STUDY

Requested by the PETI committee

European Parliament

End the cage age: Looking for alternatives

Overview of alternatives to cage housing and the impact on animal welfare and other aspects of sustainability

Policy Department for Citizens' Rights and Constitutional Affairs
Directorate-General for Internal Policies
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Abstract

This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the PETI Committee, presents alternatives for cage housing of farm animals and laying hens and sows in particular. Cage-free housing has a positive effect on the behavioural freedom and welfare of animals. No major problems arise with regard to other aspects of sustainability. Research shows that cage-free housing is currently possible or will be in the future. A shift towards cage-free housing systems may be achieved by financial and policy measures in the short term and legislation in the long term.

This document was requested by the European Parliament's Committee on Petitions.

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LIST OF ABBREVIATIONS

CAP	Common Agricultural Policy
EC	European Commission
ECI	European Citizens Initiative
EFSA	European Food Safety Authority
EP	European Parliament
EU	European Union
LCA	Life Cycle Assessment
PETI	The European Parliament's Committee on Petitions

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EXECUTIVE SUMMARY

Background

This study was requested by the European Parliament's Committee on Petitions (PETI) in response to the European Citizens Initiative (ECI) 'End the Cage Age'. The petition 'End the Cage Age' (www.endthecageage.eu) was initiated in 2018 by Compassion in World Farming and over 170 other European animal welfare/protection organisations and citizens. Over the course of one year, 1.4 million verified signatures were collected from citizens in 28 EU Member States and handed in on 2 October 2020. Over the years, the Committee on Petitions has received a considerable number of petitions on animal welfare.

This study describes best practices for non-cage systems and the effects of the various housing systems on animal welfare, on the actors involved and on aspects of sustainability. The focus of the study is on alternatives to cage housing in laying hens and in sows, because of these species the largest numbers of animals are kept in cage housing in the EU. Non-cage alternatives for these species are already available and being used. Research on most of these non-cage alternatives is also available, allowing for a proper description of such non-cage systems. For other farm animals kept in cage systems an overview is provided of possible alternatives to cage housing or improvement of the current systems.

Main findings of the study

For laying hens, both furnished cage systems and non-cage systems are used in the EU. Non-cage systems provide laying hens with more behavioural freedom and access to floor substrate, which allows them to show behaviours such as foraging and dust bathing. Laying hens are strongly motivated to perform these behaviours. In cage systems, it remains very difficult to provide hens with proper access to litter.

On the other hand, the large flock size in non-cage housing systems places specific demands on the management by the farmer. Close attention is needed to prevent welfare problems such as feather pecking and cannibalism, keel bone damage, and crowding. Therefore, proper training of farm staff is important to successfully manage non-cage flocks. A transition to non-cage housing in laying hens is possible if the farmer is able to recover the increased costs of production. From sustainability analyses published to date it appears that non-cage systems for laying hens are economically, environmentally and socially similar to furnished cage systems.

As regards sows, the focus is on the individual housing of sows around insemination and during nursing, in the farrowing crate. In the period around insemination it is important to keep sows individually in order to monitor which sows are in oestrus and also to prevent unrest and subsequent trauma. However, it seems feasible to significantly shorten the time period before the sows return to group housing - from 28 to 4 or 5 days. For the farrowing barn different systems exist, which vary from conventional crates to systems where the sow is only temporarily confined, to free-farrowing systems. For the farrowing phase it is important to select a system that safeguards both the welfare of the sow and that of the piglets. Temporary confinement of the sow around farrowing helps prevent crushing and savaging of new-born piglets.

Notably, multiple systems exist that allow for releasing the sow after a few days and allowing her to interact with the piglets. Also, multi-suckling systems exist where multiple sows and their piglets are housed together, with beneficial effects on the resilience of the piglets. As in the case of laying hens, to be able to transition to non-cage housing for sows, farmers need assurances that they will be able to recover the increased housing costs. In sustainability analyses published to date, no large differences were found between cage and non-cage pig production systems, but more research may be needed here. As regards production costs, systems where sows can be released after farrowing are more affordable than multi-suckling systems.

For the other species briefly described in this study (rabbits, ducks and geese, quail, fur animals and calves) limited alternatives to cage or individual housing were identified. For these species the most promising way towards improving welfare may be to improve the current cage housing systems (different flooring, platforms, shelters, environmental enrichment, avoiding overcrowding, social interaction between pens).

Recommendations

In order to facilitate a transition towards cage-free housing systems for farm animals in the EU, several measures could be taken at different levels and within different time frames. For short-term change, policy and financial measures (e.g. subsidies) may be the most promising. However, these types of measures are relatively voluntary and may be implemented differently by Member States, producers, and other actors involved. Adoption of legislation at EU level seems the most promising route to achieve a 100% shift towards cage-free housing systems. However, formulating and implementing legislation may take a long time and therefore seems especially promising for the longer-term change.

For laying hens, a transition away from cage housing could be facilitated by a ban on furnished cages, like the ban on conventional cages that came into force in 2012. For pigs, the time that the sows are housed individually could be shortened. Furthermore, a transition away from farrowing crates could be initiated so that sows are only confined temporarily around farrowing, or where loose farrowing is practiced. For species other than pigs and laying hens a legal ban on non-cage housing seems unrealistic at the moment.

A good way to help farmers who want to make a shift towards cage-free housing systems and to facilitate innovators and early adapters, could be to provide them with more financial security by granting subsidies and/or conditional loans. Retailers can also play an important role in the transition towards non-cage systems, for instance by only selling products from non-cage housed animals. Consequently, clear and reliable labelling of animal products regarding welfare aspects of their production is critical. Future legislation and a shift in housing systems should ideally be based on sound scientific findings.

In this study an overview is provided of scientific studies on the welfare consequences of different housing systems for laying hens and pigs. Despite the many useful studies that have been made, more knowledge of alternative and out-of-the-box housing systems is still needed. Research should not focus on one particular part of sustainability, but should look from a much broader perspective and choose a system approach.

A shift towards new housing systems is not always easy for livestock farmers who only have experience with the system they have always worked in. If bans on certain housing systems (such as furnished cages for laying hens) are considered, training and guidance is needed for farmers from countries where the majority of certain animals are kept in cages or where large parts of the farming practice involve cage housing.

For a successful shift to non-cage housing systems - either via legislation or subsidies and policies - cooperation between all actors is very important. Since most farmers do not produce, process and sell products themselves, it is important to engage all parties involved at an early stage of the transition process. This may be easier in countries where agricultural products are produced in a more integrated way, but also in those countries communication with other stakeholders is needed. It is recommended to facilitate dialogue between the different actors and let them think about new future husbandry systems collectively.

1. INTRODUCTION

KEY FINDINGS

This study focuses on alternatives for cage housing of farm animals. Laying hens and sows are chosen as the focal species for this study, because they represent the largest number of animals housed in cage systems and because different forms of alternative housing systems are already operational. The situation for other species is described more briefly.

The definition of animal welfare used in this study is the welfare concept of the Faculty of Veterinary Medicine of Utrecht University: "An individual is in a state of welfare when it is able to adapt to its living conditions and can achieve a state that it experiences as positive".

1.1. Background of the study

This study was requested by the Committee on Petitions (PETI) in response to the European Citizens Initiative (ECI) 'End the Cage Age'. The petition 'End the Cage Age' (www.endthecageage.eu) was initiated in 2018 by Compassion in World Farming and supported by over 170 other European animal welfare/protection organisations and citizens.

In light of the fact that, over the years, PETI has received a considerable number of petitions on animal welfare, the Committee considered it appropriate and useful to gather expert information on the various aspects of the treatment of farm animals. The study will:

- give a brief overview of the relevant current and/or upcoming EU legislation on animal welfare and farm animal welfare in particular;
- provide examples/best practices of non-cage livestock husbandry systems for some of the most common farm animals;
- discuss the implications of the different systems for the welfare of the animals;
- discuss the impacts of a transition to non-cage systems on the actors involved, the economy, the environment and the use of land;
- discuss the way in which a transition from cage farming to alternative systems could be facilitated with financial, regulatory and policy measures by the EU;
- provide, where possible, (policy) recommendations/suggestions that could help improve the existing EU policy/legislation on the treatment of farm animals.

1.2. Which farm animals are kept in cages?

Within the EU there are different production animal species that are kept in cages. In the report "End the cage age – Why the EU must stop caging farm animals" [1] the most common cage housing practices are described. In the report it is estimated that in the EU over 300 million production animals spend all, or a significant part, of their lives in cages.

Production animals for which (some form of) cage housing (either during part of their life or their whole life) is permitted in the EU are: pigs (sows in particular), laying hens, rabbits, ducks, geese, quail, mink, silver foxes and calves. Traditional veal calf crates, conventional battery cages, and feeding stalls for sows are prohibited. Furthermore, some Member States have stricter policies and/or have banned certain forms of cage housing [1].

1.3. Focus of the study – laying hens and sows

The overview presented in this study aims to inform policy makers, stakeholders, farmers and the general public about potential alternatives to cage housing specifically for pigs (gilts and sows) and laying hens. Sows and laying hens were chosen as focus species because they represent the largest number of animals housed in cage systems and because different forms of alternative housing systems for these animals are already operational and have been the subject of (comparative) research. Other species will be discussed briefly. For most of these other species no alternative housing systems are currently suitable or available for commercial practices.

1.4. Methods

The information provided in this study mainly originates from scientific papers and reports, among which several EFSA (European Food Safety Authority) reports on animal welfare in relation to housing systems. Furthermore, the expertise and experiences (such as good examples from practice) of the authors are used.

1.4.1. Animal welfare concept

The focus of this study is on the implications of different housing systems for the welfare of production animals. Before going into these welfare implications, it is important to define what animal welfare is and how it can be measured.

Five Freedoms

Animal welfare is a concept that can be defined at a variety of levels. Despite the attention the issue of animal welfare receives, the question remains what 'welfare' actually entails. Animal welfare is often described in a negative sense: as the absence of factors disturbing the animal's wellbeing. This approach is based on the first attempts to work out a science-based definition of welfare.

In 1965, the Brambell Committee [2] formulated the 'Five Freedoms'.

- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom to express normal species-specific behaviour
- Freedom from fear and distress

Four of these five conditions were formulated based on the idea that the lack of elements contributing to 'non-welfare' indicated the presence of welfare in animals. However, welfare is not only about being free from negative emotions. The experience of positive emotions is also important for a good welfare. This aspect is still too often left out of the conceptual approaches used for welfare.

Welfare in the positive sense

Various scientists have therefore tried to approach animal welfare in a more positive way by also looking at positive emotions of animals [3-5] and including the animal's own perception of a situation in the definition. For example: animal welfare is the quality of life as perceived by the animal itself [6]. Or: the welfare of an individual is its state as regards its attempts to cope with its environment [7].

The Faculty of Veterinary Medicine of Utrecht University considers welfare to be an internal condition that the individual experiences as positive. An individual that experiences its subjective internal

condition as negative therefore is considered to be in a state of poor welfare. The concept of animal welfare used by the faculty of Veterinary Medicine and also used for this study is:

"An individual is in a state of welfare when it is able to adapt to its living conditions and can achieve a state that it experiences as positive".

Assessment of welfare

Welfare can be assessed on a scale ranging from very good to very poor [7]. It is important to consider that animals experience emotions not only acutely, but also possess a certain capacity for emotional adaptation [8]. In order to assess animal welfare, it is therefore necessary to look at both the short-term/acute situation and the long-term/chronic situation. For short-term welfare assessment, the Five Freedoms may be a good guideline. When an individual is free from negative stimuli and is able to show its natural or species-specific behaviour, the short-term condition can be regarded as 'well'.

For long-term assessment it is necessary to look at both negative and positive states. Negative experiences or conditions exceed an individual's ability to adapt if they are not compensated by positive experiences or conditions. During a certain phase in her life a sow may be fed limited and experience hunger at a certain moment. It knows however that it will be fed later (has a feeling of controllability) and therefore still has good welfare. Or it may have positive social interactions with other sows while being hungry. At that moment the positive experiences may overrule the negative experience of hunger and the sow may still experience a good welfare. However, when the sow is kept in a cage without any environmental enrichment and is fed limited on a non-regular basis, it may experience hunger without knowing when it will be fed. In this situation the sow may have poor welfare.

The individual's ability to adapt is determined by a complex interplay of internal and external factors. Analysis of these factors allows for a relative quantitative assessment of an animal's welfare. As the animal approaches the limits of its own ability to adapt, its welfare may become threatened. Once the animal is no longer able to adapt to the situation – i.e. once its ability to adapt has been exceeded – it reaches a pathological situation characterised by physiological reactions and behaviours that do not have an adaptive value. The development of biologically unfavourable (pathological) behaviour is an indication of an inability to adapt. Stereotypical behaviour, for example, is a pathological 'adaptation' to conditions that exceed the individual's ability to adapt. The fact that the process of adaptation is rewarding and therefore increases the animal's welfare emphasises the direct relationship between the ability to adapt and the welfare of the animal. The objectively measurable component of the individual's ability to adapt is its biological functioning within a certain context.

In addition to being physiologically healthy, an important indicator for an animal's functioning is the display of natural, or species-specific, behaviour. The biological functioning of an individual within a certain context can be evaluated using behavioural observations and other quantifiable indicators. In doing so, observers must take into consideration not only the absence of negative indicators, such as avoidance behaviour, but also the presence of positive indicators, such as comfort behaviour. It is important to note, however, that it is often difficult to determine 'natural' behaviour in domesticated animal species that were selectively bred for certain purposes. The corresponding wild-types do not necessarily offer a valid reference-value. Knowledge of the specific strain and breed of the animal is therefore vital in making a reliable assessment. Instead of 'natural' behaviour, the term 'species-specific' behaviour might therefore be more appropriate.

One unquantifiable aspect is the individual's own appreciation of its welfare as 'good' or 'well', as its own perception is, by definition, subjective. This internal assessment can thus deviate significantly from objective parameters, such as physiological criteria. In this sense, 'welfare' as a subjective perception is

not objectively quantifiable. In the end, an animal's state of welfare can only be qualitatively assessed by the individual itself.

We assume that animals observe and evaluate their own welfare condition, in the sense that they experience it as positive or negative. Humans can only gather information about this evaluation indirectly when the animal's internal (emotional) state is translated into its reaction to its environment. Depending on its internal state, an animal's reaction to its surroundings will vary, and this variation can be indicative of its internal state (welfare). For example, the species-specific behaviour of a pig that enters new surroundings is exploratory behaviour. An animal that is in a state of negative welfare will display deviant behaviour, such as passive or defensive behaviour. The behaviour of an animal, in combination with knowledge about species-specific behaviour, is therefore an important 'readout parameter' of its welfare, but that behaviour must always be considered in relation to its surroundings and the context in which it takes place.

Welfare Quality

Despite the difficulties in providing objective measures of welfare based on scientifically sound data, some methodologies have nevertheless been developed. For farm animals, a frequently used and scientifically substantiated methodology for assessing animal welfare in practice developed in the EU is Welfare Quality® [9].

Welfare Quality® consists of four principles and twelve criteria for good animal welfare that build on the Five Freedoms. The four principles are: good feeding, good housing, good health and appropriate behaviour. For the scope of this study (welfare impact of alternatives to cage housing), especially the principles 'good housing' and 'appropriate behaviour' and their underlying criteria are relevant. 'Good health' is relevant for its criterion 'absence of disease'. Most of the information provided in this study will therefore relate to these three principles.

<u>Good feeding</u>

1. Absence of prolonged hunger. Animals should not suffer prolonged hunger, i.e. they should have a sufficient and appropriate diet.
2. Absence of prolonged thirst. Animals should not suffer prolonged thirst, i.e. they should have a sufficient, accessible and potable water supply.

<u>Good housing</u>

3. Comfort around resting (assessment of behaviour rather than injuries). Animals should have comfort around resting.
4. Thermal comfort. Animals should have thermal comfort, i.e. they should not be exposed to too hot or too cold conditions.
5. Ease of movement (other than health or resting-related issues). Animals should have enough space to move around freely.

<u>Good health</u>

6. Absence of injuries (except those due to disease or therapeutic or preventative interventions; neonatal mortality in piglets is included here). Animals should be free from physical injuries.
7. Absence of disease (as well as neonatal and transport-related mortality). Animals should be free of disease, i.e. farmers should maintain high standards of hygiene and care.
8. Absence of pain induced by management procedures (including stunning). Animals should not suffer pain induced by inappropriate management, handling, slaughter, or surgical procedures (e.g. castration, dehorning).

Appropriate behaviour

9. Expression of social behaviours (balance between negative, e.g. prolonged and damaging aggression, and positive aspects, e.g. social licking). Animals should be able to express normal, non-harmful and presumably positive social behaviours, e.g. foraging, grooming.
10. Expression of other welfare-related behaviours (balance between negative, e.g. stereotypies, and positive behaviours, e.g. exploration). Animals should be able to express other normal non-harmful behaviours, i.e. species-specific natural behaviours such as foraging.
11. Good human-animal relationship (reduced fear of humans). Animals should be handled well in all situations, i.e. handlers/stockpersons should promote good human-animal relationships.
12. Positive emotional state. Negative emotions such as fear, distress, frustration and apathy should be avoided and positive emotional states such as security, comfort or contentment should be promoted.

1.4.2. Other aspects of sustainability

Animal welfare is one (important) aspect of sustainability, but there are more values at stake that can be subsumed (together with animal welfare) under the umbrella term of sustainability. To assess overall sustainability of different housing systems, Life Cycle Assessment (LCA) has been developed as a tool. An LCA is a study in which the overall sustainability of a system is calculated and in which all parts of the production chain are considered. An LCA focuses on all three dimensions of sustainability: the environmental, the social (including animal welfare, involved human actors) and the economic dimensions. For both laying hen and pig husbandry systems these kinds of studies have been performed. Therefore, the results of these studies will be used to show the implications for the environment, land use, economy and actors involved.

More background information about the concepts of sustainability and welfare, also in relation to EU legislation and policies, can be found in the study 'Animal welfare in the European Union' [7] that was written for the PETI Committee in 2017.

2. PROTECTION OF FARM ANIMALS IN THE EUROPEAN UNION

KEY FINDINGS

All animals kept for farming purposes are protected by Council Directive 98/58/EC. However only for a number of farm animal species-specific legislation exists (laying hens, broilers, calves and pigs).

For laying hens, the conventional cage has been prohibited since 2012. Housing in furnished cages or non-cage systems is allowed in the EU.

Individual housing for sows has been prohibited since 2013. Individual housing around insemination and in the suckling period is allowed in the EU.

In the near future, both the Animal Welfare Strategy and the European legislation on animal welfare will be reviewed. This creates opportunities for better legal protection of farm animals and their welfare.

European standards regarding the husbandry and welfare of animals kept for farm purposes are captured in different legal acts and policy documents. European Regulations are binding legislative acts that must be applied by all Member States. European Directives must be implemented in national legislation. Directives set out goals which need to be achieved by the Member States. It is up to the Member States to make their own laws on how to achieve these goals. In certain cases national governments may adopt more stringent rules provided these are compatible with the Treaty on the Functioning of the European Union [10].

Besides the legal acts, policy documents were introduced to protect the welfare of farmed animals and to stimulate sustainable agriculture. According to the Council of the European Union, animal welfare is an integral part of sustainable agriculture [11].

2.1. EU Strategy for the Protection and Welfare of Animals 2012-2015

Since 2009 animals have been officially recognised as sentient beings in the European Union. In 2009 the Lisbon Treaty came into force and amended the Treaty on the Functioning of the European Union [10]. Article 13 of this Treaty states that:

"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, while respecting the legislative or administrative provisions and customs of the EU countries relating in particular to religious rites, cultural traditions and regional heritage."

In recognition of this, the European Commission adopted the EU Strategy for the Protection and Welfare of Animals 2012-2015 [12] in order to ensure that farm animals are kept and transported in conditions that do not subject them to maltreatment, abuse, pain and suffering. The Strategy was completed in 2018 and evaluated in 2020. The European Council invited the European Commission to develop a new Strategy based on the evaluation. The evaluation of the Strategy will be followed by the evaluation (fitness check) of legislation on animal welfare.

2.2. Fitness check on the EU legislation on welfare of farm animals

In 2020 and 2021 the European Commission will review the current animal welfare legislation for farmed animals [13]. Stakeholders and citizens can share their ideas and opinions. The review covers five Council Directives on the rearing of farm animals and two Council Regulations, on protection of animals during transport and at the time of killing, respectively. The fitness check is part of the Farm to Fork Strategy [14], a strategy for a more sustainable agriculture (including animal welfare) which was launched on the 20th of May 2020.

2.3. Legal protection of farm animals

Since 1998, Council Directive 98/58/EC [15] has been in force. This directive contains general rules for the protection of all animals (including fish, reptiles or amphibians) kept for the production of food, wool, skin, fur or other farming purposes. The rules of the directive are based on the European Convention for the Protection of Animals kept for Farming Purposes [16], which mainly reflects the 'Five Freedoms'.

As regards cage housing, the most relevant part of the directive is paragraph 7 of the Annex. This paragraph states that animals should have freedom of movement. It stipulates:

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

In addition to Council Directive 98/58/EC, four Council Directives lay down minimum standards for rearing laying hens (1999/74/EC) [17], broilers (2007/43/EC) [18], calves (2008/119/EC) [19] and pigs (2008/120/EC) [20]. Furthermore, protection of farm animals during transport and at the time of killing is covered in Regulations No. 1/2005 [21] and No. 1099/2009 [22] respectively.

2.3.1. Protection of laying hens

In Council Directive 1999/74/EC [17] minimum standards for the housing of laying hens (except breeding laying hens and systems with less than 350 hens) are laid down. Since 2012, non-enriched cages have been prohibited. Only enriched cages or alternative systems are allowed. In enriched cages hens must have at least 750 cm^2 cage area and 15 cm perch per hen.

In alternative systems, such as barn systems or free range, stocking densities shall not exceed 9 laying hens per m^2. In the systems there should be at least one laying nest for every 7 hens.

In all systems, both cage and non-cage, hens must have nests, perches and litter to allow pecking and scratching. All hens must have unrestricted access to feed and equal access to drinking nipples. More rules can be found in the directive.

To prevent hens from severe feather pecking and cannibalism, beak-trimming of laying hens is still allowed. However, some countries have banned this and others are working towards such a ban.

2.3.2. Protection of broilers

Council Directive 2007/43/EC [18] contains general standards for the rearing of broilers in conventional houses, for example stocking density. No mention is made of cage housing. However, cage systems for broilers exist, but are not very common in Europe. These systems are mainly used in Asia.

2.3.3. Protection of calves

In Council Directive 2008/119/EC [19] minimum standards for the housing of calves are laid down. The directive prohibits the housing of calves in confined individual pens from the age of 8 weeks. Until that age calves may be housed in individual calf boxes. The directive also prohibits tethering of calves, except under specific circumstances set out in the directive. Furthermore, it contains minimum standards, for example for pen size, for individual housing till 8 weeks of age, and for group housing of older calves. Although individual calf pens are not described as 'cages', they can be seen as such in terms of available movement space.

2.3.4. Protection of pigs

Minimum standards for keeping pigs are laid down in Council Directive 2008/120/EC [20]. Pigs must be housed in groups, except for farrowing sows and boars. It was previously common to house gilts and sows permanently in individual pens, but since 2013 pregnant gilts and sows must be kept in groups within 28 days after insemination until one week before expected farrowing. When gilts and sows are kept in groups, the minimum required floor area is 1.64 m^2 for gilts and 2.25 m^2 for sows. When group sizes are bigger, the floor area per animal may be 10% smaller. Individual boars need a minimum floor space of 6m^2. Some Member States have stricter policies. In the Netherlands for example, gilts and sows need to be put in group housing within 4 days after insemination.

In the time period from one week before farrowing until weaning of the piglets, the sow is usually housed in a sow crate within the pen. The sow crate prevents the sow from crushing the piglets, but it also confines the sow. When sows are kept loose in the farrowing pen, the pen must have devices (such as farrowing rails) for protecting the piglets.

2.3.5. Organic livestock production

European standards for organic production are laid down in Regulation (EU) 2018/848 [23]. Animal welfare standards for various production animal species are also included (article 14). Husbandry practices should be such that the developmental, physiological and ethological needs of the animals are met. Cages, boxes or flat decks are not permitted for any of the livestock species. Force-feeding is prohibited. Furthermore, whole slatted floors are not permitted and all animals need to have permanent access to open air areas that allow them to exercise (except when restrictions have been imposed for the protection of human and animal health).

Hens need to have this open access for at least one third of their life. Pigs need to have an exercise area that permits dunging and rooting. Sows must be kept in groups, except in the last stages of pregnancy and before weaning. During this period the sow must be able to move freely in her pen. A few days before expected farrowing, the sow must be provided with straw or other suitable material to build a nest.

Housing of calves in individual boxes is only allowed until one week of age, unless there is a veterinary reason to extend that period. Water birds need to have access to a stream, pond, lake or pool in order to respect their species-specific needs and animal welfare requirements. Rabbits must be housed in groups and provided with clean and dry resting areas of sufficient size and consisting of solid floors. They should have access to dark hiding places, a raised platform, nesting material for nursing does, and an outdoor run with vegetation.

3. WELFARE OF LAYING HENS

KEY FINDINGS

In the EU, laying hens are kept in furnished cages or non-cage systems. The main shortcoming of the furnished cage is the limited possibility for behaviours such as foraging and dustbathing, due to poor litter supply.

In non-cage systems, behavioural possibilities are greater. Attention should be given to training of personnel in non-cage systems, as management is more demanding than in cage systems. Through good management, the risk of keel bone damage and feather pecking and cannibalism can be reduced.

Based on studies published to date, a transition to non-cage systems would not have strong negative effects on sustainability and may have positive effects when free-range and especially organic production are chosen.

3.1. Alternatives for cage housing

For laying hens, conventional or battery cage housing was prohibited in 2012 under the EU Laying Hen Directive, since 'certain needs cannot be met in such cages' [24]. From 2012 onwards, only furnished cages and non-cage systems have been allowed (Figure 3.1). Furnished cages differ from conventional cages regarding space allowance (750 versus 550 cm^2 per bird). Furnished cages include perches, nests, and a pecking and scratching area, which are not supplied in conventional cages. Hens in furnished cages are typically kept in groups of 15-100 birds, depending on cage design, compared to small groups of 4 birds in conventional cages.

Figure 3:1: A furnished cage system (left), a floor housing system (middle) and a multi-tier aviary system (right). Photos Bas Rodenburg



Non-cage systems can be floor housing systems and multi-tier aviary systems. They can be indoor systems, free-range systems or organic systems with or without an added veranda (offering natural light, additional space and often fresh air). In non-cage systems, birds have more space than in furnished cages (1.111 cm^2 versus 750 cm^2 per bird). They are also provided with perches at different heights, nests and a larger litter area (minimum 1/3 of the floor surface) which allows pecking, scratching and dustbathing. In non-cage systems, birds are typically kept in flocks which can range from 500 to 50,000 birds. In large flocks, hens are usually spread over several sub-compartments within the same barn (for instance five subgroups of 6,000 birds each). Having these subgroups allows the laying hen farmer to keep a better overview of the birds, as it ensures a more even distribution of the hens over the entire building. Furthermore, behavioural problems such as feather pecking and cannibalism are less likely to spread through the whole barn when hens are housed in subgroups [25].

When the Laying Hen Directive came into force, EU countries were obliged to start the transition from conventional cages to furnished cages and non-cage systems. In some countries there was a strong investment in furnished cages, while other countries were switching to non-cage systems. In The Netherlands for instance, the percentage of farms with cage housing declined from 45% in 2008 to 14% in 2018 [26]. In the case of The Netherlands, but also Germany, this transition was aided by a decision of retailers to only sell table eggs from non-cage systems in their supermarkets. The egg coding system, a stamp on the egg showing the origin and type of housing system, helps the consumer make informed choices (0=organic, 1=free range, 2=barn, 3=cage). Some countries, such as Switzerland and more recently Austria and Germany, have banned cage systems for laying hens altogether. Between EU Member States large differences exist in the percentages of hens housed in non-cage systems. This strongly depends on the market for table eggs and egg products produced in specific housing systems.

Figure 3:2: Laying hens in the veranda (left), at the pop-holes connecting the veranda to the free range (middle) and in the free-range area (right). Photos Bas Rodenburg



In floor-housing systems, birds are placed at one level. Typically, nests, perches, feed and water are provided in a central, elevated slatted area. Next to this slatted area there is a litter area that birds can access for dustbathing and foraging behaviour (minimum 1/3 of the total floor space). In aviary systems, birds have access to multiple levels that are equipped with perches, nests, feed and water. In general aviary designs follow the bird's natural preferences and provide several separate functional areas: high night-time perches for resting during the night, tiers with feed, water and nests, and a large litter area underneath the tiers to allow foraging and dustbathing behaviour.

As mentioned previously, non-cage systems can be combined with a veranda and/or a free-range area (Figure 3.2). The veranda or winter garden is a covered part of the free-range area that can usually be closed off from the free range in case of outbreaks of avian influenza. The veranda is usually covered with bird-proof netting to avoid contact between the laying hens and wild birds or their droppings. A veranda is often intensively used by the hens for foraging, dust bathing and sun bathing. It provides an area with natural light and often fresh air. Indeed, some innovative farming concepts like Rondeel® and Kipster in The Netherlands have decided to focus on this type of range access, because they feel it provides the best compromise between welfare and health, and environmental impact. Both systems combine a large indoor foraging area with a smaller veranda on the outside of the system (Figure 3.3).

Figure 3:3: Two examples of innovative systems for laying hens: the Rondeel system, with the covered foraging area in the background (left), and the Kipster system, with the covered foraging area where enrichment is provided (right). Photos Bas Rodenburg and Maite van Gerwen.

In these concepts additional foraging opportunities (alfalfa hay racks, straw bales, pecking blocks, sand boxes, platforms) are offered in the foraging area to make it even more attractive for the hens. Free-range and organic farms are obliged to provide the hens with free-range access. According to EU legislation 4 m^2 per bird must be available. Usually these types of farms use a veranda to provide a gradual transition from the laying hen house to the free range. Free-range stable design and management vary widely between farms and countries. Ranges can be extremely well-structured with vegetation, shrubs and trees offering protection to the birds, but they can also be relatively barren and open. Offering natural or artificial cover to the hens stimulates use of the free range, as it allows the hens to seek shelter in case of predator attacks. Such cover can also offer shadow. Natural cover also has the advantage that it can provide additional foraging opportunities to the birds, for instance in the case of fruit trees. A well-structured free range allows the birds to forage, to feed on grass and other vegetation and on insects, worms and other prey items. Compared with the veranda, the free range offers more access to sunlight and better foraging opportunities. However, outdoor access also brings increased risks of predation and an increased risk of health (for instance avian influenza) and food safety problems (for instance dioxin intake from polluted soil in the free range).

3.2. Impact on welfare

Comparison of housing systems

Only a limited number of studies has focused on comparing laying hen welfare in furnished cages and the various non-cage systems [27-32]. From all studies it becomes clear however that both systems have their pros and cons in terms of animal welfare. In 2005, the Animal Health and Welfare (AHAW) Panel of EFSA produced a detailed opinion on laying hen welfare in relation to housing systems [33]. The main categories the panel considered in their welfare assessment were mortality, health (including damaging behaviour), and behaviour. Their comparison of furnished cage and non-cage systems is summarised in Table 3.4.

Furnished cage systems performed better regarding mortality, parasitic disease, bone fractures during lay, feather pecking and cannibalism, and crowding. Non-cage systems performed better regarding osteoporosis, inability to perform foraging, and inability to perform dust bathing. Free-range systems have a lower risk of feather pecking and cannibalism compared to indoor systems, as well as fewer bone fractures at depopulation. However, the risk of parasitic disease is higher in free-range systems. The panel also indicated that results can be very different for flocks with intact beaks and flocks that have been beak trimmed. Mortality and problems with feather pecking and cannibalism are much

higher in flocks with intact beaks [33]. Note that several European countries have banned beak trimming (Norway (1974), Finland (1986), Sweden (1988) Denmark (2013), Germany (2017), and The Netherlands (2019)).

Table 3:4: Comparison of laying hen welfare in furnished cages and non-cage indoor and free-range systems (summarised from the EFSA opinion on the welfare aspects of various systems of keeping laying hens [33]). Positive indicators are highlighted in green, intermediate in orange and negative indicators in red.

	Furnished cage	Non-cage indoor	Non-cage Free-range
Mortality	Low	Moderate	Moderate
Health – infectious disease	Low	Low	Low
Health – parasitic disease	Low	Moderate	High
Health – osteoporosis	Moderate	Low	Low
Health – bone fractures during laying period	Moderate	High	High
Health – bone fractures depopulation	Unknown	High	Low
Health – feather pecking and cannibalism	Moderate	High	Moderate
Health – crowding and suffocation	Low	Moderate	Moderate
Behaviour – fearfulness	Moderate	Moderate Variable	Moderate
Behaviour – inability to perform nesting	Low	Low	Low
Behaviour – inability to perform perching	Low	Low	Low
Behaviour – inability to perform foraging	High	Low	Low
Behaviour – inability to perform dust bathing	High	Low	Low

Furnished cages

Furnished cages still provide significant restrictions on bird behaviour, resulting in less diverse behavioural patterns compared with non-cage systems [29]. Drinking, feeding, foraging and, probably, dust bathing are high-priority behaviours in laying hens [33]. The ancestor of the domestic laying hen, the Red Junglefowl, spends about 65% of its active time on foraging behaviour, expressed by scratching the ground and pecking [34]. Although this motivation is slightly lower in domestic hens, hens remain highly motivated to show these behaviours [35]. Furthermore, in the absence of suitable litter, hens may redirect their pecking behaviour to the plumage of their groupmates, resulting in an increased risk of feather pecking [36].

Especially foraging and dust bathing are hampered in furnished cage systems. To support foraging and dustbathing often a scratching mat is offered on which some feed or litter is provided daily as foraging substrate. However, the amount of litter provided is very limited and the area is very small for all birds to fulfil their motivation for foraging and dust bathing. This is especially a problem in the small furnished cages which house up to 30 birds. In larger furnished cages there is slightly more space for the scratching area [37]. The larger cage size also makes it easier to provide a lay-out in which birds disturb each other less when moving through the cage than in the small furnished cages. However, also in large furnished cages litter supply remains a concern.

In a tonic immobility test birds from furnished cages were also found to be more fearful than birds from non-cage systems [29]. This is probably due to the fact that in non-cage systems hens have more control over the distance they keep from humans and other potential stressors and can move away in threatening situations. Often, hens in non-cage systems are more habituated to human activities, resulting in a reduced sensitivity to environmental stressors [28]. As was also concluded in the EFSA study, the fearfulness level can vary substantially, especially in non-cage systems [33]. This is probably related to the management of the farmer.

Non-cage systems

A welfare risk in non-cage systems is the large group size in which the birds are kept (on average about 6,000 birds). This puts many birds at risk in the case of outbreaks of feather pecking and cannibalism or in events of crowding. Feather pecking is the pecking at and the pulling out of feathers of conspecifics [36, 38]. Severe feather pecking can lead to feather damage and denuded areas. These denuded areas are in turn at risk of being the target of cannibalistic pecking. Birds in non-cage systems are more at risk to sustain feather damage than birds in furnished cages [30, 31], although feather pecking and cannibalism occur in all housing systems. The increased risk of feather pecking and cannibalism in non-cage systems is probably also one of the main factors for the on average higher cumulative mortality in non-cage systems (3% in furnished cages, 8% in non-cage systems). A meta-analysis by Weeks et al. [39] showed that especially in non-cage flocks there can be a huge variation in cumulative mortality. In their overview of 3,851 flocks, mortality was on average 10%, but it ranged from 0 to 69% in free-range flocks.

Events of crowding or smothering can be another factor contributing to mortality. Smothering events are events where hens flock together and pile up on top of each other and the hens at the bottom run the risk of suffocating [40]. Smothering can occur in the case of panic reactions, in young flocks in the nests at the onset of lay, but also throughout the laying period in the litter area or in the free range. The risk of smothering can be reduced by blocking of corners in the house [41] and dividing the area into

subcompartments. However, still relatively little is known in terms of solutions. A third area where non-cage systems perform worse than furnished cages is keel bone damage (Figure 3.5).

Keel bone damage can be separated into deformations and fractures. Keel bone fractures are thought to have a stronger effect on laying hen welfare, as these fractures may cause pain and limit the birds' physical abilities during the healing process. Rodenburg et al. [29] showed that although birds in indoor non-cage systems had stronger wing and keel bones than birds from furnished cages, keel bone fractures were more common (95% versus 60% of birds) and were more severe in birds from non-cage systems. Wilkins et al. [32] found results that went in the same direction, although their overall occurrence of keel bone fractures was lower (80% versus 36% of birds).

Figure 3:5: Examples of keel bone damage in laying hens, moving from a healthy keel on the left to a severely fractured keel with multiple fractures on the right. Photo: Wilkins et al., 2011 [32].

Keel bone fractures are thought to be the result of high-impact collisions that occur when birds move up or down in the system [42], although not all studies agree [43]. In that sense, the high perches in non-cage systems may present a risk of increased keel bone damage. Hens with keel fractures had more difficulty navigating 3D space than healthy birds [44] and also responded more positively to an environment in which they had access to analgesics, indicating that keel bone fractures are painful [45].

Another major difference between furnished cages and non-cage systems are the dust levels and the potential contact of birds with their faeces. The large litter area in non-cage systems allows for foraging and dust bathing behaviour, which are both important for welfare, but also results in much higher dust levels in the house compared with furnished cages [29]. Dust particles are a health risk for both the birds and the caretakers [46]. The potential contact with their faeces in non-cage systems may also present health risks in non-cage systems. Health problems like coccidiosis, E. Coli infections and gastro-intestinal parasites are more prevalent in non-cage systems than in furnished cages [47].

Free-range systems

Compared to indoor systems, free-range systems offer an even greater behavioural freedom than indoor non-cage systems, as free-range systems allow the birds to forage on vegetation, insects and invertebrates. The free range provides the birds with fresh air and access to sunlight, allowing sun bathing behaviour. On the other hand, the free range also presents welfare risks that can be avoided in indoor systems. Predation by foxes, martens and birds of prey is a real issue in free-range flocks. While predation by foxes can be relatively easily prevented by fox-proof fencing, preventing predation by birds of prey is more challenging [48].

In terms of health risks, the free range also provides a challenge: laying hens can be in contact with wild birds and their faeces in the free range, increasing the risk of diseases such as avian influenza. Free-

range design may help here, as Bestman et al. [49] showed in a pilot study. Providing natural cover in the free range, in the form of trees and shrubs, helps reduce the risk of avian influenza. Further research is needed in this area to substantiate these results. As indicated in the EFSA study, free-range flocks are also more at risk of parasitic infections, due to intake of parasite eggs in the free range [33]. In flocks where no de-worming is practiced, this may lead to health and welfare problems.

For free-range systems, a more resilient type of laying hen may be needed, with a stronger ability to adapt to environmental stressors. Over the past decades, breeders have focussed on selecting the best laying hens for intensive indoor systems. It may take some time to adapt laying hens to non-cage environments and especially free-range environments. It should also be investigated whether the greater behavioural freedom offered by the free range can be translated to indoor systems or systems with a covered veranda. If similar foraging opportunities and opportunities for dust and sun bathing can be realised in an indoor foraging area or in a veranda protected with bird-proof netting, this may be a safer way to provide the laying hens with a stimulating environment.

Conclusion welfare of laying hens in different housing systems

Both furnished cages and non-cage systems have their pros and cons as regards welfare. Furnished cages perform better regarding mortality and physical health, but also severely limit laying hen behaviour. Non-cage systems offer more behavioural freedom, but birds are more at risk of feather pecking, cannibalism and keel bone fractures. Free range access offers birds in non-cage systems even more behavioural possibilities, but also leads to increased health and predation risks.

All housing systems require their own specific management. In the large flocks in non-cage systems, it may be more difficult to keep an overview of the welfare and health of the laying hens. In those systems, the farmer or caretaker needs to be trained to detect early signals of problem behaviours developing. At that early stage, interventions can still be applied to prevent welfare problems (for instance offering environmental enrichment). While flocks in non-cage systems are more difficult to manage than flocks in furnished cages, the potential for good welfare seems higher in non-cage systems. If problems with feather pecking, cannibalism and keel bone damage can be prevented, laying hens in non-cage systems can have good welfare.

Adjustment of flock size may provide solutions, as well as feed management and provision of environmental enrichment [50]. This is illustrated by the relative success of organic laying hen farmers in keeping flocks with intact beaks in non-cage systems. Organic regulations limit both the size of the flock and the farm, and the stocking density, which helps reduce the risk of damaging behaviour. The behavioural restrictions in furnished cages cannot be countered by good management, so in that sense the welfare problems related to furnished cages are more challenging to address. Flocks with intact beaks are more difficult to manage than beak-trimmed flocks. When converting to flocks with intact beaks, farmers or caretakers need to be trained to detect the development of behavioural problems.

3.3. Impact on actors, the economy and the environment

When addressing the impacts of a transition to non-cage housing for laying hens, it is important to remember that non-cage systems already have a substantial market share in the EU market, especially for table eggs. One of the main challenges of the furnished cage is that the system is still a cage system and that NGOs and consumers do not really see the potential welfare improvement [51]. Although it is more costly to produce eggs in furnished cages than in conventional battery cages, the eggs from furnished cages must still be sold as cage eggs (code 3) and do not receive a premium. In comparison,

the higher costs of producing eggs in a non-cage system are largely compensated by the higher price at which the eggs can be sold compared with cage systems. European NGOs have been putting pressure on retailers to only sell table eggs from non-cage systems. In the Netherlands and Germany for instance, this has led to the situation where retailers only sell table eggs from non-cage systems. More recently, this has also occurred in other EU countries, causing a further shift from cage to non-cage housing. According to the International Egg Commission, 2019 was the first year that the majority of hens within the EU was housed in a non-cage system (51%). At present, the same shift is happening for egg products, although this development is moving at a slower pace.

Sustainability comparison

To compare sustainability between housing systems, several life-cycle assessment (LCA) studies have been conducted. An LCA study calculates the overall sustainability of a system, considering all parts of the production chain. An LCA focuses on the three dimensions of sustainability: the environmental, the social and the economic dimensions. Pelletier [52] performed an LCA on Canadian laying hen production systems. He found that the main components of sustainability of laying hen farms are feed and feed composition (35-81%), manure management (17-46%) and sourcing of pullets (19-23%). Non-organic housing systems, including both furnished cages and non-cage systems, scored quite similarly in his analysis. Organic laying hen systems scored significantly better on lifecycle resource use and emissions (57-80% of the national average). This was mainly caused by the lower impact of organic feed compared to conventional feed. Similar to this study, Abin et al. [53] also identified feed sourcing and sourcing of young pullets as major factors in an LCA analysis conducted in Spain, but they did not compare different housing systems.

Van Asselt et al. [54] compared sustainability of furnished cages, indoor non-cage systems and free-range and organic systems based on the three dimensions of sustainability. They found that the furnished cage scored best on the environmental dimension, while the organic system scored best on the social dimension (next to other aspects covering animal welfare). In the economic dimension, both furnished cages and organic systems had the highest sustainability score. Dekker et al. [55] did not include furnished cages in their LCA analysis. They mainly found differences in the economic dimension, where free-range resulted in the highest net farm income, followed by organic, indoor aviary housing, and indoor floor housing. Of course, producing organic or free-range eggs is more costly than producing eggs in indoor systems, but this difference is compensated by a higher retail price. The same applies to eggs from non-cage systems versus eggs from furnished cages.

Van Horne and Achterbosch [56] studied the effects of the EU Laying Hen Directive on the position of the EU and EU countries on the world market for eggs and egg products. Table eggs are usually not transported over long distances, so these are mainly produced in the area where they are consumed. This also applies to liquid egg products. Egg powder is more commonly traded on the world market. This could result in a situation where the EU food industry imports egg powder for use in their products which is produced outside the EU and does not meet the European welfare standards. An EU welfare label on products such as egg powder could help prevent this kind of undesirable imports. Sumner et al. [57] investigated how consumers would respond to a transition from cage eggs to eggs from non-cage systems in California. Their estimation is that consumers are relatively unresponsive to changes in price for table eggs and that the estimated 40% increase in price would only reduce sales by approximately 10%. These data fit with the experience from EU countries such as The Netherlands and Germany, where retailers decided to ban cage eggs from the supermarkets.

Conclusion sustainability comparison

In the sustainability comparisons of different laying hen housing systems published to date, differences in sustainability indexes seem relatively small. Feed and feed composition as well as sourcing of pullets seem to be major contributing factors to sustainability analyses in laying hens. Free-range and organic systems have a positive score in multiple sustainability studies. On the one hand this is caused by differences in feed sourcing (especially in the organic system), on the other hand also by the superior economic performance. It seems that the higher costs of free-range and organic production compared with indoor systems are compensated well by the higher retail price. The sustainability of indoor non-cage systems is somewhere in the middle between furnished cages and non-cage systems with outdoor access. Based on the studies published to date, a transition to non-cage systems would not have strong negative effects on sustainability and may have positive effects when opting for free-range and especially organic production.

4. WELFARE OF SOWS

KEY FINDINGS

Sows are kept individually in cages around insemination and, after farrowing, during the nursing period.

For the period after insemination, the duration of individual housing can probably be reduced to 4-5 days instead of the 24-day period in the current EU legislation.

For the nursing period, systems in which the sow is released after farrowing or free-farrowing systems can produce similar results as farrowing crates, when attention is given to prevention of crushing of piglets and piglet savaging.

In the sustainability studies published to date, differences between systems were small. Housing costs for a multi-suckling system are much higher than for farrowing crates. This difference needs to be recuperated by a higher retail price for meat from this system.

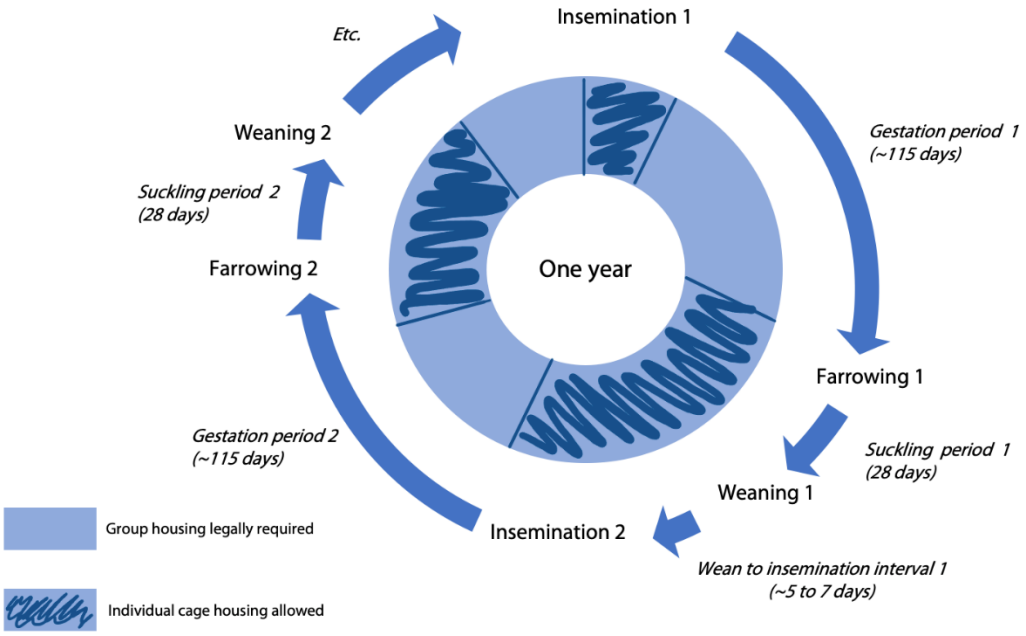
4.1. Alternatives for cage housing

In pig farming, predominantly female and male animals kept for breeding may be housed in cages during a certain period of their lives. Boars are generally housed individually, with a minimum required floor space of 6m^2 [20]. In practice however, boars are also housed in feed stalls with insufficient space and without the ability to turn around. Although this limited space allowance and individual housing have a negative impact on boar welfare and is an important aspect to consider, the further focus of this report is on cage-housing of gilts and sows. Hereafter, the term 'sow' will be used for both.

In Figure 4.1, the annual reproduction cycle of the sow is shown. Cage-housing mainly applies to sows during two different phases of the reproduction cycle: (1) before and during farrowing and the subsequent nursing period in the farrowing crate, and (2) after weaning of the piglets when sows are housed in the area in which artificial insemination takes place.

According to EU Pig Directive 2008/120/EC, within 28 days after insemination sows must be housed in groups until at least one week before the next farrowing [20]. Best practices in alternatives or reduction of cage housing can be found for both phases. For instance, a few countries have reduced the time period for which individual housing in feed stalls is allowed for insemination purposes. In a survey at EU level in 2010, The Netherlands and Sweden had the most progressive legislation in comparison to other EU countries [58]. In the Netherlands, the time period allowed for individual housing around insemination has been reduced from four weeks to four days. In Sweden, a similar short time period is used and sows are group-housed even within the insemination compartment [59].

Figure 4:1: Annual production cycle of sows.



Housing during breeding and gestation

Although housing of sows after insemination is still the subject of research, the housing of sows after weaning and before insemination (wean-to-insemination interval in Figure 4.1) is of importance and is strongly linked to the success of sow housing after insemination. Housing sows in groups before insemination has beneficial effects on social behaviour by enabling timely rank fights. Enabling such behaviour before insemination reduces it after insemination and thus reduces stress during pregnancy.

Data on the effect of group-housing sows directly after weaning on the onset of oestrus are conflicting [60-62]. Contact with an oestrous sow may stimulate the onset of oestrus [61] and reduce social stress [63]. Mixed results have been found with regard to returning the sow to group housing early (within 4 days) or late (within 4 weeks) after insemination [63]. However, from a physiological point of view there is no 'middle-of-the-road' solution. For reasons of insemination success, returning the sow to the group around day 5 after insemination is optimal.

During early pregnancy, some embryos will not survive. In case insufficient embryos survive the first 18 days after insemination, the gestation may be terminated and the sow will return to oestrus (repeat breeder) at any given point in time after day 24. The conflicting results in literature may be explained by many factors and timing can affect aggression, stress responses and, consequently, potential reproductive results. This may be due to intrinsic susceptibility of the sows and the foetus to chronic stressors during gestation (especially up to day 18 of gestation). However, given that there is little agreement between different studies regarding the best timing of group housing [64-67], other factors such as breed of sow, type of housing or group size, feed competition, and stability of the sow group may be more influential.

The use of a mixing pen, where sows of the same insemination group can first get to know each other before returning to the larger group, is recommended to reduce social stressors [63, 68]. This can, for instance, be done by opening the feeding stalls and allowing the sows of the insemination group to roam free in the insemination area. However, sufficient space for rank fighting is needed to prevent wounds and injuries. Also, group size may be important. Morgan et al. [69] showed that mixing into a group of 30 sows is more stressful than into a group of 7 or 15 sows. However, other factors such as total absolute space available, mixing procedures and percentage of replacement sows added to the

group also play a role. When repeat breeders occur, it is important that the farmer identifies these animals as soon as possible. This will not only help to keep the number of non-productive days to a minimum, but also serves to remove sows in heat from the group as soon as possible. Since these animals show increased restlessness, social interaction and mounting of other sows, they can potentially cause stress for the other animals in the pen [70]. As the majority of repeat breeders occur within the first 4 weeks [71], this is a critical period for close observation of the sows.

So-called "date-gates" or "ticket windows" offer sows in group housing the possibility of contact with boars. Sows that visit the boar more often can be electronically identified as possibly in heat [72]. This may serve as a tool to help identify sows in heat as soon as possible. It can be concluded therefore that individual housing for insemination can be shortened to 4-5 days without compromising reproductive results, when care is taken with the mixing procedure and attention is given to identification of repeat breeders.

Farrowing crates and alternative systems

Regarding farrowing systems, several alternatives to the conventional farrowing crate have been developed. In some countries, such as Sweden, Switzerland and Norway, the standard use of farrowing crates is currently prohibited. Experience from the transition to less restrictive farrowing systems can yield useful information.

The farrowing crate has been developed as a farrowing system that is easy to manage, helps prevent piglet crushing and piglet savaging, and provides better worker safety. The downside of the farrowing crate is that behaviour and movement of the sow are severely restricted. In a conventional farrowing crate behaviours like nest-building, exploration and foraging, and feeding together with the piglets are not possible or severely restricted. Also, sows are less able to interact socially with their piglets compared with systems where the sow is not restrained [73]. Alternatives are systems where the sow is only restrained for the first few days around farrowing, or systems that allow free farrowing. In recent years, systems have been developed where multiple sows with their piglets are kept together in a large family group: the multi-suckling system. In these systems, mingling of sows and their piglets can occur directly after farrowing or after a few days (when piglet suckling has been well established). This system will be discussed separately.

In order to release the sow earlier than at the end of the lactation period, several commercial pen designs are available. Most of them allow for temporary crating of the sow in the first days after parturition and easy release once the farmer deems it safe to do so. Examples of these systems are the ProDromi®, Opti-Farrow and SWAP pen.

Figure 4:2: Example of a conventional farrowing crate. Photo by Jan van Mourik.

Nicolaisen et al. [74] studied piglet crushing in conventional crates and free-farrowing pens. In their study, piglet mortality was higher in the free-farrowing systems than in the conventional crates (23 versus 12%). The majority of the crushing events took place during the first three days post farrowing. This suggests that piglet mortality was lower if the sow would be restrained during this time period and released after three days. This is indeed shown in a study by Spindler et al. [75], which found similar piglet mortality levels between crates and free-farrowing pens if the sows were restrained for 5-17 days post-farrowing. Temporary crating therefore seems a suitable alternative to crating during the entire lactation period. However, in practice the sow is often still confined based on its expected farrowing date, which is usually between 1-3 days prior to farrowing. In many cases this reduces the opportunity for nest-building behaviour.

One solution to better manage the timing of the restraint of the sow, would be to use sensor data to predict the timing of farrowing and provide the caretaker with an alert that the sow should be restrained. Oczaket al. [76] showed that this would be possible by using an ear-based accelerometer that detects sow activity levels at the start and end of nest-building behaviour, providing the farmer with automated alarms to better time restraining of the sow. In the future, similar sensor data could also be used to determine the best moment to release the sow.

Free-farrowing systems

In free farrowing, the sow is not confined to a crate at any time during farrowing and lactation. Housing may be in a simple pen, in modified pens, which may include extra features such as closable creep areas, separate dunging areas and modified flooring, or in free-range/outdoor systems with farrowing huts. One of the reasons why farmers adopted the farrowing crate was to decrease the mortality in piglets due to crushing. Several studies have indeed found a higher number of deaths due to crushing in pen systems [74, 77, 78].

Weber et al. [79] however found comparable preweaning mortality in liveborn piglets from sows in farrowing crates and free-farrowing pens. In that study, crushing was more common in free-farrowing pens, but death due to other causes was higher in farrowing crates. Kilbride et al. [80] compared crates, temporary crating, indoor free-farrowing pens, and outdoor free farrowing in huts on overall piglet mortality. They found similar levels of mortality in all four systems, although the causes for mortality differed. Farrowing crates did reduce the risk of liveborn mortality preweaning due to crushing, but the risk of mortality from other causes was higher in this system. Authors speculated that weak or low-birthweight piglets are less able to get away from the sow and are even more at a disadvantage in loose-farrowing systems. On the other hand, these piglets may have a lower chance of survival anyway and may die from other causes later in systems with farrowing crates.

Savaging of piglets by the sow is more common in gilts [81], but findings on the influence of housing system are inconclusive. Marchant Forde [81] found an increased incidence of savaging in sows housed in pens compared to those housed in crates, while others found no difference [82] or a decreased incidence [83].

It appears that comparable results regarding preweaning mortality can be obtained in loose-farrowing systems compared to crates. However, piglet crushing remains an important welfare concern. Appropriate pen design is important, and pens may be fitted with features to protect piglets from crushing, such as sloped walls, rails and bars. Other risk factors for preweaning mortality, such as large litter size and fat sows [84, 85] should be addressed as well in order to increase preweaning survival.

Multi-suckling systems

In recent years, systems that allow for more social contact between sows and other pigs have been investigated. In some there is a communal area that only the sows can access (get-away systems) where

in others multiple sows with their piglets are kept together in a large family group (multi-suckling system. (Figure4.1).

Figure 4:3: Examples of multi-suckling systems: Varkenshoff (left), Familievarken (right). Photos Maite van Gerwen and Bas Rodenburg.

In these systems, mingling of sows and their piglets can occur directly after farrowing or after a few days (when piglet suckling has been well established). These systems can be implemented both indoors and outdoors. Combinations of various systems, for example crate-farrowing or get-away systems followed by multi-suckling are also possible. In some cases, these systems are combined with longer lactation lengths (6-8 weeks). The variation in management and housing makes it difficult to compare the systems.

Studies on the effects of cross-suckling on piglet performance have been contradictory. Dybkjær et al. [86] reported a negative correlation between cross-suckling frequency and daily growth, while Olsen et al. [87] did not find a difference in birth and weaning weight between habitual and occasional cross-sucklers. Lactational oestrus (the sow coming in heat during the lactation period) is more common in multi-suckling systems [88, 89]. This can be a logistical problem for the farmer, who usually wants sows to farrow in batches to keep the weaning-to-insemination interval as short as possible and to have groups of pigs of similar size for reasons of efficiency and health. More variation in the timing of oestrus between sows may also cause less efficient oestrus detection which in turn may result in more repeated breedings.

Grimberg-Henrici et al. [90] compared piglet mortality in multi-suckling systems and conventional farrowing crates. They found higher mortality in the multi-suckling system, but remarked that mortality could be reduced by providing more space in the system (8.3 vs. 7.1 m2 per sow) and by selecting sows that were less likely to crush the piglets. The type of farrowing pen also plays a role: sows from free-farrowing pens had more settled nursings and lost fewer piglets when moved to multi-suckling system than sows from farrowing crates [86].

Conclusion housing systems

In conclusion, cage confinement affects sow welfare multiple times during her productive lifetime. Alternative systems vary on a spectrum from slight modification of conventional management practices to outdoor, free-farrowing or multi-suckling systems. The diversity of systems and factors involved complicates comparison. Although all non-cage systems have their challenges, mostly related to piglet crushing and fertility/insemination practices, it has been shown that with careful management and pen design, technical results similar to conventional systems are possible.

4.2. Impact on welfare

Behavioural restriction in farrowing crates

Restricting sows in cages is detrimental for their welfare for several reasons. Many of these reasons stem from an inability of the sow to perform certain behavioural patterns that pigs are highly motivated to perform, such as exploration, foraging, social behaviour, and nest-building. In semi-natural environments, pigs spend 52% of their time foraging and rooting and 23% in exploration and locomotion [91]. When kept confined, they still have a preference for novelty [92] and are willing to work to obtain rooting materials [93]. Both feeding stalls and farrowing crates have partially or completely slatted floors without rooting substrate, thwarting the performance of foraging and rooting. Pigs are social animals and in semi-natural conditions affiliative behaviour is common, with the exception of the period directly around farrowing [91]. Sows nearing oestrus show increased social behaviour [82]. Restricting the opportunity to perform these behaviours may impair their welfare [94].

Farrowing crates may diminish sow welfare for several reasons. Domesticated sows in (semi-)natural environments typically separate themselves from the herd approximately 24 hours before farrowing and select an appropriate, preferably sheltered, nesting site. Nest-building activity takes 1.2-3 hours. For the first two days the sow will generally stay in the nest, after which she will gradually stray further and longer from the nest [95]. Farrowing crates restrict most of these natural behaviours. A lack of space and, in most cases, suitable nesting material impair nest-building activity.

Crated sows show more abnormal behaviour and restlessness [96, 97] compared to free-farrowing sows, even when provided with similar amounts of nest-building materials [97]. At later stages of lactation, the inability to leave the "nest" may impair sow welfare. Pajor et al. [98] showed that sows chose to spend progressively longer times away from their piglets over the course of lactation, but that there are large inter-individual differences. Sows also preferred to defecate away from the nest when given the possibility.

Welfare of the piglets

Crating the sow does not only affect her welfare, but also that of the piglets. Piglet mortality is an important concern both from an ethical and an economic viewpoint. As mentioned in the previous paragraph, free farrowing increases the risk of crushing. Results on the effects of housing on the incidence of savaging are conflicting, although it seems logical that sows are less able to reach piglets when confined. Nonetheless, overall preweaning mortality results similar to those in confined farrowing can be observed in free-farrowing systems.

Notwithstanding the risks, there may also be welfare benefits for piglets of unrestrained sows. Thodberg et al. [99] found that gilts housed in crates had significantly longer mean piglet birth intervals than those in free-farrowing pens. In another study, farrowing duration in crates was longer than in pens and was linked to lower post-expulsion oxytocin pulses [100]. Oxytocin is a hormone that plays an important role in bonding between mother and offspring and higher oxytocin levels are associated with stronger bonding. Longer farrowing duration is related to a higher stillborn rate and more asphyxia in liveborn pigs, who in turn are slower to start suckling, have a higher risk of neonatal mortality, and have a slower growth rate over the first 10 weeks of life [101, 102].

Advantages of free-farrowing and multi-suckling systems

More contact between piglets and sows during the lactation period may be beneficial for several reasons. In natural circumstances piglets learn to eat solid foods partly by imitating their mother. In farrowing crates this is usually not possible as feeding troughs are too high for them to reach and

observe. Piglets usually get offered creep feed in a feeder that cannot be accessed by the sow. Since most piglets are weaned abruptly around 4 weeks of age, the transition from milk and creep feed to entirely creep feed can be challenging and may result in diarrhoea and a growth check. Piglets that have started ingesting solids before weaning in addition to nursing with the sow, have a lower risk of these problems [103, 104].

Multi-suckling systems give piglets the opportunity to mix with piglets from other litters as well. This gives multi-suckling some additional advantages over the other systems. Apart from the fact that multi-suckling systems provide the sow with a lot of behavioural freedom, they also seem to have positive effects on piglet social behaviour and resilience.

Kutzer et al. [105] compared farrowing crates, loose housing for individual litters, and group housing. They found that group housing reduced social stress at weaning and led to increased weight gain after weaning. This was confirmed by van Nieuwamerongen et al. [106], who found that weaned piglets from the multi-suckling system grew faster, were less likely to have diarrhoea, showed less damaging behaviour, and played more than weaned piglets from conventional farrowing crates.

Despite these advantages, mixing of litters may also have negative effects. Contact with other litters and sows increases the probability of contracting an infectious disease, which in turn impairs welfare and may also result in lower profitability for the farmer. Baxter et al. [107] compared 12 alternative farrowing systems with conventional farrowing crates. Both commercial outdoor systems (sow huts) and multi-suckling systems scored better than conventional crates regarding animal welfare. However, total piglet mortality was higher in multi-suckling systems (24%) than in conventional farrowing crates (18%) or outdoor systems (17%).

Conclusion welfare of sows and piglets in different systems

Free-farrowing and multi-suckling systems offer clear advantages over farrowing crates for both sow and piglets in terms of behavioural freedom, bonding with and learning from the sow, and proper development of social behaviour. Attention is needed for the prevention of crushing and piglet savaging in these alternative systems.

4.3. Impact on actors, the economy and the environment

One of the most important problems for pig farmers is the small margins made on their final product, the slaughter pig. There is a tendency for consumers to demand meat from housing systems that are considered more animal-friendly and/or healthier (organic products). While there are certainly niche markets for these types of products, the general public still considers pricing an important reason for choosing pork from one production system over the other [108]. Transparent, trustworthy labelling of products with varying levels of animal welfare standards is important to allow customers to choose products based on welfare considerations, especially in the middle segment between bulk and premium products [109].

Good stockmanship required

For farmers, good stockmanship is a recurring factor. In cage systems, pigs and production react relatively predictably, making practices like all-in-all-out housing possible. In non-cage systems, more expertise and competence is necessary, for example to adequately detect sows in oestrus or diseased sows in group housing. Operator safety is another important factor. Thorough knowledge of sow behaviour and the specific characteristics of the genetic lines at the farm are essential. Furthermore, willingness to invest in good human-animal relationships and correct record-keeping are very important.

For a successful transition to non-cage systems, adequate education of farmers and personnel is a prerequisite. Implementing alternatives to the farrowing crate requires an investment from the farmer. Baxter et al. [107] compared 12 alternative farrowing systems with conventional farrowing crates. The costs of the multi-suckling system were much higher than those of conventional crates (+92%) and outdoor systems (+249%). When combining all scores, farrowing pens where the sow could be released after farrowing appeared to be the best choice, with a better welfare score than conventional farrowing crates, but with similar piglet mortality and only slightly higher costs (+17%; [107]).

Life Cycle Assessments

Life Cycle Assessments (LCA's) are a tool to assess the environmental impact of the complex systems, taking into account the entire production cycle. Stern et al. [110] used LCA to compare three Swedish scenario's: one focused on animal welfare and natural behaviour of the animals (sows and piglets housed outdoors with huts), the second targeted low impacts on the environment and efficient use of natural resources, and the third scenario aimed at product quality and safety. Both economic and environmental impacts were taken into account.

Production costs per kg of meat produced were higher in the animal welfare scenario compared to the environmental (0.37 USD/kg) and product quality scenario (0.42 USD/kg). This was mainly attributable to higher labour costs. Unsurprisingly, the environmentally friendly scenario had the lowest energy consumption, global warming potential, land use, and surplus nutrients calculated per kilogram of meat produced. The animal welfare scenario was intermediate except for land use. In all three scenarios, building costs and labour had the highest economic impact. The highest environmental impact in all three systems was generated by the production of the pig feed, not by factors related to housing.

Other studies compared environmental sustainability between different housing systems, ranging from conventional to organic systems. In these studies, differences in environmental sustainability were limited [111, 112]. In summary, non-cage systems require more labour and thus are less economically advantageous compared to conventional systems.

Conclusion impact of transition to non-cage systems

Keeping sows in free-farrowing or multi-suckling systems requires investment from the farmer and is associated with higher production costs than conventional farrowing crates. For farmers to be able to move to non-cage production systems, sufficient economic incentives should be in place, either in the form of a reduction of specific costs or increased revenues for their products. This could be realised through welfare labelling and quality assurance. Non-cage systems are more demanding in terms of management, so proper training of farm staff is needed. As regards sustainability, from the studies published to date, differences between housing systems seem relatively limited.

5. WELFARE OF OTHER FARM ANIMALS

KEY FINDINGS

For the animal species mentioned in this chapter no realistic alternatives to cage housing are currently available, since alternative systems cause substantial other welfare problems.

At the moment, the most feasible alternatives for cage housing of rabbits, fur animals and quail are to look for better cage design, more enrichment, and lower stocking densities.

For ducks and geese used for the production of foie gras, cages can only be eliminated when force feeding is banned.

For calves, the most feasible improvements would be to provide calves with social contacts and look at possibilities for group or pair housing earlier in life.

5.1. Rabbits

In fattening rabbits, the most common housing system is conventional cage housing on wire-mesh floors. Novel cage designs focus on alternative flooring, such as plastic slatted floors, as these seem to be better for leg health of the rabbits. Rauterberg et al. [113] found that rabbits in improved cages with plastic slatted floors and partly solid floors grew faster and had fewer injuries than rabbits in conventional cages, but also a slightly higher mortality and poorer cleanliness. Trocino et al. [114] investigated the use of elevated platforms in modified cages and found that this benefited rabbit behaviour. The modified cage allowed rabbits to rear themselves to an upright position more easily and supported resting with outstretched limbs.

Rabbit does are often kept in single cages, as aggression can be a major problem. This was confirmed in a recent study by Gerencsér et al. [115], who showed that aggression in group-housed does can lead to death of the animals at the bottom of the hierarchy. Dal Bosco et al. [116] compared group housing systems for does with individual cages. They also found that, although group housing led to a reduction in stereotypical bar biting, the high level of aggression between does was cause for concern. In an EFSA study, Nielsen et al. [117] recently compared housing systems for rabbits and their consequences for rabbit welfare. They concluded that welfare consequences related to behavioural restrictions were more prominent in conventional cages, elevated pens and enriched cages, whereas those related to health problems (mainly related to hygiene and climate) were more important in floor pens, outdoor and organic systems.

As non-cage housing systems for rabbits also cause substantial welfare problems, a transition to non-cage systems might not be realistic in the short term. At the moment modified cage designs with plastic flooring, platforms, group housing and enrichment may be the most feasible alternative to conventional cages.

5.2. Ducks and geese

Ducks and geese that are kept to produce foie gras are kept in cages during the force-feeding period, which comprises the last two weeks of their lives. Before that, they are normally reared in floor housing systems for approximately 2.5 months, often with access to a free range [118]. Rochlitz and Broom [119] describe that the force-feeding period results in very poor duck welfare and that force-feeding is only possible when birds are housed in close confinement, such as the cage system. Only with the abolishment of force-feeding and an EU import ban on foie gras could cage-housing of these ducks and geese also be discontinued. This type of production is already banned in 15 EU countries. Ducks

and geese kept for meat production are often kept in floor housing systems on straw, with or without free range access [118]. A major welfare concern in ducks and geese is access to open water, which is important for general health of the birds and enables the ducks to show behaviours that are important to them such as bathing, swimming and foraging.

A cage-free alternative for foie gras production does not seem possible. Cage housing could only be prevented in a system where foie gras production would be based on voluntary intake of feed by the ducks. Under the current conditions, the only practical effort could go into improvement of the cage environment (for instance floor types that prevent problems with foot health). The alternative is a ban on this type of production, combined with an import ban on foie gras.

5.3. Quail

Domestic quail are kept to produce eggs and meat for human consumption, with increasing popularity [120]. Quail are commonly kept at high densities in conventional battery cage systems on wire floors. They are often kept at relatively low light intensities to avoid problems with aggressive head pecking and feather pecking. Indeed, Nasr et al. [121] compared light intensities between 10 lux and 250 lux and concluded that welfare was best at the lowest light intensity (based on behaviour, corticosterone levels and H/L ratio).

Clear regulation regarding quail production is lacking to some extent [120], and scientific studies into the welfare of quail under commercial production conditions are very limited. Soares et al. [122] showed that increasing space allowance from 85 to 121 cm^2 had positive effects on the immune system, which indicates that more space leads to better welfare. Nordi et al. [123] showed that quail may have better welfare in furnished cages than in standard cages. A cage equipped with litter, a sand bath and a nest resulted in an improvement in both behavioural and physiological welfare indicators compared with conventional cages. Most other studies on quail behaviour are from scientific laboratories and may have limited relevance for commercial quail production.

With increasing demand for quail products and selection for increased production traits, concerns about quail welfare under intensive farming conditions are likely to increase. Based on the higher risk of aggressive pecking and feather pecking in quails compared to laying hens, more research is needed before moving towards non-cage production systems similar to those which exist for laying hens. Until then, suggested welfare improvements are to lower stocking density, optimise flooring, and provide enrichment in the cage (nest, shelter, foraging enrichment, dust bathing opportunity).

5.4. Fur animals

The main fur animals kept in the EU are mink and silver foxes. These are predominantly kept in cage housing, often with a small nesting area with sawdust on a solid floor. Research has mainly focused on improving the cage environment, for instance by showing that mink welfare improves with access to a shelf and a tube in the cage and with positive human handling [124]. Also, it has been investigated whether increasing cage height benefits behaviour and welfare in mink [125]. It was found that mink preferred low cage areas for feeding, but higher areas to perform other behaviours such as standing upright. Meagher et al. [126] showed the benefits of simple cage enrichments, such as a ball on a chain, on mink welfare (increased play, less aggression, and less fur chewing). When fur animals are kept in a more stimulating environment, they make good use of the resources offered. In silver foxes, Koistinen and Korhonen [127] showed that all areas of an enriched cage environment were used for specific behaviours. In mink, similar studies show that mink mothers benefit from access to alleviated bunks [128]. Also, access to swimming water has been found to have beneficial effects, stimulating play

behaviour [129]. Unfortunately, these more complex housing environments are uncommon in the fur industry.

It is unlikely that future housing systems for fur animals will include non-cage systems. Enriched cage systems may be the most realistic alternative in the near future. At the same time, keeping animals for their fur is under societal debate and some countries have already banned fur farming or are in the process of doing so. The Netherlands, for instance, has recently decided to advance the initial ban on mink farming from 2024 to 2021.

5.5. Veal calves

Veal calves are calves - predominantly originating from dairy cow farms - that are fattened to produce veal at veal farms. In the past, veal calves were housed in individual crates. As this housing system was found to be too restrictive and to also limit calves' social behaviour, veal crates were prohibited by the EU in 2008 by Council Directive 2008/119/EC [130]. That directive states that veal calves must be housed in a group from 8 weeks of age.

Housing of veal calves varies from housing in small groups of around five calves on wooden slatted floors, to large group housing systems on straw. In large group housing systems calves are commonly fed using a feeding station supplying milk replacer. In those systems, milk dispense to individual calves is managed and recorded by the feeding station. In small group housing systems, without feeding stations, the calves are commonly housed in individual boxes during the first weeks after arrival at the veal farm. This is done to monitor their health and to manage milk intake at the individual level. For group housing with liquid trough feeding it is pivotal that calves in the same group require a similar amount of milk and have a similar speed of drinking in order to prevent competition for milk and subsequent feeding related disorders. For this reason, calves are frequently regrouped in order to create groups of similar composition.

Veal calves at a specific veal farm may come from many different dairy farms. Transport of veal calves within the EU and neighbouring countries is common. For instance, many dairy calves originating from Ireland and the Baltic states are fattened in The Netherlands, Belgium or other EU countries. Renaud et al. [131] show that the first weeks after arrival at the farm are also the weeks in which the highest mortality occurs, and that health at arrival is predictive of mortality risk.

It seems unlikely that veal farms with small group housing will decide to stop using individual boxes during the first weeks of production. This would make it impossible to manage and match milk intake at the individual level, as at a later age milk replacer is commonly supplied at the pen level. During the phase of individual housing, calves have visual and auditory (and sometimes tactile) contact with their groupmates.

5.6. Dairy calves

Female dairy calves that remain on the dairy farm as replacement animals are often individually housed during the first weeks of life, similar to veal calves. Calves have to be group-housed from at least 8 weeks of age or sooner [130]. For young group-housed calves 1.5 m^2 is required. For individually housed calves no space regulations are available at EU level. Solid partitions are prohibited in order to allow visual contact between calves. Some farmers use individual calf huts that are placed outside the dairy cow barn, while other farmers use individual boxes in the calf rearing compartment.

The reason for keeping the calves individually is to monitor and manage individual intake of colostrum and milk or milk replacer. Also, group-housing young calves is often seen as a health risk. However, Jensen and Larsen [132] showed that pair-housing dairy calves makes them less fearful and less

sensitive to stress and did not lead to an increase in health problems compared with individually housed calves (no difference in clinical scores, levels of the 5 most common pathogens in faeces, development of serum antibodies against the 3 most common respiratory pathogens). However, Jensen and Larsen is only one study that looked into the effects of pair-housing. More research is needed to confirm these results.

When pair-housing is not an option, for instance due to a large age difference between calves, calves should at least be able to see and hear other calves so as to avoid social isolation. Individual housing of calves with auditory, visual and tactile contact should be preferred over individual housing without social contact (and is a requirement in the EU Directive). According to current EU legislation, it is allowed to keep dairy calves individually during the first eight weeks of life. To prevent social isolation, the possibility of pair-housing should be investigated further.

6. RECOMMENDATIONS

KEY FINDINGS

Transition towards cage-free housing systems can be stimulated and facilitated by financial and policy measures in the short term.

Subsidies or conditional loans could be a good way of helping farmers who want to make a shift towards cage-free housing systems.

Clear and reliable labelling of products regarding welfare aspects can help consumers and retailers make informed choices.

More knowledge of alternative and out-of-the-box housing systems is needed. EU research programmes should take a system approach and stimulate out-of-the-box thinking.

Adoption of legislation at EU level (e.g. a European ban on cage-housing) seems the most promising route for achieving a 100% shift towards cage-free housing in the long term.

If bans on certain housing systems are considered, training and guidance is needed for farmers who are used to working with cage systems.

For a successful shift to non-cage housing systems, either via legislation or subsidies and policies, cooperation and dialogue between all actors is very important.

In this chapter policy recommendations are given to facilitate the desired shift towards cage-free farm animal housing systems. Furthermore, some general recommendations are provided for the improvement of legislation and policies to protect the welfare of farm animals. A general observation to be made is that there are already many (scientific) reports and recommendations available in addition to those mentioned in this study (e.g. EFSA reports and other advisory reports to the European Commission and the European Parliament). Therefore, it is strongly recommended to consider these sources of information and expertise, and to use them in the transition process towards cage-free housing systems.

6.1. Transition towards cage-free housing systems

In order to facilitate a transition towards cage-free housing systems for farm animals in the EU, several measures should be taken at different levels and within different time frames. For short term change, policy and financial measures (e.g. subsidies) may be the most promising. However, these types of measures are relatively voluntary and may be implemented differently by Member States, producers, and other actors involved.

Legislation seems the most promising route for achieving a full 100% shift towards cage-free housing systems. Formulating and implementing legislation might however take a lot of time and therefore seems especially promising for longer-term change.

6.1.1. Legislation

For laying hens, a transition away from cage housing could be facilitated by a ban on furnished cages, like the ban on conventional cages that came into force in 2012. At present, furnished cages are mainly used in Eastern and Southern Europe, whereas non-cage systems are used in Northern and Western Europe. Furnished cages are also more frequently used to produce egg products (e.g. liquid egg and egg powders as ingredients for cookies and cakes) than to produce table eggs. In the

Netherlands, for example, around 35% of eggs produced are processed into egg products. Some European countries already have a ban in place on all cage systems for laying hens (Austria and Switzerland) or will ban cages soon (The Netherlands and Germany). Overall, within the EU a slow shift can be seen from cage systems towards non-cage systems. A complete shift to non-cage systems can only be realised through EU legislation.

For pigs, important steps have been taken by shortening the confinement period for sows after insemination. However, sows are still confined during a large part of their life. The next step in the transition away from cage housing could be to further shorten the confinement period as, for example, the Netherlands has done. In The Netherlands sows have to be housed in the group within 4 days after insemination instead of 28 days. Also, the size of the individual sow pens could be increased. In the longer term, the final step could be to only allow some form of confinement during the moment of insemination, or even inseminate sows in the group. However, keeping sows in groups that show oestrus behaviour is very uncommon and risky, because the sows display unrest and mounting behaviour with negative consequences such as trauma. Regarding these aspects, more scientific and practical knowledge is needed.

Besides confinement around insemination, in conventional pig husbandry it is still very common to confine sows in farrowing crates from the moment around farrowing until weaning of the piglets. In the short term, this confinement period could be shortened in such a way that confinement is only allowed around the moment of farrowing and the first days after farrowing. In family systems for pigs, a short confinement period around and after farrowing is sometimes also considered and is a good way of balancing welfare of both the sow and the piglets. When sows are kept without any confinement around time of farrowing, this may lead to higher piglet mortality due to crushing. It is therefore recommended to include some form of piglet protection in free-farrowing systems, for example farrowing rails (already legally required for loose-housed sows).

For other species than pigs and laying hens, a legal ban on non-cage housing seems unrealistic at this moment. For ducks and geese, a ban on cage housing can only be achieved when force-feeding is prohibited. This means that a ban on cages would also mean a ban on the production of foie gras. At the moment, the only realistic improvement would be to formulate minimum legal standards for cage design. The same is the case for fattening rabbits, quail and animals kept for fur.

For calves, it seems unrealistic that they can be successfully group-housed during the first weeks of age, since group-housing at this stage makes it harder to manage proper milk intake and individual calf health. Improvements could be made by further specifying the legal standards for the housing of calves and shortening the period in which individual housing is allowed. For veal calves, limiting international trade and associated transport in young calves could also be considered, as this may help prevent health and welfare problems. Furthermore, extra requirements regarding tactile, visual and auditory contact for calves could be formulated, and it may be of added value to look at the possibilities of pair-housing.

Legislation for organic farming requires that animals are not confined, and the practical experiences from organic farming show that it is possible to work without confinement. The legislation for organic farming could therefore be a useful inspiration for adjusting the conventional legislation. In particular as regards housing.

So far, the choice for specific housing systems has been left to the market and to EU Member States, resulting in differences between the Member States. This also presents a risk of unequal competition between producers, since Member State A is not allowed to ban products from Member State B that do not comply with Member State A's national standards. Unequal competition from producers outside

the EU poses a risk if an EU-wide ban on cage housing would be set. It is therefore important to also consider a ban on the import of products (and processed versions of these products) that are not produced in accordance with EU-standards. This is something that should also be considered in negotiations on trade agreements.

Last but not least, legislation at the EU level is a good instrument to phase out certain husbandry systems in the future [7]. It is, however, only effective when enforcement is guaranteed. Proper enforcement by Member States' competent authorities should therefore also be a point of attention. In that regard, the recently founded EU Reference Centres for Animal Welfare for pigs and poultry can help Member States' competent authorities with capacity building and the transfer of knowledge.

6.1.2. Subsidies

Subsidies or conditional loans could be good instruments to help farmers who want to make a shift towards cage-free housing systems and to facilitate innovators and early adapters by providing financial security. Subsidies under the CAP (the Common Agricultural Policy, Europe's most important agricultural support program) could be used for this. In order to successfully stimulate a shift away from cage housing, these subsidies should only be used for cage-free systems and not for the improvement of housing conditions within cage systems or the development of new cage systems.

For individual farmers, however, the investment necessary to make a radical shift towards free-farrowing systems for sows could be too demanding and risky. Margins in pig production are very small. In those cases, temporary crating (for example only the first days after farrowing) could be a first step towards 100% free farrowing. It would require lower investments for buildings and diminish at least some of the welfare concerns for the sow, without posing big risks for the piglets. Subsidising projects that take steps towards cage-free housing, or providing conditional loans to do this, could also be tools to encourage farmers in that direction.

6.1.3. Market responsibility and labelling

The shift towards cage-free housing systems can also be left to the market. In some countries, such as the Netherlands and Germany, retailers have decided to end the sale of cage eggs as table eggs in their supermarkets after pressure by NGOs. EU consumers are generally in favour of non-cage systems for laying hens and this stimulates producers to produce more table eggs from non-cage systems. Another example can be found in broiler meat. Some supermarkets in the Netherlands have decided to only sell fresh chicken products that originate from broilers that are allowed to grow a little slower than conventional broilers (49 days instead of 42 days). This change has led to a clear improvement in broiler health and welfare.

To drive consumer demand towards more animal-friendly systems, knowledge about human behaviour change is necessary to inform consumers and stimulate and facilitate desired consumer behaviour. By extension, clear and reliable labelling of products regarding welfare aspects of their production is critical. Providing more information on production methods might also lead to increased consumer pressure on producers and retailers, and stimulate them to produce and sell more products from non-cage systems.

6.1.4. Research programmes

This study aims to provide an overview of the various scientific studies on the welfare consequences of housing systems for laying hens and pigs. Despite the many useful studies that have been made, more knowledge is still needed of alternative and out-of-the-box (literally) housing systems. More focus should be put on developing and testing (new) housing systems in which species-specific needs and

an animal-based welfare assessment are leading (e.g. animal-oriented stable design). A better understanding of what animals require is needed in order to fulfil their species-specific needs.

Also, it is important that the systems cover the many other aspects of sustainability. Research should not focus on one particular part of sustainability, but should start from a much broader perspective and choose a system approach. Rather than mainly looking at end-of-pipe solutions and quick damage control, a system-innovation approach is necessary for exploring and developing out-of-the-box solutions that are future-proof. Furthermore, knowledge about attitude and behavioural change of different actors involved (including farmers, retailers and consumers) is needed to build support or even create an intrinsic motivation for change. Last but not least, it is essential to look at ways to help innovations in farm animal husbandry develop from a niche market into the mainstream with an eye on economic feasibility/viability.

Multidisciplinary research teams with, among others, animal welfare, environmental, social and transition scientists, are a good way to take a systems approach, include the many different aspects of sustainability, and share ideas, experiences and good practice. The EU already stimulates this kind of collaboration through research programs under HORIZON2020 and the Farm to Fork Strategy. In September 2020, DG Sante (the European Commission's Directorate-General of Health and Food Safety) launched a tender for a pilot project on best practices for alternative (non-cage) laying hen housing systems. The aim of this project is to transfer knowledge and experience from countries with a large proportion of laying hens in non-cage systems towards countries which have limited experience with these systems. The project focuses mainly on the major egg producers within the EU and it demonstrates that the EC is committed to further supporting the shift towards non-cage systems within the EU.

The EU Reference Centres for Animal Welfare play an important role in sharing information and capacity building. We recommend continuing with efforts already made, stimulating out-of-the-box thinking even more, and creating space for innovators and front-runners to apply and test their ideas in practice.

6.1.5. Education, training and cooperation

A shift towards new housing systems is not always easy for livestock farmers who only have experience with the system they have always worked in. If bans on certain housing systems (such as furnished cages for laying hens) are considered, training and guidance is needed for farmers from countries where the majority of certain animals are kept in cages or where large parts of the farming practice involve cage housing. Keeping hens in non-cage systems, for example, requires targeted training for the farm manager and the animal caretakers. Especially when hens need to be kept with intact beaks.

Experience with the transition to (almost) cage-free pig production in countries such as Norway, Switzerland and Sweden has shown that it is certainly possible to make such a shift. There are big advantages for sow welfare. However, cage-free housing both in the insemination stall and in the farrowing unit demands specific skills that may be beyond the experience of many farmers.

On the other hand, there are farmers who have positive experiences. Exchange of knowledge and skills at a practical level is therefore important. Farmers may learn from these good practices and adopt certain measures on their own farm. Cross-country farm visits, international sharing of good ideas or practical examples and conversations between farmers and other actors, can be very beneficial for a successful shift towards non-cage housing. This is something the EU can stimulate and facilitate more. The tender launched by DG Sante (mentioned under research), is a good example of such an approach.

For a successful shift to non-cage housing systems, either via legislation or subsidies and policies, cooperation between all actors is very important. Since farmers do not produce, process and sell products themselves, it is important to engage all actors at an early stage of the transition process. It is recommended to facilitate dialogue between the different actors and make them think about new future housing systems collectively. The EU Platform on Animal Welfare could be used to coordinate these efforts.

6.2. General improvements of farm EU animal welfare legislation and policies

The current discussions about cage-free housing systems should be seen in the broader context of farm animal welfare. To help improve EU policy and legislation on farm animal welfare, some general recommendations are provided here. At the moment, both the Animal Welfare Strategy and the farm animal protection legislation are under review. This creates opportunities for improvements of the legal protection of animals. A large number of possible improvements were already recommended in the study "*Animal welfare in the European Union*" provided by professor Donald M. Broom for the Committee on Petitions in 2017 [7].

Although there is general legislation for the protection of farm animals and specific legislation for some of farm animal species, most farm animals in the EU are not protected by legislation. For example, there is no specific legislation for rabbits, cows, fish, parent stock for broilers and laying hens, nor is there for ducks and turkeys.

Furthermore, for some of the farm animal species major welfare issues still exist [7]. For example, sows are still kept in confinement for a large part of their life. In the management of laying hens, challenges related to feather pecking remain, and broilers still suffer from leg problems due to fast growth. Parent stock of broilers and laying hens are excluded from the current broiler and laying hen directives. Dairy cows that produce high quantities of milk still have leg disorders and mastitis, and there is no legislation that protects them. It is therefore recommended to make legislation for all, or at least the most commonly kept, (farm) animals. A universal Animal Welfare Act for all animals kept in the context of economic activities could be a way to do this [7, 11]. In addition, species-specific legislation could be drafted for farm animal species such as farmed fish, rabbits, dairy cows, sheep and goats, turkeys, quail, ducks, and parent stock of broilers and laying hens.

In formulating animal welfare legislation, the outcomes of scientific studies, among which EFSA-reports, can be very useful. In professor Broom's study [7], a complete list of these EFSA reports can be found. Furthermore, the already existing legislation for organic production could be used as an example. Besides the formulation of animal welfare related legislation, it is also important to consider animals and their welfare in legislation and trade agreements that might have (indirect) effects on animal welfare.

An often-heard argument against legislation as a method for change, is that legislation can result in problems shifting from one country or continent to another. This does not have to be the case. Broom [7] describes many good examples of how EU legislation has had much positive influence in the world and has led to improved husbandry conditions of animals kept in third countries that take the EU as an example. Furthermore, the EU can make sure that animal products that do not comply with EU standards cannot be imported into the EU. Such an import ban is also important for European farmers who do their best to meet the higher European standards. For those farmers, it would be unfair to have

to compete with producers outside the EU that produce according to lower standards and, in most cases, at lower production costs.

The Strategy for the Protection and Welfare of Animals 2012-2015 already contains many of the aforementioned recommendations. It is suggested, nonetheless, to formulate more concrete goals in a new strategy to be developed.

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This study, commissioned by the European Parliament's Policy Department for Citizens' Rights and Constitutional Affairs at the request of the PETI Committee, presents alternatives for cage housing of farm animals and laying hens and sows in particular. Cage-free housing has a positive effect on the behavioural freedom and welfare of animals. No major problems arise with regard to other aspects of sustainability. Research shows that cage-free housing is currently possible or will be in the future. A shift towards cage-free housing systems may be achieved by financial and policy measures in the short term and legislation in the long term.

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