		3
Thermal comfort		1	3			4
Good health	**12**	**10**	**21**	**19**	**12**	**74**
Absence of pain induced by management procedures	5	4	6	4		19
Absence of injuries	1	1	6	5	1	14
Absence of disease	6	5	9	10	11	41
Appropriate behaviour	**8**	**1**	**7**	**6**		**21**
Good human-animal relationships				1		1
Positive emotional state			1	1		2
Expression of social behaviours	1	1	1	1		4

Welfare Quality principles	Red meat supply chain	Dairy supply chain	Poultry meat supply chain	Egg supply chain	animal feed chain	Final total
Expression of other welfare-related behaviours	7		5	3		14
Final total	**20**	**12**	**36**	**29**	**12**	**109**

5. Welfare consequences and legislation and regulations

The BuRO has linked the welfare consequences gathered from the chains to the Animals Act and the underlying decrees and ministerial regulations, such as the Animal Keepers Decree and the Animal Keepers Regulation (see Appendix 2 for a complete overview).

Regulations were checked to ascertain whether each of the welfare consequences had been included in them and also whether regulations relate to a welfare consequence or to the risk factors that contribute to the welfare consequence (for example, hygiene requirements, a risk factor for disease). Also see Section 1 for more information about legislation and regulations. See Table 9 for an overview of the various categories defined by the BuRO.

Table 9. Description of the categorisation of legislation and regulations by the BuRO.

Category	Description
Not included in legislation and regulations	The welfare consequence or underlying risk factors is/are not covered in the Animals Act or underlying regulations or in European legislation and regulations.
Qualitative goal-oriented regulation (open standard)	The welfare consequence or underlying risk factors is/are covered in the Animals Act or underlying regulations and qualitative goal-oriented regulation, also referred to as an open standard.
Quantitative goal-oriented regulation	The welfare consequence or underlying risk factors is/are covered in the Animals Act or underlying regulations and quantitative goal-oriented regulation.
Means-oriented regulation	The welfare consequence or underlying risk factors is/are covered in the Animals Act or underlying regulations in the form of a means-oriented regulation.
Qualitative goal-oriented regulation determined by a court decision	The welfare consequence or underlying risk factors is/are covered in the Animals Act or underlying regulations and qualitative goal-oriented regulation, also referred to as an open standard. However, the nature of this standard has been determined by a court decision.
Permitted by legislation and regulations	A welfare consequence or the risk factor that contributes to the welfare consequence is permitted under the Animals Act or underlying regulations.
Permitted by legislation and regulations under certain conditions	A welfare consequence or the risk factor that contributes to the welfare consequence is permitted under the Animals Act or underlying regulations under certain conditions.
Required by legislation and regulations	A welfare consequence or the risk factor that contributes to the welfare consequence is required under the Animals Act or underlying regulations.
Just European legislation and regulations	The welfare consequence or underlying risks factors do not feature as national standards in the Animals Act or underlying regulations but are part of European legislation and regulations that are in force in the Netherlands.

The overview in Table 10 shows that most welfare consequences are covered in legislation and regulations as part of a qualitative goal-oriented regulation (open standard). These goal-oriented regulations relate to both welfare consequences and risk factors (see Appendix 2 for a full overview).

The following seven welfare consequences identified in the risk assessments carried out in the various chains are not addressed in legislation or regulations:

1. Breeding-related health problems in cattle;
2. The after-effects of beak trimming on poultry kept for meat production;
3. The after-effects of beak trimming on laying hens;
4. Skeletal abnormalities in ducks, broilers and grandparent and parent stock;
5. Damage to the plumage of the grandparent and parent stock of broilers;
6. The smothering of laying hens (caused by them huddling together);
7. A fear of people in laying hens.

According to legislation and regulations, six welfare consequences are permitted under certain conditions. These consequences are the result of the following animal management interventions:

1. The disbudding of cattle, sheep and goats;
2. The killing of cattle, sheep and goats without stunning them first;
3. The grinding of piglets' teeth;
4. The castration of piglets;
5. The tail docking of piglets;
6. The cutting of the back toe of grandparent and parent poultry rearing stock.

Just one welfare consequence is permitted according to legislation and regulations: limiting the behavioural repertoire of sows by placing them in separate housing shortly before giving birth and when suckling. Finally, the 'ear tagging' intervention on cattle, sheep and goats, which causes the 'pain' welfare consequence, is compulsory.

Means-oriented regulations are in place - in some form or other - for 17 welfare consequences and cover footpad dermatitis scores for broilers, the housing provided for broiler parent stock, ventilation and cooling and heating systems for broilers and enrichment for pigs, among other things.

Table 10. Numbers of welfare consequences specified by the red meat, dairy, poultry meat, egg and animal feed supply chains, categorised by type of legislation and regulations and Welfare Quality.

Categorisation of legislation	Good health	Good housing	Good feeding	Appropriate behaviour	Final total
Not included in legislation and regulations	4	1		2	7
Qualitative goal-oriented regulation	51	6		13	70
Qualitative goal-oriented regulation and means-oriented regulation	7	1		3	11
Qualitative goal-oriented regulation and permitted under certain conditions				1	1
Qualitative goal-oriented regulation, quantitative goal-oriented regulation and means-oriented regulation	2			1	3
Qualitative goal-oriented regulation, means-oriented regulation and permitted under certain conditions				1	1
Means-oriented regulation	1				1
Means-oriented regulation and permitted	1				1
Qualitative goal-oriented regulation determined by a court decision			2[41]		2
Qualitative goal-oriented regulation determined by a court decision, other qualitative goal-oriented regulation welfare consequence			3[42]		3
Permitted by legislation and regulations				1	1
Permitted under certain conditions	6				6
Required by legislation and regulations	1				1
Just EU legislation	1				1
Final total	**74**	**8**	**5**	**22**	**109**

[41] Judgement of the Trade and Industry Appeals Tribunal, July 2018: chicks must have access to water and feed within 36 hours.
http://deeplink.rechtspraak.nl/uitspraak?id=ECLI:NL:CBB:2018:309
[42] Judgement of the Trade and Industry Appeals Tribunal, July 2018: chicks must have access to water and feed within 36 hours.
http://deeplink.rechtspraak.nl/uitspraak?id=ECLI:NL:CBB:2018:309

5.1. Criteria for the Welfare Quality concept and qualitative goal-oriented regulations

The majority of welfare consequences are covered by legislation and regulations in the form of qualitative goal-oriented regulations (open standards) and fall primarily under the 'Absence of injuries' and 'Absence of disease' aspects of the 'good health' principle and 'Expression of other welfare-related behaviours' aspect of the 'appropriate behaviour' principle (also see Table 10 for an overview and Appendix 2 for more information). In this subsection, these three criteria are explained in more detail and linked to the goal-oriented regulations in the Animal Keepers Decree.

5.1.1. Absence of injuries

Animals may not be injured or experience pain as a result of the housing in which they are kept, for example. If animals are injured, they must be taken care of and, if necessary, a veterinarian must be contacted. These rules are clear, because of which they safeguard animal welfare where injuries are concerned.
Legislation and regulations applicable:

The Animal Keepers Decree
Article 1.7. Caring for animals
Anyone who keeps an animal must ensure that an animal:
c. that appears to be sick or injured receives care immediately in the appropriate manner.

Article 1.8. Housing
2. Any housing, including the floor, in which an animal lives, and animal shelter facilities must be designed, built and maintained in such way that they do not cause the animal injury or pain and may not contain sharp edges or protuberances on which the animal can injure itself.
3. In the space in which an animal is kept, no materials and, where appropriate, no ground cover may be used that is unsuitable or harmful to the animal.

Article 2.4. Caring for production animals
4. If necessary, a sick or injured animal will be separated from other animals in appropriate housing, with dry bedding - if required.
5. If the care referred to in Article 1.7, preamble and (c) does not improve the state of the animal, a veterinarian must be consulted as soon as possible.

5.1.2. Absence of disease

Sick animals must be taken care of and, if necessary, a veterinary must be contacted. These rules are quite clear and safeguard animal welfare. It is (of course) not prohibited for animals to become sick, but the prevention of illness in animals is not a direct part of legislation and regulations either. However, a number of goal-oriented regulations are in place that pertain to a number of risk factors for various diseases, such as diet, hygiene, appropriate care and sufficient fresh air.

The Animals Act
Article 2.1. Cruelty to animals

1. It is prohibited to cause an animal pain or injury or to harm the health or well-being of the animal without good reason or in excess of what is acceptable for this reason.

Article 2.2. Keeping animals

8. Animal keepers are prohibited from withholding the necessary care from the animals they keep.

The Animal Keepers Decree
Article 1.7. Caring for animals

Anyone who keeps an animal must ensure that an animal:
1. is cared for by a person who possesses the required knowledge and skills for the provision of animal care;
2. is placed under the supervision of a person who is clearly capable of caring for the animal;
3. that appears to be sick or injured receives care immediately in the appropriate manner;
4. has adequate housing with sufficiently hygienic living conditions;
5. is given an adequate amount of healthy food suitable for its species and its age in a manner that is appropriate for the animal's stage of development.
6. has access to an adequate amount of water of appropriate quality or can meet its need for water in another manner;
7. receives sufficient fresh air or oxygen.

Article 2.4. Caring for production animals

4. If necessary, a sick or injured animal will be separated from other animals in appropriate housing, with dry bedding - if necessary.
5. When the care referred to in Article 1.7, preamble and (c) does not improve the condition of the animal, a veterinarian must be consulted as soon as possible.
6. An animal must be fed at the intervals appropriate for its physiological needs at the very least.
7. The food and drink provided and also the way in which it is provided must not cause an animal any unnecessary suffering or injury.

Article 2.5. Lighting and ventilation

3. The material used in the housing in which animals are kept must not be harmful to them and must be possible to thoroughly clean and disinfect.
4. Air circulation, dust levels, temperature, relative humidity and gas concentrations in the vicinity of animals must not be harmful to them.

Explanation: the Animal Keepers Decree also includes a number of cleaning and disinfection-related articles in respect of calves and laying hens, for example.

5.1.3. Species-specific behaviour

The following legislation and regulations apply:

Animal Keepers Decree
Article 1.6. Keeping animals
2. An animal must be given sufficient space for its physiological and ethological needs.

According to Article 1.6 of the Animal Keepers Decree, animals must have the space they need to display species-specific behaviour and meet their physiological and ethological needs. This is a very open standard. The explanatory memorandum on the Animal Keepers Decree states: *"This means that animals must be given the space they need to display species-specific, natural and social behaviour, including interaction with people and conspecifics."*[43] However, the decree does not specify exactly what the species-specific and natural behaviours of the various popular farm animal species are. Animals must be given enough space to meet these needs too. But what is "enough"?

Legislation and regulations would be clearer if they stated the physiological and ethological needs applicable per animal species. It should not be forgotten that animals have needs other than physiological and ethological needs too. These needs arise in their brains and can only be met by a physiological change or a certain behaviour. As such, it is better to refer to 'biological needs' or 'needs' (Broom, 2017). Finally, there is an absence in legislation of any link with positive behaviour, because the basic needs of the various animal species have not been described.

Knowledge about the basic needs of many farm animals is now available. EFSA scientific reports and opinions often start with a summary of the needs of animals (Broom, 2017). For example, its reports about dairy cattle (EFSA, 2009b) and meat rabbits (EFSA, 2005).

Legislation is brief on the subject of consequences for animal welfare if these basic needs are not met and also on the prevention of the development of undesired behaviours. One example of undesired behaviour that animals could develop if basic needs are not met is feather pecking behaviour among laying hens. Feather pecking is redirected ground picking behaviour. Chickens may start to peck each other if their need to forage is not met. This could then also escalate into cannibalism. Research has revealed many risk factors, such as untreated beaks and insufficient litter, roughage and food (Visser et al., 2015a; BuRO, 2018a). However, these risk factors for feather pecking among laying hens are not identified specifically in legislation and feather pecking is not mentioned in either the Animals Act or the Animal Keepers Decree. However, a ban on trimming the beaks of poultry has been

[43] Explanatory Memorandum, Bulletin of Acts and Decrees 2014, 210, Decree of 5 June 2014, setting out the regulations governing keepers of animals (Animals Keepers Decree).

in place since 1 January 2019; there are a number of exceptions to this ban though.[44] [45]

Legislation and regulations do include the requirement to meet basic needs for some animal species. Pigs, for example:

The Animal Keepers Decree
Article 2.14. Aggression
1. Measures must be taken to limit aggression in groups as much as possible. These measures must include the provision of straw or other material to weaned pigs and rearing pigs at the very least.
2. If there are signs of serious fights between pigs, the cause of these fights must be investigated immediately.

Article 2.22. Enrichment and floor covering
1. Pigs must always have enough of the materials they need to explore and play. This material must consist of straw, hay, wood, sawdust, mushroom compost, turf or a mixture of the above, or other suitable materials, provided they do not put the health of the animals at risk.
2. In the week before the expected farrowing time, sows and gilts must be given sufficient quantities of suitable nesting material, unless this is technically not feasible because of the slurry system used at the farm.

Explanation: Article 2.22(2) does provide scope for exceptions for sows and gilts.

And veal calves:

The Animal Keepers Decree
Article 2.41. Feeding
1. Calves must be fed at least twice a day.
2. Without prejudice to Articles 1.7(e) and 2.4(6), calves must be given feed that meets their behavioural needs.
3. The feed provided must contain enough iron for animals to achieve an average haemoglobin content of at least 4.5 mmol/l.
4. Calves that are more than two weeks old must be fed a certain amount of fibrous food every day. The amount of this food must be increased from 50 grams to 250 grams a day for calves from the age of eight to 20 weeks.

This article fails to sufficiently consider the need to ruminate that calves have. The question is whether 250 grams of fibrous food a day is enough for calves to be able to meet the need that calves have to ruminate (BuRO, 2015). Various research projects have shown that this quantity is not enough to meet the behavioural needs of veal calves during the entire finishing period (Webb et al., 2012).

[44] Exceptions are laying-hen parent stock, great grandparent and grandparent stock, mother animals or slower-growing broilers, father animals from the breeding sector, the day-old chicks of chickens destined for export, or turkeys and poultry being kept in veranda housing with integrated plastic feeding pans at the time when this regulation enters into force.
[45] Article 7.3. Exemption from the ban on beak treatment on poultry, Veterinarians Regulation, https://wetten.overheid.nl/BWBR0035238/2019-06-01.

5.2. Welfare consequences as the result of breeding policy, legislation and regulations

In the dairy, poultry meat and egg chains, welfare consequences are specified that are the result of breeding policy and selection for high productivity. For example, popular bulls are often used to sire dairy cattle as this yields offspring with positive traits like high milk production. However, the use of a small group of bulls can lead to a higher inbreeding coefficient and the manifestation of genetic defects in the population, resulting in health and welfare problems (BuRO, 2017).

"The most important animal welfare problems experienced by broilers stem from genetic selection for fast growth, body weight and build. These welfare problems are limited locomotion or activity by animals, skeletal abnormalities, footpad dermatitis, various infectious and non-infectious respiratory and gastrointestinal problems, disturbed rest, a limited behavioural repertoire and weight problems." (BuRO, 2018b). Turkeys become overweight too, because of which they are no longer able to display their full behavioural repertoire.

One consequence of selection for high productivity among laying hens is burn out. The high productivity expected of hens can result in a negative energy equilibrium and, if animals lack the reserves necessary to cope, they may weaken, become emaciated and ultimately die (Visser et al., 2015a; BuRO, 2018a).

Legislation and regulations do apply indirectly to the welfare consequences of this breeding policy. For example, animals that appear to be sick or injured must receive immediate and appropriate care. However, no specific national legislation or regulations apply for farm animals in respect of the underlying risk factor (the hazard): selection for high productivity. Although Article 2.6 of the Animals Act (which is about breeding animals) does provide possibilities to set rules on animal welfare and the breeding of animals, no specifics have been provided for in respect of farm animals yet.

However, Article 3.4 of the Animal Keepers Decree does include an article on the welfare of and breeding policy for companion animals. This article implements Article 5 of the European Convention for the Protection of Pet Animals[46].

The Animal Keepers Decree
Article 3.4.
1. It is prohibited to breed companion animals in a manner that is detrimental to the welfare and health of the parent animal or its offspring.
2. When breeding, as referred to in Paragraph 1, efforts must be made to ensure that the following is avoided as much as possible at the very least:
a. The passing on of serious genetic abnormalities and diseases to offspring or their acquisition of the aforementioned abnormalities and diseases;
b. The passing on to offspring of external characteristics that have a harmful effect on the health or welfare of animals or their possible acquisition of these external characteristics;
c. The passing on to offspring of serious behavioural abnormalities or their possible acquisition of these abnormalities;
d. Unnatural reproduction methods;
e. Harm to the health or welfare of an animal or its offspring due to the number of nests or offspring that a companion animal has.

In 2016, the Council on Animal Affairs also mentioned this difference in legislation and regulations between farm animals and companion animals and recommended the inclusion of a general provision for farm animals too, to avoid welfare and health problems when breeding farm animals as much as possible (RDA, 2016). The then State Secretary for Economic Affairs responded as follows to the recommendation of the Council on Animal Affairs in the following letter to the House of Representatives[47] on 22 April 2016: "*Welfare problems among farm animals may sometimes also be the result of breeding to achieve a certain trait, even if efforts are always focused on breeding healthy animals. Entrepreneurs benefit most from this. It is the responsibility of the sector to ensure that animals are bred in a socially acceptable manner. The solution lies in actions that the sectors take themselves. For example, in the 'Initiatiefgroep Duurzame Fokkerij' (the sustainable breeding initiative group) or other chain initiatives. Incidentally, there is less scope to set national rules on farm animals than on companion animals, because European regulations about the breeding of farm animals are already in place."*

Breeding procedures for farm animals are part of European Directive 98/58/EC concerning the protection of animals kept for farming purposes. Article 21 of the annex reads: "*Breeding procedures 21. No animal shall be kept for farming purposes unless it can reasonably be expected, on the basis of its genotype or phenotype, that it can be kept without detrimental effect on its health or welfare."* This article has been implemented in national legislation in the list for animals kept for production (Annex II, Animal Keepers Decree). This list has been taken from the

[46] Explanatory Memorandum, Bulletin of Acts and Decrees 2014, 210, Decree of 5 June 2014, setting out the regulations governing keepers of animals (Animals Keepers Decree).
[47] Parliamentary Paper, Parliamentary House of Representatives of the States General, 2015-2016, 28286, No. 859. Second status letter on animal welfare

earlier Animals Farmed for Production (Designation) Decree (*Besluit aanwijzing voor productie te houden dieren*), part of the Animal Health and Welfare Act (*Gezondheids- en welzijnswet voor dieren (GWWD)*). At the time, this list specified the animals or animal species that could be kept for production purposes in an acceptable manner. Wageningen-UR conducted various analyses of animal suffering for the Animals Act. These analyses of animal suffering also revealed several welfare consequences that ensue from breeding policy. For example, health problems and genetic disorders in horses, a genetically high growth rate in broilers, hunger for broiler parent stock as a result of feed restrictions, routine caesarean births for double-muscled cattle and high growth rates and locomotion problems in meat turkeys (Leenstra et al., 2007; Leenstra et al., 2009). The explanatory memorandum on the Animal Keepers Decree states the following on this subject: "*The (..) analyses of animal suffering referred to revealed that, although animal welfare needs to be improved, there is currently no immediate reason to exclude animals that were included in the annex previously. Added to this, greater significance is given to the importance of the purpose for which animals are being kept, being food production – partly in view of the fact that animal husbandry is an important economic factor in the Netherlands – than the intrinsic value of animals. For this reason, the list of animals to be kept for the production of animal products will continue to be part of the operation of the present decree. It is also important to observe that the general housing and care standards included in Articles 1.6 up to and including 1.8 of the decree and also the additional housing and care standards included in Articles 2.3 up to and including 2.5 of the decree for animals that are used for production purposes, which serve to implement Directive 98/58/EC, guarantee the basic welfare level of the animals concerned"* [48]. The list for animals kept for production is at animal-species level, because of which it is very general. A species may or may not be kept for production purposes and the list does not take different breeds into consideration or the welfare consequences resulting from the breeding policy for the species in question. One example is the *Gallus Gallus* (chicken) species. This chicken can be kept for production purposes, but this category includes all laying hen and meat chicken species; there is a huge amount of variation in welfare consequences as a result of differences in breeding policy.

The European Animal Breeding Regulation, Regulation (EU) 2016/1012[49], is directly applicable in the Netherlands too. This regulation sets out conditions for the breeding of cattle, pigs, sheep, goats and equidae. This includes rules for breeding programmes: "*with the overall aim of improving, in a sustainable manner, the production and non-production traits of animals of a breed or to preserve a breed."* However, this regulation does not mention animal welfare specifically and it does not apply to poultry either. Article 3 of this regulation is relevant too. It stipulates that breeding rules that restrict or impede the trade in breeding animals and

[48] Explanatory Memorandum, Bulletin of Acts and Decrees 2014, 210, Decree of 5 June 2014, setting out the regulations governing keepers of animals (Animals Keepers Decree).
[49] Regulation (EU) 2016/1012 of the European Parliament and the Council of 8 June 2016 on zootechnical and genealogical conditions for the breeding, trade in and entry into the Union of purebred breeding animals, hybrid breeding pigs and the germinal products thereof and amending Regulation (EU) No 652/2014, Council Directives 89/608/EEC and 90/425/EEC and repealing certain acts in the area of animal breeding ('Animal Breeding Regulation') (Text with EEA relevance)
OJ L 171, 29.6.2016, p. 66–143.

germinal products are not permitted. The tightening up of rules in the Netherlands may not impede the international trade in animals to which the breeding regulation applies. Therefore, livestock farmers are still able to import these animals.

Current legislation and regulations do not directly protect farm animals from the negative consequences of breeding policy. The examples above from the various chains show that, despite existing legislation and regulations, there are still welfare consequences for farm animals as a result of current breeding policy. In these cases, animal welfare is subordinate to (high) productivity. Given the European Breeding Regulation, the link with the Breeding procedures part of European Directive 98/58/EC concerning the protection of animals kept for farming purposes and large international breeding organisations, it would be best to arrange the tightening of regulations on the animal welfare aspects of breeding policy for farm animals at the European level.

5.3. Types of legislation and regulations and the supply chains

Differences in types of legislation and regulations apply within the supply chains and animal species too, as shown in Table 11. Of the 12 welfare consequences in the dairy chain, nine are only part of a qualitative goal-oriented regulation (open standard) in legislation and regulations. A similar situation applies in the egg chain. In the red meat chain, many welfare consequences are permitted under certain conditions. For example, piglet castration, tooth grinding and tail docking. In the poultry and red meat chains, more means-oriented regulations and quantitative goal-oriented regulations apply too.

Many of these means-oriented regulations and quantitative goal-oriented regulations originate from European directives. For example, Directive 2007/43/EC laying down minimum rules for the protection of chickens kept for meat production and Directive 2008/120/EC laying down minimum standards for the protection of pigs. There is no separate EU directive for animal species in the dairy chain, such as cattle, sheep and goats. They are covered solely by general Directive 98/58/EC concerning the protection of animals kept for farming purposes. This directive does not include any means-oriented regulations or quantitative goal-oriented regulations. Given these differences in legislation, major differences exist between animal species for similar welfare consequences. For example, footpad dermatitis in broilers and footpad dermatitis in meat ducks. For broilers, the incidence of footpad dermatitis in each flock must be scored. This data must be retained and, depending on the score, a maximum stock density determined; the animal keeper must draft an improvement plan in the event of high scores. However, if ducks have footpad dermatitis, this is covered solely by the goal-oriented regulations on caring for sick animals and hygienic housing.

Table 11. Numbers of welfare consequences mentioned in the red meat, dairy, poultry meat, egg and animal feed supply chains, categorised by type of legislation and regulations and chains.

Legislation category	Egg supply chain	Poultry meat supply chain	Red meat supply chain	Dairy supply chain	animal feed chain	Final total
Not included in legislation and regulations	3	3		1		**7**
Qualitative goal-oriented regulation	22	21	6	9	12	**70**
Qualitative goal-oriented regulation and means-oriented regulation	1	6	4			**11**
Qualitative goal-oriented regulation and permitted under certain conditions			1			**1**
Qualitative goal-oriented regulation, quantitative goal-oriented regulation and means-oriented regulation			3			**3**
Qualitative goal-oriented regulation, means-oriented regulation and permitted under certain conditions			1			**1**
Means-oriented regulation		1				**1**
Means-oriented regulation and permitted	1					**1**
Qualitative goal-oriented regulation determined by a court decision	1	1				**2**
Qualitative goal-oriented regulation determined by a court decision, other qualitative goal-oriented regulation welfare consequence	1	2				**3**
Permitted by legislation and regulations			1			**1**
Permitted under certain conditions		1	4	1		**6**
Required by legislation and regulations				1		**1**

Just EU legislation		1				**1**
Final total	**29**	**34**	**20**	**12**	**12**	**109**

6. Recording data and animal welfare

6.1. Information for risk assessment

As described in Section 4, the BuRO carried out its risk assessments on the basis of EFSA methodology and each risk assessment consists of the following steps:

1. Hazard identification: the threats to animal welfare that have been identified by academic experts and experts in professional practice and which have been described in international scientific literature;
2. Hazard characterisation: the relevance (welfare impact) consisting of the severity and duration of welfare;
3. Exposure assessment: the likelihood of threats, including the number of animals affected by them. In relation to animal welfare, this is the occurrence of certain conditions, situations and practices that affect the welfare of animals;
4. Risk assessment: the overall assessment of the nature and severity of each threat, and the likelihood/prevalence thereof in the Netherlands.

The BuRO needs access to various data sources to be able to establish prevalence and exposure. Information that the BuRO needs to be able to carry out a full risk assessment includes data on the prevalence of welfare consequences, such as animal diseases, and how often animals are exposed to risk factors (hazards) of the welfare consequences. For example, outdoor access as a risk factor of predation among laying hens and the mortality rate as a consequence of predation.

6.2. Obligation to record information in the Animals Act

The Animals Act and underlying legislation and regulations require animal keepers to record certain information. For example:

- The veterinary medicinal products administered to animals to treat them;
- A business health plan;
- The medical care provided to animals;
- Mortality.

Broiler farmers must keep more information, which is also of a more detailed nature:

- Number of broilers;
- Stocking density;
- Daily and cumulative mortality;
- Footpad dermatitis score.

Broiler farmers must also actively pass on this information and report the mortality rate and stocking density recorded to the minister (RVO.nl). If footpad dermatitis scores are too high, the livestock farmer must prepare an improvement plan and submit it to RVO.nl. Besides this data, the BuRO does not have any direct insight into data that could be useful to the realisation of a full risk assessment. The government does not have this other information either; it is kept by the individual

livestock farmers. The latter must be in a position to submit this information when requested to do so. This data must be obtained via other sources, such as research reports or public data. This data is often recorded on paper and information is available from a number of digital systems - there is no central digital system.

The BuRO raised this point in previous risk assessments too:

The red meat supply chain (BuRO, 2015):
"It is not currently possible to properly assess the full extent of the animal welfare risks associated with the red meat supply chain due to the insufficient systematic registration of relevant parameters like animal health and behaviour (cattle, pigs) and premature mortality (pigs) in animals in the various stages of the supply chain. Consequently, considerable uncertainty underlies estimates of animal welfare risks."

The following advice was given to the NVWA: "*Systematically register data (nature, frequency) on risks for animal welfare in every link in the red meat chain to gain an insight into animal welfare risks in the red meat chain and to be able to quantify compliance with relevant animal welfare regulations."*

The dairy supply chain (BuRO, 2017):
"Collect and exchange data from and between all parts of the dairy supply chain (primary establishment, milk factory, COKZ, NVWA) in order to gain an ongoing and up-to-date picture of food safety and animal welfare compliance and safeguards, and to ensure that these data can be used nationally and internationally in risk assessments and analyses. In doing so, ensure that data on dairy products can be correlated at least with data on the use of animal feed and animal medicines at farm level."

The egg supply chain (BuRO, 2018a):
"There is no comprehensive overview of the key figures within laying poultry farming (or the egg supply chain), which effective precludes broad-spectrum risk-based monitoring."

The poultry meat supply chain (BuRO, 2018b):
"No compulsory registrations are available about footpad dermatitis for poultry, other than fast-growing broilers at maximum stocking density. Although footpad dermatitis is a serious problem for these other types of poultry too, no adequate regulations are in place for them."

The following advice was given: *"Ensure that it becomes possible to utilise all digital government data sources and food-chain information better and also that links can be established between data sources to facilitate the collection of prevalence data for the optimisation of risk-based and information-based supervision in the primary phase."*

6.3. Information based on animal indicators

Scientific research carried out on animal welfare in recent years has increasingly used animal indicators (and environmental factors) to assess animal welfare.

Welfare indicators are also being developed at European level. The EFSA has published various documents on this subject. For example, documents about animal indicators for dairy cattle (EFSA, 2012a) and pigs (EFSA, 2012c). Animal indicators are also being considered by the EU Reference Centres for Animal Welfare (EURCAW) created by the European Commission (European Commission, 2020). The EURCAW-Pigs has already developed various factsheets containing indicators for tail biting and housing in farrowing crates, among other things (EURCAW-Pigs, 2020).

Animal indicators give an impression of current and past animal welfare. In slaughterhouses, live animals and carcasses are already subject to quite detailed examination. For example, bruising, bone fractures and the condition of meat can provide information about welfare on the farm, during transport or prior to slaughter (Broom, 2017). If this information is recorded, it can be used for enforcement purposes and for BuRO risk assessments. Points that could be scored include footpad dermatitis and bumblefoot in laying hens. In the case of broilers, the scoring of footpad dermatitis in each flock is required by law. If a broiler farmer scores an average of more than 120 points over the space of a year, he/she must lower his/her stocking density and prepare an improvement plan. Similar requirements and measures ought to be introduced for other poultry too. The preparation of an improvement plan by an animal keeper when the score calculated at the slaughterhouse is above a certain value could also be used in respect of keel bone fractures and injuries as a result of feather pecking among laying hens, stomach and lung problems in veal calves and pigs and injuries as a result of tail biting by pigs. Protocols have been developed for the scoring of animal-based indicators at farms as part of the Welfare Quality concept and the European Animal Welfare Indicators Project (AWIN), for example. It should be possible to develop standards at an international level based on these protocols and animal indicators.

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Appendices

Appendix 1 Action plan for the evaluation of the Animals Act by the Ministry of Agriculture, Nature and Food

The following questions are key in the Ministry of LNV action plan on the evaluation of the Animals Act. The questions marked in bold form the basis for the contribution from the BuRO:

A simplified and coherent system
- Has the Act led to a simplified and coherent system of rules?
- Do the individual rules complement each other?
- Do any of the rules contradict each other?
- Are the rules accessible and clear to the target groups to which the regulations relate (animal keepers, veterinaries, dealers and enforcers, etc.) and are they only detailed where necessary?
- Have the number of rules formulated been limited to keep the bureaucratic burden to a minimum?
- Does the legal framework offer enough scope for initiatives by citizens and companies and for new developments in the field of animal husbandry?

Animal protection
- **Do the rules safeguard the level of animal protection envisaged by the Act?**
- **Have the rules been formulated to ensure that animals are protected as much as possible against human activity that affects their physical and ethological welfare?**
- **Does the legal framework sufficiently take the intrinsic value of individual animals into consideration?**

Do the rules protect humans and the environment?
- Are the risks that animals could pose managed by the rules?
- Do the rules safeguard the safety of animal products for users and consumers?
- Are unwanted emissions of substances into the environment limited and prevented?

Weighing up interests
- Are the various interests weighed up against each other when drafting the rules?
- **Is the intrinsic value of the individual animal taken into consideration when drafting rules?**

Enforcement[50]
- Is it possible to intervene effectively if (it is likely that) the rules have been broken?
- Are the sanctions that have been provided for adequate?
- The ambition was to increase the penalty for animal abusers. Has this ambition been achieved?

[50] In respect of supervision, enforcement and judicial review.

The following is observed in the second bullet point of the list setting out the scope of the evaluation:
The object is to evaluate legislation, not the policy formulated or the effectiveness of enforcement. As such, the evaluation will record how parties would like to see animal welfare improved. The proposal is to assess these wishes and include them in the policy response. If they lead to the addition of new regulations to the Animals Act, they will be included in the follow-up project.

Appendix 2 Welfare consequences, legislation and regulations
Approach to the categorisation of welfare consequences from the chains:

1. **The welfare consequences per chain have been categorised in accordance with the Welfare Quality concept**

Table 12. The Welfare Quality concept principles and criteria (Jones & Manteca, 2009).

Principles	Criteria
Good feeding	1. Absence of prolonged hunger 2. Absence of prolonged thirst
Good housing	3. Comfort around resting 4. Thermal comfort 5. Ease of movement
Good health	6. Absence of injuries 7. Absence of disease 8. Absence of pain induced by management procedures
Appropriate behaviour	9. Expression of social behaviours 10. Expression of other welfare related behaviours 11. Good human-animal relationships 12. Positive emotional state

2. **Welfare consequences per chain and linked to legislation and regulations**

The following abbreviations are used in the tables below:
AA = The Animals Act
AKD = The Animal Keepers Decree
VR = The Veterinarians Regulation
VD = The Veterinarians Decree
AKR = The Animal Keepers Regulation

3. **Legislation linked to type of legislation**

Categorisation in the tables below:

A. Not included in legislation and regulations;
B. Qualitative goal-oriented regulation (open standard);
C. Quantitative goal-oriented regulation;
D. Means-oriented regulation;
E. Goal-oriented regulation determined by a court decision;
F. Permitted by legislation and regulations;
G. Permitted by legislation and regulations under certain conditions;
H. Required by legislation and regulations;
I. Just European legislation and regulations.

The red meat supply chain

Table 13. Welfare consequences from the red meat chain and applicable legislation and regulations

WQ principle	WQ criteria	Welfare consequences	Animal species	Legislation and regulations	Type of legislation
Good health	6	Injuries from tail and ear biting	Pigs	AKD: Articles 1.6(2), 1.7(c), 2.4.(4) and (5), 2.14(1), 2.22(1)	B, D
Good health	7	Health problems (diarrhoea and lung infections)	Calves	AKD: Articles 1.7(g), 2.5(4), 2.32(3)	B, C, D
Good health	7	Infection with salmonella and E.coli	Cattle	AKD: Article 1.7(d)	B
Good health	7	Increased infection pressure	Veal calves	AKD: Articles 1.7(d), 2.36(1), 2.44	B
Good health	7	Gastric abnormalities	Sows and fattening pigs	AKD: Articles 1.7(c) and (e), 2.26(3)	B
Good health	7	Claw problems	Veal calves	AKD: Articles 1.7(c), 2.4(4) and 5, 2.35, 2.36	B, D
Good health	7	Health problems due to feed regime	Veal calves	AKD: Articles 1.7(e), 2.4(6), 2.41	B, C, D
Good health	8	Hyperventilation and dyspnoea from stunning pigs CO2	Pigs	AKD: Articles 1.12, 1.13(1), 1.14	B
Good health	8	Castrating piglets	Pigs	AA: Articles 2.8(2)(b), 2.9(3), AKD: Article 2.12(a), VD: Article 2.3 (a)(1) and (2)	G
Good health	8	Tail docking	Pigs - piglets	AA: Articles 2.8(2)(b), 2.9(3) AKD: Article	G

				2.12(b), VD: Article 2.3	
Good health	8	Tooth grinding	Pigs - piglets	AA: Articles 2.8(2)(b), 2.9(3) AKD: Article 2.12(c), VD: Article 2.3(c)	G
Good health	8	Killing without stunning	Cattle, sheep, goats	AA: Article 2.10(4), AKD: Articles 5.8, 5.8(a), 5.8(b), 5.9 5.9(a)	G
Appropriate behaviour	9	Social stress	Calves	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Abnormal suckling behaviour	Calves	AKD: Article 1.6(2).	B
Normal patterns of behaviour	10	Non-fulfilment of the need to ruminate	Veal calves	AKD: Articles 1.7(e), 2.4(6), 2.41	B, C, D
Appropriate behaviour	10	Tail and ear biting	Pigs	AKD: Articles 1.6(2), 1.7(c), 2.4.(4) and (5), 2.14(1), 2.22(1)	B, D
Appropriate behaviour	10	Limitation of the expression of appropriate behaviour	Veal calves	AKD: Articles 1.6(2), 2.35, 2.36	B, D
Appropriate behaviour	10	Limitation of behavioural repertoire - insufficient enrichment materials	Pigs	AKD: Articles 1.6(2), 2.14(1), 2.22	B, D, G
Appropriate behaviour	10	Limitation of behavioural repertoire - insufficient provision of nesting material	Pigs - sows	AKD: Articles 1.6(2), 2.22	B, G
Appropriate behaviour	10	Limited behavioural repertoire	Sows	AKD: 1.6(1) and (2), 2.15(1), 2.17(2), 2.19, 2.22(3)	G

The dairy supply chain

Table 14. Welfare consequences from the dairy chain and applicable legislation and regulations

WQ principle	WQ criteria	Welfare consequences	Animal species	Legislation and regulations	Type of legislation
Good housing	4	Heat stress	Cattle, sheep, goats	Inside: AA: Articles 2.1(1), 2.2(8), Outside: AKD: 1.6(3).	B
Good health	6	Injuries	Cattle, sheep, goats	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	7	Lameness	Cattle, sheep, goats	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	7	Barn hygiene	Cattle, sheep, goats	AKD: Article 1.7(d)	B
Good health	7	Viral and bacterial infections	Cattle, sheep, goats	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	7	Parasitic infections: ectoparasites and endoparasites	Cattle, sheep, goats	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	7	Metabolic disorders	Cattle, sheep, goats	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	8	Artificial insemination	Cattle	AKD: Article 1.17(1)	B
Good health	8	Health problems due to breeding policy	Cattle	None	A
Good health	8	Disbudding	Cattle, sheep, goats	AA: Articles 2.8(2)(b), 2.9(3) 3 cattle: AKD: Article 2.28(b), VD: Article 2.4(a) sheep and goats: VD: Article 2.5(b), AKD: Article 2.77(a)	G
Good health	8	Ear tagging	Cattle, sheep, goats	AA: Articles 2.8(2))b), 2.9(3), AKD: Article 2.28(c), VD: Article 2.6(c)	H
Appropriate behaviour	9	Social stress	Cattle, sheep, goats	AKD: Article 1.6(2).	B

The poultry meat supply chain

Table 15. Welfare consequences from the poultry meat chain and applicable legislation and regulations.

WQ principle	WQ criteria	Welfare consequences	Animal species	Legislation and regulations	Type of legislation
Good feeding	1	Reduced feed intake	Rearing grandparent and parent stock, grandparent and parent breeding, hatchery, broilers	AA: Articles 2.1(1), 2.2(8) AKD: Article 1.7(e), Article 2.4(6) Parent stock: AKD: Articles 2.65(d)(1)(d) and (4) and (5)	B, E
Good feeding	1	Reduced feed/water	Hatchery	AA: Articles 2.1(1), 2.2(8) AKD: Article 1.7(3), Article 2.4(6)	E
Good feeding	2	Reduced water intake	Rearing grandparent and parent stock, grandparent and parent breeding, hatchery, broilers	AA: Articles 2.1(1), 2.2(8) AKD: Article 1.7(f).	B, E
Good housing	3	Reduced quality of plumage	Grandparent and parent breeding birds	AKD: Article 1.7(d), Article 2.65f(3), Ducks: no water --> AKD: Article 1.6(2).	B
Good housing	4	Hypothermia	Hatchery	AKD: Articles 1.7(g), 2.5(4)	B
Good housing	4	Hyperthermia	Hatchery, broilers, slaughterhouse	AKD: Articles 1.7(g), 2.5(4) Broilers AKD: Articles 2.56, 2.57 Turkeys AKD: Article 2.76(f)	B, D
Good housing	4	Damage to plumage	Grandparent and parent rearing,	None	A

			grandparent and parent breeding		
Good housing	5	Limited activity/locomotion	Grandparent and parent rearing, grandparent and parent breeding, broiler farm	AKD: Articles 1.6(2), 1.8(1), 2.5(1)	B
Good health	6	Major injuries	Grandparent and parent stock, grandparent and parent breeding, broilers, slaughter	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	6	Bone fractures, muscle tears, dislocations	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Articles 1.7(c), 1.8(2) and (3), 2.4(4) and (5)	B
Good health	6	Chest irritation	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Articles 1.7(c) and (d), 2.4(4) and (5), 2.65(f)(3), 2.76(e), 2.76(i)(2)	B, D
Good health	6	Heel dermatitis	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Articles 1.7(c) and (d), 2.4(4) and (5), 2.65(f)(3), 2.76(e), 2.76(i)(3)	B, D
Good health	6	Small wounds or scratches	Hatchery, broilers	AKD: 1.7(c), 2.4(4) and (5), Article 1.8(2) and (3), Article 2.65(d)(1)	B, D
Good health	6	Footpad dermatitis	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers, ducks, turkeys	AKD: Article 1.7(c), Article 2.4(4) and (5) Broilers: AKD Article 2.63. AKR: Articles 6.5, 6.6, 6.9 Parent stock: AKD: Article 2.65(f)(3); Turkeys: AKD: Article 2.76(e). 2.76(i)(3)	B, D
Good health	7	Dirty eyes and nostrils	Duck	AKD: Article 1.7(c), Article	B

				2.4(4) and (5), 1.6(2)	
Good health	7	Non-infectious gastrointestinal problems	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: 1.7 (e) and (f), AKD: Article 2.4(6)	B
Good health	7	Non-infectious respiratory problems	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers, turkeys	AKD: Article 1.7(g), 2.5(4); Broilers: AKD: Article 2.57 Turkeys: AKD 2.76(f)(1)	B, D
Good health	7	Mild and severe respiratory problems	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers, turkeys	AKD: Article 1.7(c), Article 2.4(4) and (5)	B
Good health	7	Infectious gastrointestinal problems	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Article 1.7(c), Article 2.4(4) and (6)	B
Good health	7	Endoparasitic infections	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Articles 1.7(c) and (d), 1.8(4), 2.4(4) and (5), 2.5(3)	B
Good health	7	Ectoparasitic infections	Grandparent and parent rearing stock, grandparent and parent breeding stock,	AKD: Articles 1.7(c) and (d), 1.8(4), 2.4(4) and (5), 2.5(3)	B
Good health	7	Skeletal deviations	Grandparent and parent breeding stock, grandparent and parent rearing stock, broiler farm, ducks	None	A
Good health	7	Death	Broiler farm	AKD: Articles 2.52(1)(d), 2.53, 2.62	D
Good health	8	Cutting when still conscious		EU legislation	I
Good health	8	Killing at farm	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers, hatchery	AKD: Articles 1.12, 1.13(1), 1.14	B

Good health	8	Hooking up	Slaughter	AA: Article 2.1(1).	B
Good health	8	Hopeless suffering	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers	AKD: Articles 1.7(c), 2.4(4) and (5)	B
Good health	8	Beak trimming (after intervention)	Grandparent and parent rearing stock, grandparent and parent breeding stock,	None	A
Good health	8	Cutting back toe	Grandparent and parent rearing stock	AA: Article 2.8(2((b), AKD: Article 2.47(c), VD: Article 2.2(b).	G
Appropriate behaviour	9	Interaction between dominant roosters	Grandparent and parent breeding stock	AKD: Article 1.7(a)	B
Appropriate behaviour	10	Feather pecking	Grandparent and parent rearing stock, grandparent and parent breeding stock, broilers, turkeys	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Limited behavioural repertoire	Grandparent and parent breeding stock, grandparent and parent breeding stock, broiler farm, hatchery	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Disturbed rest	Grandparent and parent rearing stock, grandparent and parent breeding stock, broiler farm	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Limited preening behaviour	Duck	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Too heavy	Broiler farm, ducks, turkeys	AKD: Article 1.6(2).	B
Appropriate behaviour	12	Fear of environment	Slaughter	AA: Article 2.1(1).	B

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Table 16. Welfare consequences from the egg chain and applicable legislation and regulations.

WQ principle	WQ criteria	Welfare consequences	Animal species	Legislation and regulations	Type of legislation
Good feeding	1	Reduced feed intake	Hatchery, laying - all systems	AA: Articles 2.1(1), 2.2(8), AKD: Article 1.7(e) and (f), 2.4(6), 2.70(1)(f), (2)(c), 2.71. (2)(e), 2.72(1)(e)	B, E
Good feeding	2	Reduced water intake	Hatchery;	AA: Articles 2.1(1), 2.2(8) AKD: Article 1.7(f).	E
Good housing	3	Trapped in the system	Rearing - barn/free-range and enriched cage, laying - all systems	AKD: Articles 1.8(2) and (3), 2.5(3)	B
Good housing	3	Predation	Laying - organic	AKD: Articles 1.6(3), 2.70(3)	B
Good health	6	Toe amputations and toe injury	Rearing - all systems, laying - all systems	AKD: Articles 1.8(2) and (3), 2.5(3)	B
Good health	6	Major injuries	Rearing - all systems, laying - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	6	Pecking injuries	Rearing - all systems, laying - all systems	AKD: 1.6(2), 1.7(c), 2.4.(4) and (5)	B
Good health	6	Footpad dermatitis	Rearing - barn/free-range and enriched cage, laying - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	6	Keel bone fractures	Laying - all systems	AKD: Articles 1.7(c), 1.8(1), 2.4(4) and (5)	B
Good health	7	Non-infectious respiratory problems	Rearing - all systems, laying - all systems	AKD: Articles 1.7(g), 2.5(4)	B

Good health	7	Weak animals	Hatchery;	AA Articles 2.1(1), 2.2(8), AKD: Articles 1.7(c), 2.4(4) and (5)	B
Good health	7	Bumble foot	Laying - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	7	Serious infectious respiratory problems	Laying - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	7	Mild infectious respiratory problems	Laying - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	7	Infectious gastro-intestinal problems	Rearing - all systems	AKD: Articles 1.7(c) 2.4(4) and (5)	B
Good health	7	Burning out	Laying - all systems	AKD: Articles 1.7(c),(e) and (f), 2.4(4), (5) and (6)	B
Good health	7	Ecto-parasitic infections	Rearing - all systems, laying - all systems	AKD: Articles 1.7(c), (d), 1.8(4), 2.4(4) and (5), 2.5(3), 5, 2.76.(1) and (2)	B
Good health	7	Non-infectious gastro-intestinal problems	Rearing - all systems, laying - all systems	AKD: Articles 1.7(e) and (f), 2.4(6)	B
Good health	7	Endo-parasitic infections	Laying - barn, free range and organic	AKD: Articles 1.7(c) and (d), 1.8(4), 2.4(4) and (5), 2.5(3), 2.70(3) and 2.76.(1) and (2)	B
Good health	8	Killing at primary businesses	Rearing - all systems, laying - all systems	AKD Articles 1.12, 1.13(1), 1.14	B
Good health	8	Hopeless suffering	Laying - all systems	AKD: Articles 1.7(c), 2.4(4) and (5)	B
Good health	8	Beak trimming - after effects	Rearing - barn/free range and enriched cage	None	A
Good health	8	Beak trimming	Hatchery	VR Article 7.3.	D, G
Appropriate behaviour	9	Social stress	Rearing - all systems, laying - all systems	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Feather pecking	Rearing - all systems, laying - all systems	AKD: Article 1.6(2).	B
Appropriate behaviour	10	Disturbed rest	Hatchery	AA: Article 2.1(1), AKD: Article, 1.6(2)	B
Appropriate behaviour	10	Limited behavioural repertoire	Rearing - all systems, laying - all systems,	AKD: Articles 1.6(2), 2.70, 2.71, 2.72	B, D

Appropriate behaviour	11	Fear of people	Rearing - all systems, laying - all systems	None	A
Appropriate behaviour	12	Smothering	Rearing - all systems, laying, barn and free range - organic	None	A

The animal feed chain

Table 17. Welfare consequences from the animal feed chain and applicable legislation and regulations.

WQ principle	WQ criteria	Welfare consequences	Animal species	Legislation and regulations	Type of legislation
Good health	6	Traumatic reticuloperitonitis	Grazing animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Copper poisoning	Sheep	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Reduced fertility	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Acute mortality	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Birth defects	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Reduced weight	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Immunomodulation	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B

Good health	7	Botulism	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Cryptosporidiosis	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Listeriosis	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Salmonellosis	Farm animals	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B
Good health	7	Abortion	Sheep and goats	AKD: Articles 1.7(c) and (e), 2.4(4), (5) and (7)	B

Appendix 3 Search terms

a. The terms 'animal welfare', 'five freedoms animal welfare', 'definition animal welfare', 'intrinsic value of animal' and 'eu legislation animal welfare' were used in Google Scholar searches;
b. The term 'goal-oriented regulations' was used in Google searches;
c. Finally, reference lists from retrieved literature were used, known sources - NVWA, RDA and EFSA reports, for example - were studied, WUR reports on previous red meat, dairy, poultry meat and egg chain risk assessments were utilised and the BuRO also studied books about animal welfare and other known scientific articles that were already in its possession.