# Scenarios for addressing the dilemma of 'the culling of day-old male chicks of layer breeds'

T.G.C.M. van Niekerk
J.A. Workamp

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T.G.C.M. van Niekerk[1]
J.A. Workamp[2]

1 Wageningen Livestock Research
2 AviConsult

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Samenvatting NL Het doden van eendagshaantjes van legrassen staat al enige tijd ter discussie en heeft geleid tot Kamermoties, die vragen om het verbieden van deze praktijk. Middels een korte literatuurstudie en het interviewen van vele sectorpartijen is getracht alle ins en outs rondom het doden van eendagshaantjes van legrassen in kaart te brengen en met ondersteuning van een werkgroep scenario's op te stellen hoe invulling kan worden gegeven aan deze Kamermoties.

Summary UK The culling of day-old male chicks of layer breeds has been a subject of debate for some time, leading to a political call to ban this practice. Based on a short literature review and interviews with many parties in the sector, we have tried to map all the ins and outs of culling day-old male chicks of layer breeds, and, with the support of a working group, outline scenarios on how to meet the political demand for policy.


PO Box 338, 6700 AH Wageningen, T 0317 48 39 53, E info.livestockresearch@wur.nl, www.wur.nl/livestock-research. Wageningen Livestock Research is part of Wageningen University & Research.



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# Abbreviations and terms

**Abbreviations**

| Abbreviation | Meaning |
|---|---|
| AAT | Agri Advanced Technologies GmbH (company behind the Cheggy in ovo technique) |
| Anevei | Algemene Nederlandse Vereniging van Eierhandelaren en Eiproductfabrikanten (General Dutch Association for Egg Traders and Egg Product Companies) |
| BLk | Beter Leven ('Better Life') quality label of the Dutch animal welfare Organisation |
| CenSAS | Centre for Sustainable Animal Stewardship |
| COBK | Centrale Organisatie Broedeieren en Kuikens (Central Organisation for Hatching Eggs and Chicks) |
| EDH | Day-old male chicks |
| IKB | Integrale Ketenbeheersing (Integrated Chain Management) |
| KAT | Verein für **k**ontrollierte **a**lternative **T**ierhaltungsformen e.V. (Organisation for Controlled Alternative Animal Husbandry; Private German Organisation) |
| LNV | Ministry of Agriculture, Nature and Food Quality |
| LTO/NOP | Land- en Tuinbouworganisatie/Nederlandse Organisatie van Pluimveehouders (Agriculture and Horticulture Organisation/Dutch Organisation of Poultry Farmers) |
| MKT | Mit Küken Töten (with chick culling) |
| NVP | Nederlandse Vakbond Pluimveehouders (Dutch Poultry Farmers Union) |
| OKT | Ohne Küken Töten (without chick culling) |
| Skal | Originally: Stichting Keur Alternatief voortgebrachte Landbouwproducten (Foundation for the Certification of Alternatively Produced Agricultural Products)<br>Now: Skal Biocontrole: Regulator of Organic Production |
| VLOG | Verband Lebensmittel Ohne Gentechnik (Non-GMO Food Association) |
| WEcR | Wageningen Economic Research |
| WLR | Wageningen Livestock Research |

**Terms**

| Term | Meaning within this report |
|---|---|
| Allantois | The allantois is one of the three amniotic membranes developed by the embryo during the incubation process. This sac-like structure is primarily involved in nutrition and elimination. The function of the allantois is to collect fluid waste from the embryo and to exchange the gases used by the embryo. |
| Brother cockerels | Male chicks from the same hatch as the hens. |
| Feed, animal fodder, animal feed | General term for animal feed, consisting of processed or unprocessed raw materials. When it comes to hatching eggs, this is a processed product; when it comes to day-old chicks, it can be either a processed product or the entire chick (see also the term 'food animal'). |
| Dual purpose breeds | Breeds of laying hens, of which the males produce more meat than males from regular, specialised layer breeds, and of which the hens lay fewer eggs than hens from regular, specialised layer breeds. |
| Day-old male chicks | Male chicks from a layer breed; the brothers of the female day-old chicks intended to be reared and to produce eggs for consumption during the laying period (or in the selection or breeding sector: for the production of hatching eggs). |
| Male eggs | Hatching eggs that are expected (following sexing in the hatching egg) to produce a male day-old chick. |
| In ovo techniques | Techniques for determining the sex of an embryo in an incubated egg. Where the term refers to the 'In Ovo' company, it is capitalised and appears in quotation marks. |
| Hatchery | Establishment that incubates hatching eggs of different origins (companies, breeds), sorts the chicks (viable, cockerel, hen), vaccinates them if needed, and then distributes them to buyers in the Netherlands and abroad. |
| Layer males | Day-old male chicks of regular layer breeds that are reared up to a specific slaughter age with a specific final weight. |
| Laying hens | Ready-to-lay hens of the Gallus gallus species, raised to produce other eggs than hatching eggs. |
| Egg packing station | Company where eggs coming from poultry farms are sorted for quality and weight, packaged, and sent out to buyers (industry, retail, catering). |
| Feather sexing breeds | Chicken breeds in which feather length, or feather or down colour varies in male and female chicks, so that the sex can be determined visually. |
| Food animal | Day-old chicks, mice or other animals that are fed in their entirety to predators, reptiles, etc. (see also the term 'feed'). |

# Foreword

In response to two motions in the House of Representatives, the Ministry of Agriculture, Nature and Food Quality (LNV) established a Day-old Male Chicks Steering Group to advise them on the issue of 'the culling of day-old male chicks'. This report is intended to map all the ins and outs of culling day-old male chicks from layer breeds for the Day-old Male Chicks Steering Group, and, with the support of a working group, to formulate scenarios on how these parliamentary motions can be given shape.

Although there is some literature available, these publications tend to focus only on a limited number of aspects, such as an overview of in ovo techniques, experiences with the rearing of layer males, and the comparison between broilers and dual purpose chickens. Most of the information required to be able to responsibly outline scenarios concerns the consequences of a ban on culling day-old male chicks for the various links in the sector, and this information could not be found in the literature. This is why we conducted a great number of interviews.

These interviews allowed us to collect a lot of useful information, leading us to understand how complex this issue is; many facets of it were brought to light through the interviews. What was striking was that in interviews with representatives from all kinds of organisations and companies, both within and beyond the primary sector, the same general ideas and directions emerged. There was not a single aspect on which the various parties provided contradictory information. This made it easier for us, as authors, to integrate the broad information we received from various parties in this report. We integrated information from the literature and interviews into a number of scenarios, with a description of their consequences. Based on these scenarios, we formulated a number of conclusions and recommendations.

We hereby wish to express our sincere gratitude to all interviewees for their time, help, and openness. We also want to thank the working group for their helpful advice and support in generating this report.

We hope that this report will provide the Steering Group and the Ministry of Agriculture, Nature and Food Quality (LNV) with sufficient information to reach a well-considered decision.

Jan Workamp
Thea van Niekerk
July 2022

# Summary

The culling of day-old male chicks has been attracting attention for quite some time. Germany, France, and Austria have already imposed legislation that prohibits the culling of day-old male chicks, or only allows it under certain conditions. In June 2021, two motions on this topic were adopted in the Dutch House of Representatives, in both cases calling for a ban. In response, LNV established a Day-old Male Chicks Steering Group to advise the Minister on how to address the issue of the culling of day-old male chicks. The Steering Group subsequently formulated an assignment, with the objective of *generating an extensive, substantive, and technical analysis of the way in which a ban on the culling of day-old male chicks could be implemented, the group of chicks that this ban would apply to, and any alternatives available in this context that would benefit animals, farmers, the environment, and consumers. This analysis leads to a sketch of various scenarios for implementing a ban, based on which the Steering Group can formulate a recommendation for the Minister of LNV.* As part of this assignment, a working group was established that has helped the authors of this report to make contacts, collect information, and generate this report.

Although there is some literature available, these publications tend to focus only on a limited number of aspects, such as an overview of in ovo techniques, experiences with the rearing of layer males, and the comparison between broilers and dual purpose chickens. Most of the information required to be able to responsibly outline scenarios concerns the consequences of a ban on culling day-old male chicks for the various links in the sector, and this information could not be found in the literature. This is why the authors opted to conduct a total of 25 interviews with people who were in some way involved in this matter: poultry farmers, veterinarians, a buyer of day-old male chicks, and representatives of hatcheries, egg packing stations, animal feed factories, suppliers of in ovo techniques, zoos, and one slaughterhouse. Regarding the economic and sustainability aspects, we requested information from WEcR. In addition to the information obtained from the interviews, we also integrated in this report information from the available literature, partially provided by a number of interviewees, and partially arising from a short literature review conducted by WLR.

We discovered that the issue of 'the culling of day-old male chicks' is highly complex, and many of its facets were brought to light in the interviews. The information from the literature and the interviews has been processed into scenarios, with a description of their consequences. Based on these scenarios, we formulated a number of conclusions and recommendations. This report does not cover the ethical aspects of culling day-old male chicks, in ovo sexing, raising alternatives (such as mice) and rearing dual purpose chickens. Furthermore, the scenarios are described within the frameworks of the poultry sector as it is today; a potentially broader discussion is beyond the scope of this report.

When incubating eggs to produce new laying hens, approximately 50% of eggs result in the birth of a male chick. These are therefore the brothers of laying hens. As a rule, these male chicks are culled at the hatchery and used almost entirely as food animals by bird shelters, falconers, and zoos, to name a few examples. A very limited portion (<0.5%) is destroyed.

If culling of day-old male chicks is prohibited or only allowed under certain conditions, as is already the case in Germany, Austria, and France, there are at present two direct routes available, besides culling day-old male chicks to be used as animal feed (should exceptional conditions apply): in ovo sexing and rearing the cockerels to a slaughter-ready age.
To prevent male chicks from being born, techniques have been developed in past years to determine the embryos' sex in the hatching egg. Following this sexing in the hatching egg (in ovo sexing), the eggs that are predicted by the sexing procedure to produce a male are removed from the incubation process. There are currently four in ovo sexing techniques on the market. The techniques most commonly used in the Netherlands involve sexing on Day 9 of the incubation process. These techniques cannot be applied to all eggs, and there is also a substantial portion of eggs that produce

an unclear result or no result at all. The additional costs of invasive in ovo sexing methods are currently approximately €3.50 per day-old hen.
The alternative is to allow day-old male chicks to hatch and rear them for 12 to 13 weeks (the KAT-requirement is minimum 70 days). The minimum living weight norm is usually approximately 1300 grams. In the Netherlands, there is at present no slaughterhouse that can slaughter such low-weight poultry. As a result of the German legislation, most day-old male chicks reared in Dutch hatcheries are slaughtered in Poland (and a limited portion in Belgium). This relatively long rearing period, combined with a low final weight, results in a highly unfavourable feed conversion ratio (approximately 3.5 to 4.0). This makes the rearing of day-old male chicks a loss-making option under the current circumstances. In 2021, the costs amounted to approximately €3.50 per reared day-old male chick, which is more or less equal to the costs of in ovo sexing (approximately €3.50 per day-old hen). Due to the increase in feed prices, these costs have since (May 2022) increased to approximately €4.00 per layer male. The $CO_2$ production per kg of meat is 2.5 times higher for layer males than for regular broilers. An issue for concern in the rearing of layer males is aggression, and the resulting high loss rate, if suitable housing is not available and/or adequate management is not applied. Due to their limited meat production, layer males are currently hard to sell, and are therefore usually marketed as mechanically separated meat (MSM). They are also sold in their entirety at dumping prices on the African market, which causes problems for local producers. A number of initiatives have been launched to promote cockerel meat by informing consumers and trying to interest them in this product, which could potentially lead to developments on the market (rising demand).

A third alternative is keeping dual purpose breeds, with the intention of creating a profitable sales market for both the hens' eggs and the cockerels' meat. The hens of these breeds lay fewer eggs, but the cockerels produce enough meat to deliver a sellable product. In particular in the organic sector, which is hesitant about in ovo sexing and seeks to distinguish itself from the regular market, the dual purpose chicken may represent a future alternative, not only by producing a cockerel for which a market can be generated, but also by being better aligned with the ideological principles of organic production when it comes to the hens (producing an animal less strongly focused on egg-laying potential). One advantage of dual purpose chickens is that they are less prone to pecking behaviour (Giersberg et al., 2019) and are more likely than regular laying hens to thrive on feed made of low value feed ingredients (Röhe et al., 2019). The latter could be interesting in terms of $CO_2$ footprint.

If day-old male chicks are no longer available for zoos, bird shelters and falconries, these organisations will have to source them elsewhere, or buy fewer of them and switch to other types of prey, such as mice. Processed products are not an option for these buyers, because they are not accepted by wild animals. There are already applications for the creation of mice farms. To guarantee the same hygiene status, these companies would have to work at SPF level. Aside from the question of whether breeding alternative food animals is possible or even desirable in terms of costs, hygiene, and legislation, there is also an ethical consideration here: Is it justifiable to replace culling day-old male chicks by killing another species that has to be bred solely for this purpose?

For many years now, logistics have been an essential aspect of incubating eggs, and they are becoming increasingly complex due to the growing number of factors that must be taken into consideration, and the fact that decisions must be made increasingly early. OKT has added a number of extra elements to the already complex logistics of the incubation process. The first of these is of course in ovo sexing, which will not be performed on all eggs. For example, the organic sector has indicated that they are still undecided concerning in ovo sexing and the rearing of cockerels. The invasive in ovo techniques cannot yet be used on the eggs of young and older parent stock. These eggs are therefore incubated, so that in the event of a ban on culling, these cockerels would have to be reared anyway (or the eggs would have to be incubated abroad). In addition, there is still a margin of error, and the sex of some of the embryos remains unclear. To avoid having to rear cockerels after all, when in ovo sexing produces unclear or no results, the hatching eggs in question are removed from the incubation process. This therefore also leads to the loss of embryos that would have produced a hen.
To avoid being confronted with too many cockerels to be reared, the chicks are also sexed by hand at the hatchery.

A substantial portion of day-old female chicks hatched in the Netherlands are exported (see Section 4.4), mostly to Africa, where they are reared to produce eggs for the local market. A surcharge for OKT chicks for export is not realistic, because the buyers would not be willing or able to pay it. These chicks are therefore produced as MKT. If OKT production is made compulsory, this export from the Netherlands will stop. Some Dutch hatcheries already have breeding capacity abroad (for example in Belgium) or are planning to create such capacity (for example in Hungary or Turkey). The expectation is therefore that they will continue to produce MKT chicks abroad if the Netherlands imposes a ban on the culling of day-old male chicks. In case of a European ban, this operation might relocate outside Europe.

The German OKT regulations forbid the culling of day-old male chicks. However, this only applies to chicks incubated in Germany, not those incubated abroad. This means that German layer poultry farmers who wish to sell MKT eggs can still purchase MKT laying hens, but they have to do so abroad. It also means that the Netherlands can still export MKT hens or eggs to Germany.
Just as in the Netherlands, German laying hen farmers produce partly table eggs, and partly eggs for the industry. Since the industry is not yet interested in OKT, they will presumably not be willing to pay a surcharge for such eggs. This leaves German laying hen farmers who produce industry eggs with two options: Import MKT hens and continue to produce industry eggs, or switch to OKT and produce table eggs. The expectation is that a large portion of these farmers will opt for producing table eggs for the German market. This means that part of the Dutch export of table eggs will disappear and be replaced by the production of OKT table eggs by German poultry farmers. On the other hand, this will create more room on the German market for Dutch MKT industry eggs. Another development in Germany concerns the increase in local sales (doorstep sales and village shops) of cheaper eggs, without OKT requirements, which requires importing MKT animals.

Dutch companies that cannot meet the requirements for the production of table eggs (usually somewhat older companies) are currently producing industry eggs. We do not expect an OKT surcharge to be charged for industry eggs. Since for these companies it is no option to purchase OKT hens, if a general ban is imposed, they will have to source MKT hens from abroad. The same applies to poultry farmers who have not been offered a suitable agreement for the purchase of OKT eggs, or who do not wish to take the additional risks inherent in this kind of purchasing agreement.
The cost price of a day-old hen (and therefore of a laying hen) whose brothers are not euthanised on Day 1 at the hatchery, is €3.50 to €4.00 higher than in the conventional method.
This increase in costs means that a layer poultry farmer would have to pay more or less double the current purchase price for a 17-18 weeks pullet. For an average-size company (approximately 40,000 laying hens), this represents, assuming €4.00 per hen, additional costs of €160,000 per production round. Assuming a maintenance period of approximately 18 months, for an average-size company, this amounts to over €100,000 of additional yearly costs per poultry farmer. The replacement market in the Dutch layer sector represents approximately 20 million laying hens per year. In case of a full transition from culling day-old male chicks to in ovo sexing or rearing layer males, the additional costs for the entire Dutch layer sector, based on €4.00 per hen, would amount to approximately €80 million per year.
To compensate for these additional costs (and accompanying risks), the market should structurally increase the price of an OKT egg by a minimum of 1½ euro cent. In the early days of OKT requirements from the German market, it was mostly the periphery (egg traders and hatcheries) that bore the financial risks by assuming the costs of in ovo sexing or the rearing of day-old male chicks. These financial risks are now shifting to the primary producers: the poultry farmers.
Furthermore, if a general ban is imposed, there is a real risk that buyers of OKT eggs will see the additional requirement (of not culling day-old male chicks) as a legal precondition for negotiations, such that if poultry farmers are unable to integrate the additional costs in their retail price, they will not or only partly be able to recoup these costs.

The many interviews we held provided us with a lot of useful information, from different perspectives. With respect to the poultry sector, the unanimous conclusion was that the current German and other market requirements have already led to a substantial change in the Netherlands. The interviewees also observed that the German general ban seems to have led to an OKT/MKT hens ratio of 70% to 30%. In the Netherlands, without a ban, the ratio in 2022 will be as follows: 40% OKT hens to 60%

MKT hens. The question is to what extent a Dutch ban would lead to changes in this ratio in the Netherlands.

We describe three scenarios for addressing the dilemma of the 'culling of day-old male chicks'. Per scenario, we indicate what the most likely consequences are for all parties involved: the poultry sector (primary producers and periphery) and buyers of eggs, day-old hens and culled day-old male chicks. Based on a number of guiding principles and assumptions, we then calculated the numbers of day-old male chicks the various scenarios apply to. These figures are shown in Table 8.2 in Chapter 8.

**A) Dutch ban on the culling of day-old male chicks, without exceptions, hereafter referred to as 'general ban'**

**B) Dutch ban on the culling of day-old male chicks, with exceptions for specific purposes, hereafter referred to as 'partial ban'**

Variant B1) Dutch ban on the culling of day-old male chicks, with the exception of day-old male chicks used for a specific purpose (animal feed): among others as pet food, for zoos, bird shelters, and falconries (variant as included in Austrian and French legislation).

Variant B2) Dutch ban on the culling of day-old male chicks, with the exceptions as set out in the French legislation, see Chapter 5.3.

Variant B3) Dutch ban on the culling of day-old male chicks, with the exception of day-old male chicks with a specific purpose (animal feed, variant B1), and with the exception of day-old male chicks whose sister hens are exported.

Variant B4) Dutch ban on the culling of day-old male chicks, with the exceptions as set out in the French legislation (variant B2), and with the exception of day-old male chicks whose sister hens are exported.

**C) Decision concerning a Dutch ban on the culling of day-old male chicks following evaluation**

A general Dutch ban (Scenario A) would lead to a dramatic decline in the Dutch hatching capacity; the relevant companies will relocate this hatching capacity to other countries (for example Belgium, Turkey, and Hungary) and export similar volumes of day-old hens whose brothers are euthanised in these countries (and possibly exported as animal feed to the Netherlands) from these countries.

Under any other scenario, the Dutch hatching capacity is expected to remain globally the same, with only relatively minor shifts. A general Dutch ban would also lead to the import of MKT laying hens (whose brothers will be culled abroad).

Compared to the 2018 situation, all scenarios lead to a decrease in the number of euthanised day-old male chicks, from a total of 44 million to 36 million. This decrease is already happening (2022), aided by the introduction of OKT legislation in Germany. This legislation has already led to a drop of 8 million (from 44 to 36 million), as apparent from the calculations of Scenario C (see Table 8.2). Scenario B (including all four variants) and scenario C lead to the same number of euthanised day-old male chicks in the Netherlands. At European level, the number of euthanised day-old male chicks would remain stable, irrespective of the chosen scenario (so also in case of a general Dutch ban), on the understanding that a general Dutch ban would lead to the euthanising of day-old male chicks no longer taking place in the Netherlands, but in surrounding countries with potentially less strict rules in this respect than in the Netherlands.

Our investigation of the issue of 'the culling of day-old male chicks' has led us to the following conclusions:

With respect to the four routes described:

1. Traditionally, the male chicks of layer breeds are euthanised on Day 1 at the hatchery by means of $CO_2$ gassing. The euthanising of day-old male chicks in Dutch hatcheries is subject to a strict prescribed protocol. The large majority of euthanised day-old male chicks are used as animal feed, with only a small portion (<0.5%) being destroyed.
2. To prevent as much as possible layer males from hatching, suppliers of in ovo techniques and users (hatcheries) have in the past two to three years worked on developing techniques for

determining the sex of an embryo inside the hatching egg. The costs of this kind of procedure are approximately €3.50 per hen. Further development of in ovo techniques is required to increase this sexing procedure's efficiency and reduce its costs.

3. The rearing of day-old male chicks, assuming they come from regular layer breeds, has many disadvantages, which can be summarised as following: compared to the rearing of broilers, it is an inefficient form of meat production that results in a hard-to-sell final product. The rearing of day-old male chicks is viewed by the interviewees as a temporary solution that can be phased out once in ovo techniques are further developed. They believe that this will remain an option for day-old male chicks born as a result of errors in in ovo techniques or as part of a concept (for example, organic production) and for day-old male chicks for which there is already a sales market or one can be created, for example as layer male of dual purpose chickens.
4. Dual purpose chickens: for the regular market, dual purpose chickens are most probably not a real option, in any case not in the short to medium term. The lower profit from the eggs and the costs of rearing the cockerels will result in more expensive eggs *and* more expensive cockerel meat. Switching to dual purpose chickens seems to be an interesting option for the organic sector to distinguish itself from regular free range hens and to avoid the in ovo option, which is considered less desirable in this sector.

With respect to the relocation (from the Netherlands to other countries) of the euthanising of day-old male chicks and the export of animal material (laying hens and selection and breeding animals):

5. A partial or general Dutch ban on the culling of day-old male chicks will lead to the almost complete relocation of the euthanising of day-old male chicks to other countries, with the risk that this procedure is performed under less strict conditions abroad than in the Netherlands. This will result in the import of MKT chicks or pullets. Irrespective of the chosen scenario, at the European level, the Dutch companies (including their international branches) will continue to euthanise the same number of day-old male chicks.
6. In case of a general Dutch ban on the culling of day-old male chicks, the additional costs for OKT will lead most of the current international buyers of this Dutch animal material (including African countries) to seek alternative suppliers: foreign competitors or Dutch companies with branches abroad. Some of these countries impose less strict requirements regarding animal health, animal welfare, and the environment than the Netherlands.

With respect to animal feed:

7. For many reasons, euthanised day-old male chicks form an essential element in the diet of raptors in bird shelters and falconries, various animal species in zoos, and privately kept exotic animals/reptiles.
8. If the Netherlands imposes a general ban, the supply of euthanised day-old male chicks from Dutch hatcheries would disappear. This would leave two options:
    a. Using alternative food sources, such as mice, from nurseries. This would lead to the emergence of a new form of intensive animal farming (or an increase in an existing, but so far limited form of farming), that is as yet subject to very few to no rules regarding matters such as animal welfare, animal health, and the environment, and that would have the same purpose as day-old male chicks: culling and use as animal feed.
    b. Importing euthanised day-old male chicks, which means, depending on the country of origin and the hygiene status of the supplier, higher risks concerning animal health and the question of whether euthanising is performed in the same protocolled way as in the Netherlands.

With respect to the market/consumer:

9. As a result of the German legislation, even without a ban, the Netherlands have already witnessed a substantial shift to OKT hens: in 2022, approximately 40% of Dutch laying hens produce OKT eggs and 60% MKT eggs. Imposing a ban might shift this further, but it is not clear how strong this effect would be. In Germany, with a ban, the new ratio is 70% OKT hens to 30% MKT hens. However, due to rising food prices, a clear decline can currently be observed (June 2022) in German consumers' purchasing of eggs from the higher price segment (organic eggs, Freiland eggs, and OKT eggs).
10. The surcharge for an OKT egg for the consumer amounts to four to five euro cents per piece, on the shop shelf. This is a substantial surcharge on the current average egg price (10 to 30%)

which can, with the present decline in purchasing power, affect consumer behaviour, with the risk that the additional costs will not, or only partly be recouped.

11. It is as yet unclear how the market will further develop. Will more retail parties, in the Netherlands and abroad, impose OKT requirements? Will consumers continue to be willing to pay the surcharge (4-5 euro cents per piece), or will they opt for MKT eggs? For example, by purchasing directly from the producer (doorstep sales) or from a local shop selling agricultural products. Or will egg consumption decrease overall? And how will the demand for OKT eggs in the food production industry develop? To what extent will developments take place in other European countries with respect to legislation? Will EU legislation be implemented, and if so, within what time frame? The answers to these questions affect the outcomes of all the scenarios described.
12. Even if the Netherlands impose a general ban on the culling of day-old male chicks, part of the Dutch egg production will continue to consist of MKT eggs. These eggs will then be produced using imported laying hens (day-old female chicks or pullets) from countries where euthanising day-old male chicks is still allowed.
13. By shifting from the euthanising of day-old male chicks to other options (in ovo, rearing layer males, or dual purpose chickens), aside from the negative effect of selling cockerel meat on the developments in particular in African countries, there is also another negative effect for poor countries: it will lead to raw feed ingredients being more scarce and therefore more expensive for them. This is because all three options lead to a higher feed intake. The higher feed intake in European countries where these developments occur (or will occur) will lead to increased scarcity on the global raw feed ingredient market, which will negatively affect poor countries. In addition to this effect, other discussions are also taking place, the results of which may affect the global requirements for raw materials, such as: a reduction in human consumption of meat and an increase in human consumption of plant-based foods, and even better use of waste flows for animal feeds.

With respect to sustainability/the environment:
Although we have not yet calculated sustainability across the entire egg chain for all scenarios, the following negative aspects of OKT requirements are already clear:

14. In ovo sexing using invasive methods requires an average of 3.5 hatching eggs per hen. With the conventional approach (euthanising on Day 1), you only need 2.5 hatching eggs. To produce this higher number of hatching eggs, more parent stock has to be kept.
15. When rearing day-old male chicks, the feed conversion (kg feed per kg meat) is high and the $CO_2$ production per kilo, expressed in $CO_2$ equivalents, is up to 2.5 higher than with regular broilers.
16. In case of a general ban, the production of day-old chicks will shift to other countries. This implies transport of Dutch hatching eggs to other countries, and transport of animal material, such as euthanised day-old male chicks and MKT day-old hens or pullets from other countries to the Netherlands.

Final conclusions:

17. The financial risks for the poultry sector (since the risks have largely shifted to poultry farmers, this affects them particularly) have increased substantially with the introduction of OKT requirements. This is already the case now, with these requirements being imposed on the German market. With the potential inclusion of OKT requirements as a basic condition (because of legislation being in force), if no measures are taken against this, a situation may arise in which all the risks and financial burden will come to rest on the shoulders of poultry farmers. In this context, see also Chapter 10.2: Recommendations.
18. All the scenarios described, including Scenario C, lead to the same number of euthanised day-old male chicks at European level. The choice for specific Dutch legislation does not lead to any changes in this respect. The legislation on the culling of day-old male chicks that applies in some European countries at present tends to be very diverse. With this observation, it is safe to assume that it is unlikely that uniform European legislation concerning the culling of day-old male chicks will be adopted anytime soon. However, experience has also shown that, over time, countries can shift their position on such matters, and a European ban may be introduced after a few years. Germany and France recently opened the debate on this matter. This aspect may play a role in deciding on a time frame for reaching a final decision concerning a ban, or the duration

of the transition period should a ban be imposed. The reason is that this aspect plays a role in the potential relocation of production capacity (and therefore also the euthanising of day-old male chicks) to other European countries.

19. The ability to sex hatching eggs before they are placed in the incubator can be seen as the ideal ultimate goal of sexing. If such a method was to become available, one could opt to not allow any male chicks to hatch, the incubation process would not have to be interrupted (since it would not have started yet), and therefore, the current loss of hatching eggs could be prevented. The resulting 'male eggs' could potentially still be used as eggs for consumption. Once sexing can be performed at this early stage, the approach used in the relevant method will determine whether it is acceptable to all parties involved.

The issue of 'the culling of day-old male chicks' is complex and involves many facets. In choosing a specific scenario, thorough consideration of the consequences is warranted.

In formulating and adopting legislation concerning the culling of day-old male chicks, attention should be devoted to the following:

1. The mentioned consequences, see Chapter 8, Scenario A, in short:
    a. The relocation of hatchery activities, of both breeding and hatching companies, to other countries, in order to produce day-old hens for export.
    b. The relocation of the euthanising of day-old male chicks to other countries.
    c. The effect on the availability of day-old male chicks to be used as animal feed.
    d. The emergence of a new form of livestock farming, namely the rearing of layer males.
    e. The emergence of new forms of animal farming (or extension of existing, so far limited forms of farming) such as the breeding of alternative animal feed sources such as mice (with attention to potential problems such as animal diseases, zoonoses, and environmental impact).
    f. The import of MKT animals for the production of MKT eggs in the Netherlands
2. In the various scenarios, three situations are mentioned that warrant exemption from a potential ban on the culling of day-old male chicks:
    a. In case of regulated animal diseases
    b. Chicks and embryos that are screened out as non-viable at the hatchery
    c. Animals that are wounded or suffer from a disease that causes them intense pain or suffering, with no other practical solutions for relieving this pain or suffering.
3. In the various scenarios, a number of specific situations are mentioned that require special attention when formulating a potential ban on the culling of day-old male chicks:
    a. Chicks from selection or breeding lines
    b. Chicks intended for scientific research, in particular the pharmaceutical industry or veterinary diagnostics
    c. Chicks intended to be used as animal feed
    d. Chicks that failed to be detected using the applicable methods (sexing errors at the hatchery).
4. The time frame for the entry into force of legislation: a minimum period of five years is required to give the sector time to make a solid transition: further development and practical implementation of in ovo techniques, the availability of additional research results, monitoring of the market, etc. In addition, one should take into account the economic depreciation of hatcheries and hatching equipment, which is usually considered to have a time frame of 15 years. A compensation scheme should be instituted for premature depreciation of equipment/buildings that can no longer be used. Incidentally, the workings of the free market also lead to a transition with economic consequences, which also requires a transition period, to be agreed upon between market parties.
5. Control over the market and limiting risks for poultry farmers, such as compensation schemes in case of mass culling and new initiatives, like the creation of a national fund that farmers can appeal to in case of a situation that cannot be insured against, and which leads to the depreciation of OKT eggs (for example, a substantial drop in production or high mortality).

Possible additional regulations may be drawn up concerning the following:

6. Structural financial construction to compensate for additional costs as broad support for the transition of the Dutch sector, including a compensation scheme for hatcheries for any vacancies arising from the implementation of one of the scenarios.
7. Promoting the use of dual purpose chickens and/or developing other initiatives, for example, creating market demand for dual purpose chickens.
8. Regulations for new sectors, such as the rearing of layer males and food animal breeding (husbandry and environment).
9. Facilitating the discussion on the use of breeds for laying hens in case of a future revision of the European Organic Regulation.

In addition to potential legislation and regulations for supporting the transition to an OKT layer poultry sector, a number of research paths deserve attention:

10. Further development of in ovo sexing, ideally to be performed on Day 0 (before the eggs are placed in the incubator)
11. Maximum age for in ovo sexing in relation to the development of the embryo and its corresponding state of awareness
12. Effects of in ovo sexing on embryo development, chick quality, and further development/output during the production period
13. Ethical and respectful treatment of the male eggs removed from the incubation process
14. Initiatives with dual purpose chickens, for example gaining more knowledge and experience with dual purpose breeds
15. Options for prolonged production periods for laying hens
16. Animal-friendly moulting of laying hens
17. Risks of food animal breeding (for example mice) with respect to the transmission of pathogens to other forms of animal farming and/or humans (zoonoses).

Explanation of the recommended time frames:

A) <u>For Scenarios A and B:</u>

After approximately two years of practical experience, the interviewees involved in choosing between in ovo sexing and rearing layer males unanimously agree that the rearing of layer males, with the exception of specific niche markets, must be seen as a temporary measure, and that, to the extent that OKT requirements apply, in ovo sexing should be used as much as possible. In various chapters in this report, we have indicated which aspects, such as the day of the incubation process, and which areas for improvement, such as reducing the number of hatching eggs needed, still need to be optimised in these experts' opinion. Technical developments may lead to improvement of the sustainability and reduction of the costs of in ovo sexing.

These developments cost time, probably five years or so, and it will most probably not be possible to accelerate this process should a Dutch ban be imposed. The current German legislation is in fact already creating the need for these further developments. In the meantime, innovators and users are given the opportunity to gain experience with the techniques and make the right choice (technologically and financially). Once in ovo sexing is applied more broadly, the rearing of day-old male chicks can be phased out.

A period of five years preceding a ban can, furthermore, be used for the following:

- Conducting additional research, for example into the age at which an embryo first experiences pain signals (and therefore the last day in the incubation process when in ovo sexing may be performed) or into the need to treat the screened out hatching eggs.
- Monitoring the consequences (in the Netherlands and abroad) of foreign legislation on a ban for the requirements set by the retail sector and for consumer behaviour.

One can also imagine that during this period, developments will occur with respect to new techniques, making it possible to sex an egg before it is placed in the incubator (for example with genetic manipulation), that such a method could technically be used to avoid culling day-old male chicks.

However, should such a technique become available, a number of aspects would have to be considered (such as legislation and ethics), with all parties involved submitting their input.

It is also possible that during this period, developments occur concerning the selling of cockerel meat/OKT eggs that seem promising in terms of resolving the issue of 'the culling of day-old male chicks'.

If the Netherlands impose a general ban on the culling of day-old male chicks, part of the Dutch hatching capacity will relocate to other countries, due to the limited export market for Dutch-produced OKT chicks. This means that some of the Dutch hatching capacity will become unusable before the end of its economic depreciation period (15 years).

B) For Scenario C:
This scenario presupposes a gradual process, first without a legal ban (possibly with stricter regulations on aspects such as the treatment of screened out hatched eggs) and with the possibility of deciding, after an evaluation, to introduce a partial or general ban after all. If a ban is imposed in the end, this would allow for a more careful consideration of the structure, phasing and design of this ban, in alignment with the situation at that time. In addition to improving the technical aspects (for example further developing in ovo techniques), efforts are also made to give consumers the opportunity to more consciously purchase food products, and to create financial constructions to ensure that primary producers are rewarded fairly for adjusting their production process. This approach is closely aligned with the wish to benefit animals, farmers, the environment, and consumers.

The evaluation term could be set at three years, and this period could be used for the following:

- Raising consumer awareness by providing information on this issue and implementing a transparent surcharge for OKT eggs; to be worked out in further detail, not included in this report.
- Creating a fair revenue model for poultry farmers, with sufficient compensation for the additional costs of OKT; also to be worked out in further detail, not included in this report.
- Conducting additional research, for example into the age at which an embryo first experiences pain signals (and therefore the last day in the incubation process when in ovo sexing can be performed) or into the need to treat the screened out hatching eggs.
- Making a broad inventory of research results in this field (in ovo sexing, dual purpose chickens, etc.).
- Monitoring the consequences (in the Netherlands and abroad) of foreign legislation on a ban for the requirements set by the retail sector and for consumer behaviour.
- Promoting alternatives, such as the use of dual purpose chickens, with both hen and cockerel being optimally used, and stimulating research into the use of waste flows to feed these animals, in an effort to reduce the $CO_2$ footprint.

If a decision is made to implement Scenario C, the precondition is that an evaluation is carried out after three years, on the basis of criteria and associated parameters to be defined at that time. The most important criterion, in line with the two parliamentary motions, can already be mentioned, namely "a decrease in the number of day-old male chicks culled in the Netherlands." Based on this evaluation, one could potentially decide to introduce a general or partial ban that would enter into force after a set transition period, for example two years, leading to a total period for further technological developments of in ovo techniques of five years, as in Scenarios A and B. In this scenario too, one could take into account the 15-year economic depreciation period for hatching capacity.

If a decision is made to implement Scenario A or B, we also recommend that an evaluation be carried out before establishing a final legislative text. This creates the opportunity to fine-tune the law to match the current situation.

# 1 Introduction

## 1.1 Background

The culling of day-old male chicks has been under debate for quite some time. For example, Germany and France adopted a law imposing a ban on the culling of day-old male chicks. In Germany, this ban came into force on 1-1-2022. On 5 February, 2022, the French Minister of Agriculture adopted Decree no 2022-137 concerning a ban on the culling of chicks from the Gallus gallus species intended for the production of eggs for consumption. This decree states that during a transition period ending in late 2022 hatcheries need acquire in ovo sexing technologies, so that the ban on culling chicks can be implemented from 2023 onwards.
In the Netherlands too, there is much discussion around this topic. In 2019, the poultry sector produced a sustainability plan entitled 'Implementation Plan for the Poultry Sector'. This plan includes the ambition of formulating socially acceptable solutions for the culling of day-old male chicks by 2025.

The background of this issue is that over the last decades, the global poultry sector has dramatically improved its efficiency as a result of genetic selection for desirable features (economic and other). Poultry is kept for its eggs and meat. In an effort to optimise both production goals, two separate selection lines have emerged: one line (with different breeds and cross-breeds) for the production of poultry meat, and one line (also with different breeds and cross-breeds) for the production of eggs for human consumption. In the meat sector, animals are bred that are efficient at producing meat, but lay relatively few eggs. Both the cockerels and the hens of these breeds can be used to produce poultry meat. In the layer sector, animals are bred that are efficient at producing eggs, but that tend to produce little meat. The female chicks are raised to become ready-to-lay hens. The day-old male chicks of these breeds are traditionally euthanised at the hatchery on Day 1 using $CO_2$ gassing, because they do not lay eggs, and, if reared, would produce little meat compared to broilers; the feed conversion ratio (kg feed per kg meat) is very unfavourable. The euthanised day-old male chicks are almost all used as animal feed; in order of magnitude of use: for raptors (bird shelters and falconries), for zoos, in pet food, and for reptiles.

The euthanising of day-old male chicks of layer breeds, if done correctly, as is the case under the Dutch protocol (see section 7.2.2), is not considered by experts as an animal welfare problem.

The fact that day-old male chicks are traditionally euthanised on Day 1 at the hatchery, because they do not lay eggs, and produce relatively little meat is triggering responses from society, with people arguing that all animals have a right to life because - despite not having any economic value - they do have inherent value. Although the Dutch legislation does permit the culling of day-old male chicks, this practice is being called into question. Opponents of the culling of day-old male chicks appeal to the animals' intrinsic value and their resulting right to life. Those who have no objections to the culling of day-old male chicks appeal mostly to technical and economic aspects, and wonder whether there is any real difference between 1. euthanising chicks at the hatchery and using them as animal feed, and 2. rearing layer males, slaughtering them after 12 weeks, with a very limited to no market for this meat, while at the same time breeding other animals (mice) to replace day-old chicks as animal feed. This is primarily an ethical consideration.

In June 2021, two motions were adopted in the Dutch House of Representatives on this topic, namely:

- Motion put forward by Beckerman and Boswijk
  *Requests the Dutch government to investigate how and within what time frame a ban can be imposed on the culling of day-old male chicks. One of the considerations in this context is that this should be done in a way that benefits animals, farmers, and consumers.*

- Motion put forward by Vestering and Beckerman
  *Make a statement to the effect that the culling of male chicks must be forbidden.*

Partly in response to above-mentioned motions, the Ministry of Agriculture, Nature and Food Quality (LNV) has been given a prominent role, and the Day-old Male Chicks Steering Group was created, led by LNV. This Steering Group includes representatives from the following organisations: COBK, Anevei, NVP, LTO/NOP, Dierenbescherming and LNV.

The objective of the Steering Group is to

> *Fulfill the adopted Beckerman and Boswijk motion by investigating how and within what time frame a ban can be imposed on the culling of day-old male chicks, taking into consideration that the suggested alternative must benefit animals, farmers, the environment[1], and consumers. In this context, it is important to coordinate the time frame and define the group of male chicks concerned.*

The ambition is to submit a recommendation to the Minister of Agriculture, Nature and Food Quality (LNV) in the spring of 2022. This requires mapping various technical and ethical aspects. CenSAS has been asked by the Ministry of Agriculture, Nature and Food Quality (LNV) to formulate a vision on the ethical aspects of culling day-old male chicks. This aspect is not addressed in this report. Much technical information is already available from the relevant sectors and WUR.

## 1.2 Project objective

The objective of this project is to use the currently available information to produce an extensive, substantive and technical analysis of how a ban on the culling of day-old male chicks could be imposed in the Netherlands, how to define the group of male chicks, and what alternatives are available that benefit animals, farmers, the environment, and consumers. This analysis leads to a sketch of various scenarios for implementing a ban, based on which the Steering Group can formulate a recommendation for the Minister of LNV.

The assignment from the Steering Group includes the following tasks for the authors:
- Collect available, reliable information that is as independent as possible based on the aspects defined
- Identify potential blank spots and investigate, together with the working group, how these blank spots can be filled
- Where possible, fill the blank spots, for example using interviews
- Write an analysis based on the input provided
- Coordinate and chair the working group
- Based on the information provided, and in consultation with the working group, outline a number of scenarios for implementing a ban, including the pros and cons and the consequences of each scenario. These scenarios should be submitted to the Steering Group for adoption, with a recommendation from the working group.

## 1.3 Scope

This project focuses on collecting information concerning the various routes within the layer sector: the current practice (euthanising), applying sexing techniques to the hatching egg (in ovo sexing), rearing layer males, and keeping dual purpose chickens. We did not request any specific information from other sub-sectors of the poultry industry, such as producers of breeding and parent stock.
The ethical aspects of culling day-old male chicks, in ovo sexing, breeding alternatives (such as mice) and the keeping of dual purpose chickens, are not included in this report. These aspects are the subject of a separate report by CenSAS.

[1] The environmental aspect was added by the Steering Group to the Beckerman and Boswijk motion.

# 2 Method

## 2.1 Method

The authors conducted a total of 25 interviews with persons who are in some way involved in this issue: poultry farmers, veterinarians, a purchaser of day-old male chicks, and representatives of hatcheries, egg packing stations, animal feed factories, in ovo technique suppliers, zoos, and one slaughterhouse. Regarding the economic and sustainability aspects, we requested information from WEcR. See Table 2.1 for a complete overview of the organisations with which our interviewees are affiliated.

These interviews allowed us to collect a lot of useful information on all aspects that play a role in the issue of 'the culling of day-old male chicks'. This information has been integrated in this report. The issue turns out to be extremely complex and involve many aspects.

***Table 2.1*** *Overview of interviews held.*

| Sector | Organisation |
|---|---|
| Hatcheries | Broederij 't Anker |
| | Ter Heerdt |
| | Verbeek |
| | Agromix |
| Breeders | European Layer Distribution |
| Veterinarians | Fair Poultry |
| | Poultry Vets |
| | Demetris |
| Animal feed producers | De Heus |
| | Agrifirm |
| Technology | Vencomatic |
| | In Ovo |
| | Hatchtech (Selectegg, Planteg) |
| Egg trade | Van Zetten |
| | Kwetters/Hardeman |
| | Gebr. Van Beek |
| | Interovo |
| Food animals | Vereniging Dier & Park |
| | Dutch Zoo Federation |
| | Kiezebrink Animal Feed |
| Slaughterhouse | Slachterij Van der Meer |
| Economic aspects | WEcR |
| Layer poultry farmers | 2 companies |
| Broiler farmer | 1 company |

In addition to the information obtained from interviews, we also integrated in this report information from the available literature, in part offered by some of the interviewees and in part resulting from a short literature review conducted by WLR.

## 2.2 Project organisation

LNV established a Day-old Male Chicks Steering Group, under its own chairmanship. This Steering Group includes representatives from the following organisations: COBK, Anevei, NVP, LTO/NOP, Dierenbescherming, and LNV. This Steering Group was given the task of investigating how and within what time frame a ban could be imposed on the culling of day-old male chicks.

The Steering Group in turn appointed a Project Leader to coordinate the project, make sure that the information becomes available, and map the blank spots. The Project Leader is responsible for directing the formulation of scenarios for how a ban could be imposed.

In addition, a working group was launched, with representatives from the same organisations as in the Steering Group, but with different staff. This working group is responsible for deciding on the approach used (how this report is formulated), and coordinating the project to ensure a complete and correct representation of the facts. Policy-related decisions are made by the Steering Group. In addition, the Project Leader is responsible, in collaboration with the working group and based on the available information, for outlining scenarios for how and within what time frame a ban can be imposed on the culling of day-old male chicks. These scenarios are then submitted to the Steering Group, with a recommendation from the working group where possible.

In addition to the Project Leader, a WUR researcher is also actively involved in the project. The WUR researcher is responsible for performing some of the tasks assigned to the Project Leader, according to the following division of tasks:
The Project Leader:

- is responsible for coordinating the process and focuses primarily on collecting and submitting user experiences (for example by means of interviews);
- is responsible for weighing the various interests and, together with the working group, formulating a number of scenarios that can then be submitted to the Steering Group.

The researcher:

- is responsible for collecting the data supplied by the working group and the interviews, write it up and assess its value;
- is responsible for mapping the blank spots in knowledge;
- is responsible for creating objective overviews of pros and cons, based on the available information.

The project leader and the researcher join forces to formulate the scenario sketches.

The researcher is responsible for a correct overview of the available knowledge and gaps in knowledge. The final responsibility for the scenarios to be delivered rests with the project leader.

# 3 Animal species

This report mostly concerns hens and cockerels of chicken breeds in the egg-production column. The issue focuses on the entire production period from hatching egg to end-of-lay laying hens. The European 1999/74 (E.U., 1999) guideline defines laying hens as follows:

> *Laying hens: hens of the species Gallus gallus which have reached laying maturity and are kept for production of eggs not intended for hatching.*

The total life cycle of a laying hen consists of a rearing period, from Day 0 (when the egg hatches) to relocation at 17-18 weeks to a layer house, and a laying period, from start of lay to end of lay, when the animals are slaughtered at 72-100 weeks.

The parents and grand-parents of laying hens fall outside the scope of this report, as do the various poultry sub-types in the meat sector.

## 3.1 Laying hens

Layer breeds are primarily selected for efficient egg production. In the past 25 years, the number of eggs per animal has increased from 297 to 327 at 72 weeks, the period during which the animals are kept has increased (from 72 to 100 weeks), and the feed conversion ratio (kg feed per kg egg) has decreased from 2.31 to 2.0 (Koenig et al., 2012). White laying hens have the highest production level in this context, followed by brown hens. Dual purpose hens lay substantially fewer eggs (Table 3.2).

***Table 3.2*** *Key figures for various types of laying hens (Lohmann, 2021).*

| | Results up to 80 weeks | | | | Animal weight (kg) | |
|---|---|---|---|---|---|---|
| Type of animal | # eggs | Kg egg mass / hen housed | Egg weight (g) (average) | Kg feed / kg egg | 17 w | end of laying period |
| White laying hens (LSL Classic) | 371 [1)] | 23.20 | 62.5 | 2.0 - 2.2 | 1.27 | 1.79 |
| Brown laying hens (Lohmann Brown Classic) | 363 [2)] | 23.13 | 63.7 | 2.15 - 2.25 | 1.42 | 2.05 |
| Dual purpose hen (Lohmann Dual) | 310 | 18.79 | 60.6 | 2.35 - 2.45 | 1.44[3] | 2.09[3] |

1) 467 eggs at 100 weeks

2) 412 eggs at 90 weeks

3) Animal weight is similar to that of the Lohmann Brown; figures concerning feed conversion and animal weight are slightly higher than reported on the website of Lohmann Breeders, adjustments have been made according to information shared verbally by Lohmann Breeders.

In terms of behaviour, laying hens are very active. Brown hens are less shy than white hens, and have a tendency to come towards people, while white hens are more likely to keep their distance. Fear responses are more of a problem with white hens than with brown hens. On the other hand, white hens move more easily through three-dimensional housing systems than do the brown hens.

### 3.1.1 Dual purpose chickens

Dual purpose chickens are chickens with a double purpose, namely egg production by hens and meat production by cockerels. Lohmann Breeders indicates it has realised this by combining the genetics of laying hens and broilers. According to Lohmann, this combination represents a compromise on both

fronts (meat and eggs), because it is impossible to combine top egg production and high meat production in a single animal (see also Table 3.2). In this segment, they have brought the Lohmann Dual on the market. Hendrix Genetics focuses on the Sasso breeds and crossbreeds, a chicken developed for Africa, and intended to be more robust, less prone to illness, and better able to cope with low value feed ingredients.

In terms of behaviour, dual purpose chickens tend to be calmer than laying hens, but more active than broilers. Giersberg et al. (2019) indicate that the risk of feather pecking is lower in dual purpose chickens than in laying hens, and that the cockerels are also calmer than those of regular layer breeds.
More information on dual purpose chickens can be found in Section 6.4.

### 3.1.2 Rearing of laying hens

The period from chick to egg-laying laying hen is referred to as the rearing period. As a rule, during this period, the animals are kept in separate rearing houses, where they remain until they reach approximately 17-18 weeks and have grown from 40-45 gram chicks into young hens of approximately 1400 grams. Brown hens are slightly more robust in build and tend to be heavier than white hens, although the differences between the two types have decreased over the years. Although growth is important, it clearly stands in relation to the future purpose of the animal: optimal physical development for optimal laying timing, in combination with light stimulation. During this period, the animals are prepared for laying with the right nutrition, lighting (the right light stimulus for egg production), and living environment (getting used to the 3D environment, preventing pecking). The animals are kept in housing systems, in which they learn to navigate both distance and height. These systems are usually equipped with multiple levels and perches.
During the rearing period, the laying hens are administered vaccines, spread over the rearing period. These are needed to prepare the animals for the laying period, when they will be kept for a long period of time.

## 3.2 Layer males

When incubating eggs to produce new laying hens, approximately 50% of eggs result in the birth of a male chick. These are therefore the brothers of laying hens. Until recently, these male chicks were culled at the hatchery as a standard, and almost all of them were sold to bird shelters, zoos, and other parties. A very limited portion (<0.5%) was destroyed. Krautwald-Junghanns (2021) gives the following definition of brother cockerels:
"Brother cockerels are the male brothers of female laying hens that are not culled immediately after hatching, but are reared and slaughtered. These are therefore males from a layer hybrid."
Two aspects are important in this context:

1. These are males from layer breeds, meaning breeds that are primarily selected for the high egg production and efficiency of the females. Meat development is counterproductive in this selection, meaning therefore that these breeds are indirectly selected for low meat production.
2. Increasingly, people are using a stricter definition of 'brother cockerel', to refer explicitly to the hatched brothers of a flock of laying hens, and not some 'random' flock consisting of an equal number of males from layer breeds. This is explained in Figure 3.1.

When hatching a flock of future laying hens, there are a number of available options:

1. The hatching eggs are not sexed beforehand, and the 50% of hatched male chicks are euthanised at the hatchery.
2. The hatching eggs are not sexed beforehand, and the 50% of hatched male chicks are reared up to a certain age, and then slaughtered for meat production.
3. The hatching eggs are sexed during incubation, the male eggs are removed and used as animal feed, so that in principle, no male chicks are hatched.

These options lead to three different situations, outlined in Figure 3.1. Female chicks may have no brothers, because the male eggs are removed prematurely from the incubation process via in ovo techniques, or because the chicks are euthanised immediately after hatching at the hatchery (Situation 1). If the female chicks have brothers, these are reared, leading to Situation 2. If the hens have no brothers, and the buyer still wants cockerels, the hens can be sold together with a (remnant) batch of cockerels from a different hatch. These are strictly speaking layer males, but not brother cockerels. These layer males are equal in number to the laying hens. In Germany, such layer males are known as 'Kopfäquivalenten' or 'Kopfhähne'. This is illustrated in Situation 3. Brother cockerels are the actual brothers of a flock of laying hens, as shown in Situation 2.

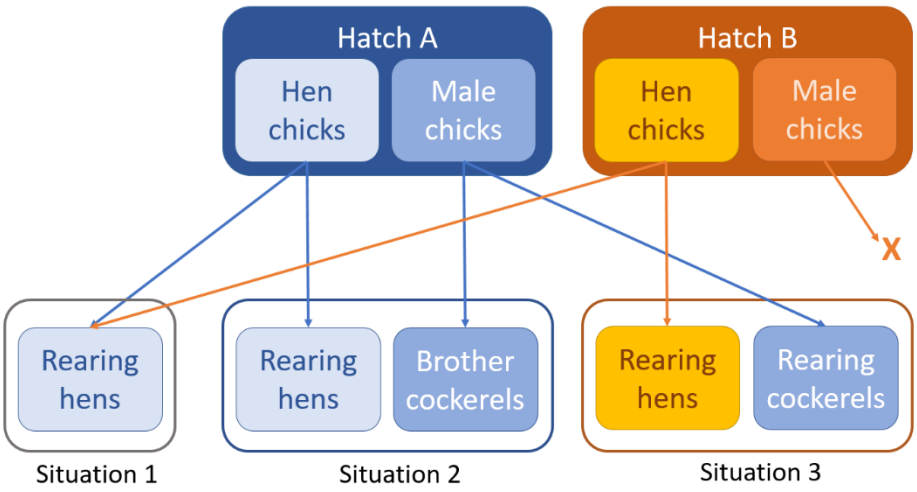


***Figure 3.1*** *Explanation of the concept of brother cockerels; in the strictest sense, these are males from the same hatch as a flock of laying hens.*

Situation 1: Only hens are reared, and the cockerels are either euthanised at the hatchery, not born thanks to in ovo sexing, or reared (see Situation 3).

Situation 2: Both hens and cockerels are born, and both are reared; the cockerels are brother cockerels in the strict sense.

Situation 3: No cockerels are born, or they are euthanised at the hatchery; if the buyer wants cockerels to be reared, cockerels from another batch are offered and reared in equal number to the female chicks; strictly speaking, these are not brother cockerels. In Germany, these cockerels are known as 'Kopfhähne'.

In terms of behaviour, layer males more closely resemble laying hens than broilers. They are very active, and enjoy sitting on elevated structures. The cockerels of white layer breeds are more fearful, as do their sisters, than cockerels of brown layer breeds. With both types, smothering[2] can be a problem. With layer males, sexual maturation plays a role in behaviour. Around 10 weeks, aggression intensifies, which can become problematic if the housing is not suitable and/or adequate management is not applied.

[2] For unknown reasons, these animals can suddenly start pile up on top of eachother in large numbers, with the animals trapped below sometimes dying of suffocation, leading to high loss rates.

# 4 Numbers / scope

## 4.1 European layer sector

Of the total of 372.4 million laying hens kept in the European Union in 2020, 178.8 million (48%) were housed in enriched cages. Of the 193.6 million hens (52%) that were not kept in cages, 23.2 million hens were kept under organic conditions, representing 6.2% of all laying hens in the European Union. Of the non-organic hens, 126.2 million (33.9%) were kept in barn systems, and 44.2 million (11.9%) in free-range systems (E.U., 2022). According to these figures, Germany has the largest laying hen population in Europe, with 56.2 million laying hens, followed by respectively Poland, France, Spain, and Italy. With 33.1 million hens, the Netherlands occupies sixth position in Europe, representing 8.9% of all laying hens in the European Union. Places 7 to 10 are held by respectively Belgium, Rumania, Portugal, and Sweden.

## 4.2 Dutch egg production chain

Dutch egg production consists of a great number of chain links, with a varying number of companies per link. Figure 4.1 illustrates the various links and their size (van Horne, 2020). Of the total number of eggs produced in the Netherlands, approximately one third is sold in the Netherlands. Buyers include supermarkets (table eggs) and food service companies (including restaurants and catering), and many eggs are processed in food products such as sauces, bread/baked goods, and pasta. Germany is by far the most important market for Dutch eggs (81% of the Dutch export). Approximately 10% are exported to Belgium, 4% to Switzerland, and 1% to France and Austria. In 2018, Dutch egg export to countries outside the EU amounted to less than 5% (van Horne, 2020).

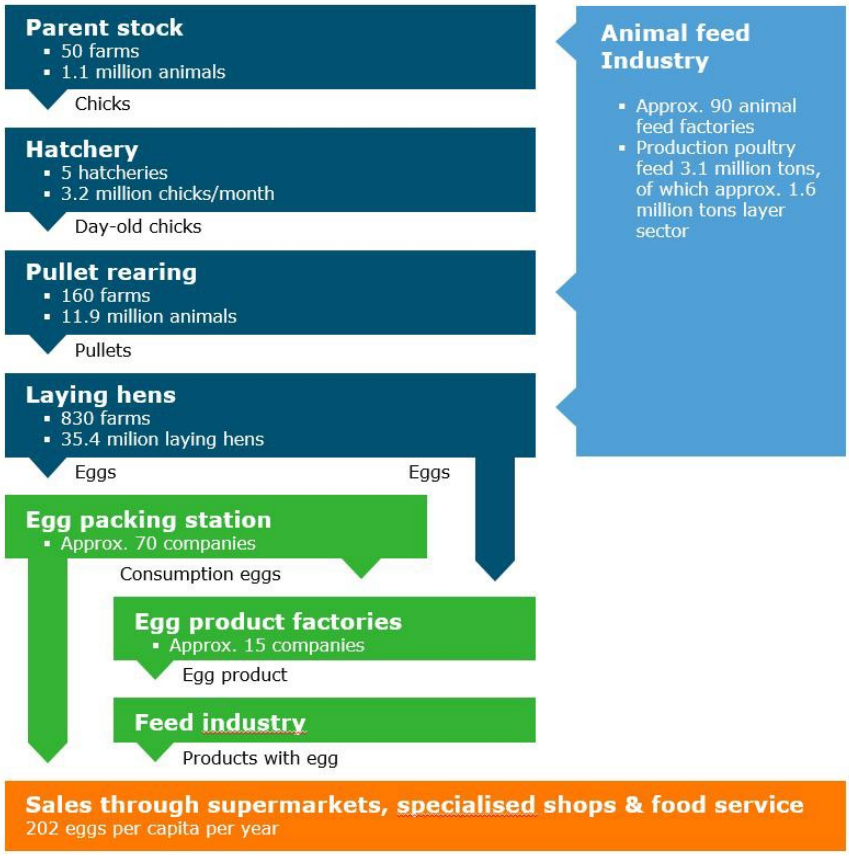


***Figure 4.1*** *Links and link size of the Dutch egg sector based on Dutch branches (2018 data) (van Horne, 2020).*

## 4.3 Scope of production of day-old male chicks

Day-old female chicks are produced in Dutch hatcheries for the Dutch replacement market and for export. Assuming a production of 3.2 million female chicks per month (in 2018) as indicated in van Horne (2020), this amounts to 38.4 million female chicks and therefore also 38.4 male chicks per year. These figures do not include euthanised day-old male chicks from parent stock (cockerels or hens from various lines). If these chicks were to be included, the total number of euthanised chicks would match the figures below (Table 4.1 and 4.2).

Bokma-Bakker and Leenstra (2010) offer an overview of the production of frozen day-old male chicks in Europe in 2010.

***Table 4.1*** *Production of frozen day-old male chicks in Europe in 2010.*

| Producer | x million pieces | x 1000kg |
|---|---|---|
| Kiezebrink (NL): | 45 | 1,800 |
| * of which from the Netherlands | 40 | 1,600 |
| * of which from Belgium | 5 | 200 |
| Mulder Diervoeding (NL) | 2 | 80 |
| **Total for the Netherlands** | **42** | **1,680** |
| | | |
| Kiezebrink (UK) | 13 | 520 |
| Labdial (ES) | 40 | 1,600 |
| Hassel (PL) | 15 | 600 |
| Honeybrook (UK) | 20 | 800 |
| Other | 5 | 200 |
| **Total for Europe** | **135** | **5,400** |

(Bokma-Bakker and Leenstra, 2010)

The large majority of euthanised day-old male chicks is intended for use as animal feed, a small portion (<0.5%) is destroyed; this refers to the selection of chicks marked as Cat1 material[3].
The Netherlands is one of the largest processors of these dead chicks: Kiezebrink International is an internationally operating wholesale dealer in animal feed, subsuming Kiezebrink Putten BV (Netherlands) and Kiezebrink UK (UK branch). The company was founded in the early 1990s and at first focused primarily on supplying frozen day-old male chicks to zoos and falconries. Following the aviary influenza outbreak of 2003, and with an eye to risk spreading, the company extended their product line to include other frozen food animals, such as rats and mice, as well as dry feed and supplements. When it comes to frozen day-old chicks, Kiezebrink is the European market leader. Kiezebrink Nederland freezes the chicks using a special procedure, and exports them throughout Europe. Within the European Union, they sell to clients in the Netherlands, Denmark, Germany, Finland, France, Ireland, Italy, Latvia, Luxembourg, Malta, Austria, the Czech Republic, and Sweden. Outside the European Union, the chicks are sold in the UK, Hong Kong, Dubai, and Switzerland.

Kiezebrink sells over 43.6 million chicks per year, amounting to 1.7 million kg (Baltes, 2022). Most of the day-old Kiezebrink chicks are sold via dealers. When it comes to direct sales, their most important sales channels are bird shelters and raptor farms, followed by zoos, and pet food sellers. The portion sold as reptile food is clearly more limited (Table 4.2).

***Table 4.2*** *Distribution of sales of dead day-old male chicks by Kiezebrink Nederland.*

| Category | Number of items | Number of kg |
|---|---|---|
| Dealer | 25,209,653 | 1,008,386 |
| Raptors | 8,140,694 | 325,628 |
| Zoo | 5,285,764 | 211,431 |
| Petfood | 4,722,222 | 188,889 |
| Reptiles | 262,986 | 10,519 |
| Total | 43,621,319 | 1,744,853 |

(Baltes, 2022)

[3] Animal by-products are divided into three categories, established in the European Animal By-products Regulation (Regulation (EC) no 1069/2009) and based on the risk for public and animal health. Per category, there are provisions on how the material should be destroyed, or can be processed or used.

### 4.3.1 Organic day-old male chicks

In the Netherlands, 60.6% of hens are kept in barn systems, 17.8% in free-range systems, 15.2% in enriched cages, and 6.4% in organic housing systems (E.U., 2022).
The Dutch organic sector has not yet voiced a final preference when it comes to in ovo sexing versus rearing layer males.
In terms of footprint (use of raw materials and $CO_2$ emissions), rearing layer males for meat production is considered to be inefficient. In addition, there is still a lack of knowledge and experience on how to adequately rear layer males. Animal welfare is an area of concern in this context. In addition, the organic rearing of layer males is not yet profitable, the sales market is currently limited, and the required selling price has not yet been realised.
Although the organic sector considers in ovo sexing to be a better alternative than the culling of day-old male chicks, it has mixed feelings about the ethical concerns surrounding this practice. In addition, the distribution of costs and risks between various sector parties is not yet sufficiently clear.
The organic sector is therefore reluctant to apply in ovo techniques, and may opt for the rearing of cockerels. In both cases, in the future organic day-old chicks will not be available as animal feed.

## 4.4 Export of laying hens

Based on the available hatching capacity, insights into the sales of day-old male chicks, and a replacement market of approximately 20 million laying hens per year, we can conclude that in 2018, the Netherlands exported approximately 24 million day-old female chicks, amounting to approximately 6 million breeder or parent stock, and approximately 18 million day-old female chicks (laying hens). In addition to this export from the Netherlands, hatcheries of Dutch origin operating from their foreign branches (mostly in Belgium) also export day-old female chicks, although these figures are not included in this report (since they are not relevant for the choice for a specific scenario).

# 5 Legislation and developments in surrounding countries

## 5.1 European legislation

The European legislation does not distinguish a layer male category. It is therefore unclear whether layer males fall under laying hens or under broilers. Since they are kept for meat production, they are usually subject to the norms for broilers, which is arbitrary, since they are from a different breed, and therefore show different behaviour and reach a different final weight.
Organic layer males are subject to clear regulations, by virtue of being mentioned specifically in the new EU organic regulations. Commission Implementing Regulation (EU) 2020/464 offers provisions for the production of organic layer males (E.U., 2020), with layer male being defined as a male chicken of layer breeds intended for meat production. The provisions of the Regulation apply to the indoor space, the veranda, and the free-range area. Table 5.1 lists the requirements for the indoor space.
Regulation (EU) 2018/848 (E.U., 2018) specifies a minimum slaughter age of 81 days for poultry, without further specifications per poultry type. This age limit therefore also applies to organic layer males.

***Table 5.1*** *Stocking density and minimum surface area for organically reared layer males according to the Commission Implementing Regulation (EU) 2020/464 (E.U., 2020)*.

| | |
|---|---|
| **Indoor space** | |
| Max. stocking density (per $m^2$ usable surface) * | 21 kg living weight/$m^2$ |
| Minimum surface area outdoor space | 1 $m^2$/animal |
| Perches or elevated platforms, or both:<br>• min. perch/animal<br>• min. elevated platform/animal<br>(Any combination of perches or elevated platforms, or both, available when the animals are young) | <br>• 10 cm/animal<br>• 100 $cm^2$/animal |
| Multi-tiered system | Max 3 floors, including the ground floor |
| **Compartments** | |
| Maximum number of animals per compartment | 4800 animals |
| Side partitions | Solid side partitions or half-solid side partitions or nets or mesh |

* Mobile henhouses may be used, such that stocking density may be increased to maximum 30 kg of living weight per $m^2$, on condition that the floor surface of the mobile henhouse does not exceed 150 $m^2$.

There are a number of transitional periods for henhouses built before the new organic regulation entered into force. These concern the following modifications to the henhouse:
No later than 1 January 2024, the following must be present or modified:

- Length of popholes in the henhouse for access to the covered veranda
- Solid side partitions
- Perches or elevated platforms

No later than 1 January 2029, the following must comply with the regulations:

- Wintergarden (covered veranda) and the accompanying calculations of stocking density and minimum indoor space
- For multi-tiered systems: the maximum number of floors and the presence of a manure removal system under every tier
- Outdoor spaces (free-range) of which the outer boundary is further than 150 m from the closest pophole for entering/exiting the henhouse should be brought back to maximum 150 m no later than 1 January 2029
- Stocking density and minimum surface area of indoor and outdoor space

In the period until these dates, these requirements do not apply, and neither do any previous requirements, to the extent that they can be traced, since there were no such requirements for layer males anyway.

## 5.2 Germany

On 20 May 2021, the German Bundestag decided to forbid the culling of day-old male chicks starting from 1 January 2022. (BMEL, 2021; Bundesregierung, 2021; BMEL, 2022). This makes Germany the first country to ban the culling of day-old male chicks (Loon, 2021).

The legislation is defined as follows (BMEL, 2021):
It is prohibited to
1. cull male chicks of the domestic fowl species from selection lines that are selected for egg production,
2. perform interventions on the chicken egg on or after Day 7 of the incubation process, which are performed on the egg during or after in ovo sexing, and cause or have as a consequence the death of the chicken embryo.
Item 1 does not apply if
- the culling of chicks is prescribed or recommended according to animal health requirements, or is necessary in individual cases for reasons pertaining to animal welfare,
- the culled chicks are non-hatchable.
Item 1 takes effect on 1 January 2022, and Item 2 on 1 January 2024. The explanatory notes state that no evaluation of the legislation is planned at present.

This ban also applies to animals sold as food chicks. The ban applies to chicks born in Germany. It is therefore still possible to import day-old hens or pullets whose brothers were euthanised at a foreign hatchery.
In ovo sexing is permitted, but the German legislation states that as of 2024, it is prohibited to kill embryos after Day 6 of the incubation period. So far, there are no techniques ready for practical use for determining a chick's sex before Day 7 of the incubation period.

Despite the ban on culling day-old male chicks, eggs for consumption from flocks of which the cockerels were culled can still be legally sold in Germany. These could be import eggs, or eggs from imported laying hens. The German legislation only forbids the culling of day-old male chicks on German territory, but does not impose any further restrictions on this point.

The German market goes further by imposing non-statutory requirements: they require products (meat and eggs) to have an OKT ‘Ohne Küken Töten’ quality label. Eggs for consumption with this quality label must come from flocks of which the day-old male chicks were not culled (or not born due to the incubation process being interrupted after in ovo sexing).
For the rearing of layer males, the German KAT ('Kontrollierte Alternative Tierhaltungsformen') quality system has formulated guidelines/criteria to guarantee the cockerels’ welfare (Table 5.2). Although KAT is not primary legislation but a private label applying to affiliated parties only, in practice, it does set the tone for the general approach in Germany.

***Table 5.2*** *Norms for conventionally and organically reared layer males according to the KAT regulation (KAT, 2021).*

| | **Conventional** | **Organic** |
|---|---|---|
| Stocking density | • Until 30-6-2024: From 35 days max 20 animals/$m^2$ usable area; in case of multiple floors max 40 animals/$m^2$ usable area<br>• Starting from 1-7-2024: From 35 days max 18 animals/$m^2$ usable area; in case of multiple floors max 36 animals/$m^2$ usable area | Starting from 1-1-2022:<br>• From 1 day max 100 animals/$m^2$ usable area<br>• From 35 days (in case of joint female/male chick rearing starting from 50 days) max 14 animals/$m^2$ usable area; in case of multiple floors max 28 animals/$m^2$ usable area |
| Slaughter age | • Min 70 days and minimum 1300 grams | |
| Usable area | • Min 30 cm wide, min 40 cm of overhead space<br>• Max 14% occupied by feed/water/perches<br>• Manure can fall maximum 1 level lower<br>• Landing platforms may count towards usable area on condition that they are min 30 cm wide, and with min 40 cm of overhead space | |
| Floors | • Max 4 floors, including the ground floor | • Max 3 floors, including the ground floor |
| Litter area | • Min 25% of the available floor area<br>• Available no later than at 35 days | • Min 1/3 of the available floor area<br>• Available no later than at 22 days and open to all animals starting from 28 days |
| Perches | • Min 17 cm away from the wall, with min 25 cm spacing<br>• Min 40 cm of overhead space for landing platforms, min 20 cm of overhead space for perches, which the animals can jump onto<br>• Min 1/3 elevated<br>• Available from 1 day | |
| Perch length | • From 35 days min 6 cm/animal | • From 35 days (in case of joint rearing of female/male chicks: starting from 50 days) min 10 cm/animal or 100 $cm^2$/animal of elevated area |
| Feed | • From 50 days min 4.5 cm/animal or when using round feeders 2 cm/animal | |
| Water | • From 50 days min 10 animals/nipple or when using round drinkers 1 cm/animal | |
| Light | • Daylight apertures min 3% of the floor surface area<br>• From 15 days onwards 8 hours of uninterrupted darkness and 8 hours of light with a dimmer phase | |
| Wintergarden | -- | • Min 1$m^2$/56 animals, available for min 1/3 of the life span |
| Free range | -- | • Popholes min 30 cm high and 40 cm wide<br>• New construction: 1 $m^2$/animal<br>• Max distance to the henhouse: 150 m<br>• Available for min 1/3 of the time [1)] |
| Group size | • 4800 animals per compartment | |
| Side partitions | • Solid side partitions or half-solid side partitions or nets or mesh | • With closing doors and no mixing of groups |
| Other | • As early as possible additional material, such as hay racks, straw bales, pecking stones<br>• Live wires are forbidden<br>• Emergency power supply is mandatory | • From 1 day additional material, such as hay racks, straw bales, pecking stones<br>• If there are more than 8000 animals, emergency power aggregate mandatory |

1) According to Regulation (EU) 2018/848 (E.U., 2018) the animals should from the earliest age that is practically possible, and as soon as physiological and physical conditions allow it, have uninterrupted access to the outdoors, except when temporary restrictions are imposed by European Union legislation.

## 5.3 France

On 5 February 2022, the French Ministry of Agriculture adopted the following legislation: Decree no 2022-137, dated 5 February 2022, concerning a ban on the culling of chicks from the Gallus gallus species intended for the production of eggs for human consumption and the protection of animals in the context of their slaughtering until death ensues outside slaughtering establishments (JORF, 2022).

This decree states that hatcheries have until the end of a transition period ending in late 2022 to acquire in ovo sexing technologies, so that the ban on culling chicks can be implemented from 2023 onwards.

Hatcheries that were already operational on the date of the publication of this Decree have until 31 December 2022 to install approved equipment. There are 5 hatcheries in France and the French Minister has committed to support them in the required investments up to a total of €10 million euro per hatchery (company, not location). In addition, the system they will install will not be considered technically outdated for a period of five years, which means that during this period, it can be used irrespective of potential future changes in legislation. The sector is also working on a system intended to ensure that the costs are spread across the entire sector. In ovo sexing is permitted until Day 15 of the incubation period.

The culling of day-old male chicks is still permitted:

- for chicks from selection or breeding lines;
- for chicks intended for scientific research, in particular for the pharmaceutical industry, or for veterinary diagnostics;
- for chicks intended as animal feed;
- in case of regulated animal diseases;
- for chicks and embryos that are screened out as non-viable in the hatcheries;
- for animals who are wounded or suffer from a disease that causes them intense pain or suffering, and where there are no other practical solutions for relieving this pain or suffering;
- for chicks that failed to be detected using the methods applied (cockerels born as a result of imperfections (sexing errors) in the in ovo technique used).

An evaluation is planned five years after this Decree takes effect.

The French Ministry of Agriculture has provided some explanatory notes on this Decree, which are summarised below.

The Decree of 5 February 2022 sets a limit on the number of incubation days (15) during which sexing may be performed on hatching eggs. No specific method/technique is prescribed. Most hatcheries in France have opted for the non-invasive AAT method, which can only be used to sex eggs from colour-sexing brown layer breeds (the large majority of French table eggs are brown).

The exemption for culling of day-old male chicks to be used as animal feed is intended to allow feeding these chicks to wild fauna living in captivity (reptiles, raptors, etc). A Decree is currently being prepared, which specifies that the only permitted method for culling chicks is gassing. The 'shredding' of chicks will subsequently no longer be permitted.

In order to limit the long-term application of this exception to day-old male chicks from white layer breeds (whose eggs are mostly sold to the industry), the French government is promoting the development of non-invasive sexing methods that can be applied at an earlier incubation stage. These methods could then also be applied to brown layer breeds.

The French government supports the poultry sector financially with grants for the purchase of in ovo equipment (at the moment primarily AAT equipment) and financial support in three development directions:

- the use of new techniques, applicable to all layer breeds;
- in case of the exception for use as animal feed: the use of $CO_2$ equipment for euthanising the chicks and equipment for freezing the culled chicks;
- rearing of layer males; in this context, the Decree states: "this option only makes sense if new markets can be found for these chicks."

## 5.4 Italy

Italy is the third European country to prepare a ban on the culling of chicks (AAT, 2021).
After Germany and France, the Italian Parliament has adopted a legal amendment with the goal of banning the culling of male day-old chicks in the layer poultry sector by the end of 2026. The Italian Minister has submitted this new law to the Parliament. It still has to be approved by the Senate, as the second House.

In early 2021, AAT produced the first in ovo-sexed flocks at the Italian Hy-Line hatchery using a demo system, in response to the domestic demand for in ovo-sexed laying hens locally produced in Italy. Since October 2021, a large machine has been operational for delivering OKT pullets to Italian layer poultry farmers.

## 5.5 Austria

As of 1 January 2022, it is no longer permitted to destroy viable chicks in Austria (Hoepke, 2021). It is still permitted to cull chicks to be used as animal feed. Every year, approximately 16 million chicks are sold in Austria to zoos, animal parks, and raptor parks, with so far approximately half of them being imported frozen from abroad, specifically from Germany, the Netherlands, Spain, Italy, and Eastern Europe. The reason for this is that Austria does not yet have the required logistics and cooling technology – the animals are snap frozen.
In 2019, Austrian day-old male chicks from layer breeds had the following destination (Hoepke, 2019):

- 70.1% (nearly 6.6 million chicks) were sold to zoos and animal parks and bird-of-prey stations
- 2.8% were sold to animal shelters and stork farms
- 16.2% (approximately 1.5 million chicks) were destroyed

Approximately 10.9% of day-old male chicks were reared.

Austria is the first country to implement the rearing of male chicks in all organic egg production (and in some premium barn system programmes) as part of an industry-wide agreement. This agreement was signed approximately five years ago, and is due to be further extended in accordance with the sector agreement.

According to the data of the "Land schafft Leben" association, there are currently three hatcheries in Austria that supply laying hen farmers (over 1200 throughout the country). According to the "Land schafft Leben" association, "the hatcheries produce approximately 18 million chicks for laying production, of which approximately nine million are males."

## 5.6 Switzerland

As far as is known, there is as yet no legislation in Switzerland that forbids the culling of day-old male chicks. The Swiss Gallosuisse egg sector organisation is working towards making this transition on its own initiative (Schuller, 2021). They indicate that at present, approximately 3.5 million male chicks are gassed. Approximately 700,000 of these are sold as food animals to zoos and other similar organisations. The sector wants to preserve this amount of food animals, because they are important

and would otherwise have to be imported. For the remaining 2.1 million chicks, solutions are being sought. The organic sector (in Switzerland approximately 700,000 of the 3.5 million day-old male chicks) is following its own path, but Gallosuisse sees in ovo techniques as the primary solution. Gallosuisse views dual purpose animals and the rearing of cockerels as alternatives for niche markets only. Bio-suisse, the organic branch organisation, on the other hand, is more in favour of dual purpose chickens (Frommelt, 2021). They are of the opinion that the current in ovo techniques do not offer any real improvement in terms of animal welfare, since they are currently performed at an age when embryos may already feel pain. They want to close the gap between broiler and layer breeds in the organic sector, so that cockerels can also be used to good purpose.
Gallosuisse is in dialogue with the entire chain to find acceptable solutions, with the goal of reducing as much as possible the culling of day-old male chicks. They fear that a political decision and legislation may actually slow down any positive developments. The Swiss non-organic sector has set as its objective to completely transition to in ovo sexing by the end of 2023. They indicate that the techniques are now still in their infancy, and that these two years are needed to develop them fully. The sector also needs this time to transition to OKT hens. If this transition was to take place straight away, these hens (or to start with, the eggs) would have to be sourced abroad (Hafner, 2022). Bio-suisse has given itself more time to transition, and is working towards a full transition by the end of 2025 (Frommelt, 2021).

## 5.7 Other developments

Not all European countries are formulating legislation for the culling of day-old male chicks. In some countries, governments are talking about it (for example Denmark), while in other countries, the retail industry is taking the lead. For example, Bio-Planet, Colruyt Group's retail formula focusing on organic and ecological products, has opted to only sell eggs from production lines with no male layer chicks. Bio-Planet is not in favour of rearing cockerels due to the poor feed conversion and limited meat yield. Instead, they opt for in ovo techniques, to prevent day-old male chicks from being born. They see this as an "innovative and more animal-friendly solution" (Vanheerentals, 2022).

In addition, Germany and France are pushing for European regulations, and have put the topic on the agenda. The matter was also discussed at a meeting of the European Commission (AGRIFISH Council on 19 July 2021). We can therefore expect the issue to be raised during the upcoming review of the animal welfare legislation. The European countries will therefore soon meet to discuss the desirability and possibilities of legislation. It is impossible to predict the results of this debate and the accompanying time frames.

# 6 Outline of four routes

This chapter describes the practical aspects of four routes:

1) Conventional approach (euthanising of day-old male chicks)
2) In ovo sexing (sexing in the hatching egg)
3) Rearing day-old male chicks
4) Dual purpose chickens

In Chapter 7, you will find a further description of other relevant aspects of these routes.

## 6.1 Conventional approach (euthanising of day-old male chicks)

Traditionally, the male chicks of layer breeds are euthanised on Day 1 at the hatchery (see Introduction chapter). In the Netherlands, euthanasia is carried out with $CO_2$ gassing, in accordance with a strict protocol (see Section 7.2.2). The cockerels are transported on the same day, if intended for use as animal feed, in cooled units.

Figure 5.1 illustrates the conventional approach: euthanising the day-old male chicks at the hatchery. These cockerels are sold as animal feed, while the hens are used for the Dutch replacement market (new laying hens) and for export, particularly to African countries.

This approach requires approximately 2½ hatching eggs per day-old female chick, the future laying hen, assuming a hatching rate of 80% on average, with 50% male chicks.

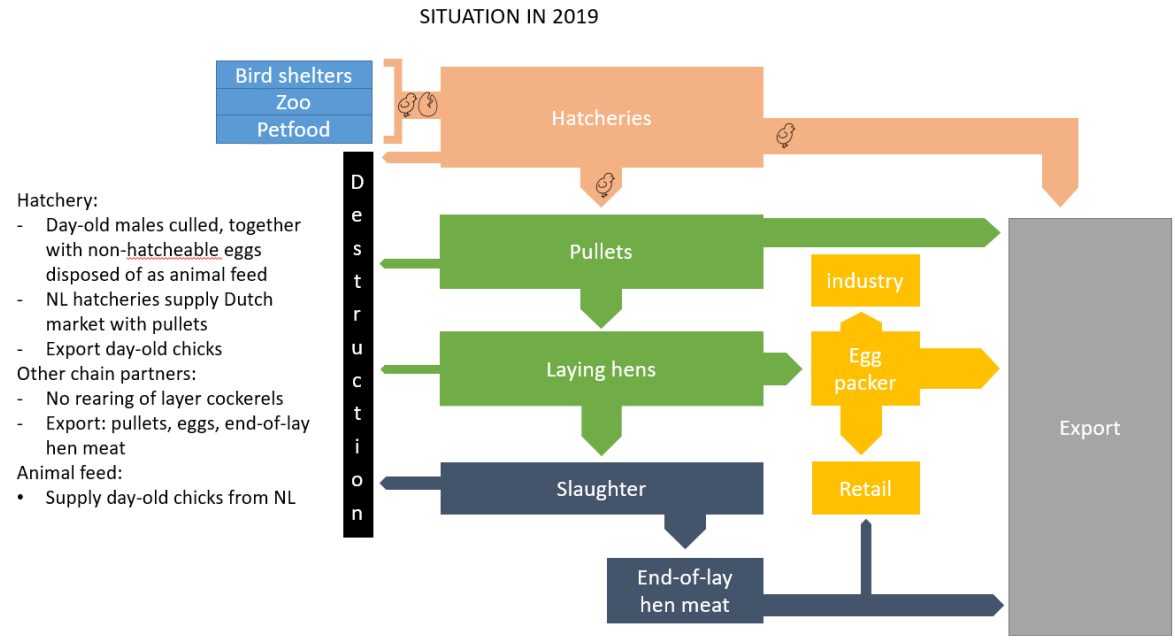


***Figure 5.1*** *Schematic representation of the conventional approach.*

Slaughterhouses also produce slaughter material to be used as animal feed, and some dead animals resulting from the breeding, laying and slaughtering process are destroyed. These lines have been left out for reasons of clarity.

## 6.2 In ovo sexing

To prevent male chicks from being born, techniques have been developed in past years to determine the embryos' sex in the hatching egg. Following this sexing in the hatching egg (in ovo sexing), some eggs are removed from the incubation process and disposed of. This applies to hatching eggs designated by the sexing procedure as male eggs, and the majority of hatching eggs for which no clear result could be obtained (in case of a doubtful result, the hatchery decides which eggs to incubate further). There are currently four in ovo sexing techniques on the market, and a few others are being developed. Table 6.1 offers an overview of the techniques, with some details. Three of the four techniques make use of allantois fluid from the egg. These techniques are invasive as theyrequire to make a small hole in the egg shell. AAT/Cheggy uses a non-invasive method that uses light reflection to observe the development/colour of the feathers. However, this method can only be used on brown, feather-sexing breeds. In addition, it can only be used starting from Day 13 of the incubation process. The other three techniques are currently applied on Day 9.

***Allantois and embryonic development***

The allantois is one of the three amniotic membranes developed by the embryo during the incubation process. This sac-like structure contains blood vessels that supply the embryo with oxygen and remove carbon dioxide. The allantois also saves excretions, and absorbs albumin for the embryo to feed on, and calcium from the shell for its skeletal development.

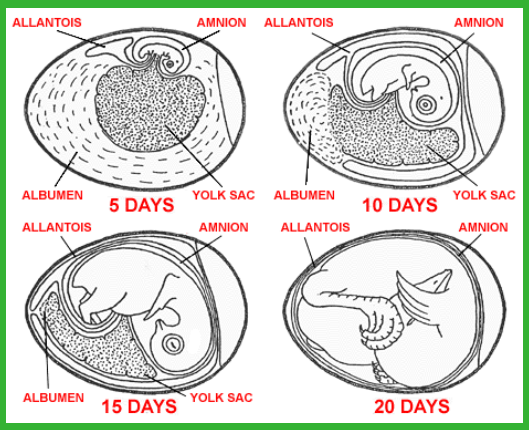


Figure: Successive changes in the position of the chicken embryo and its embryonic membranes

(A. L. Romanoff, Cornell Rural School Leaflet, September, 1939; in Chickscope, 1998)

After sexing, the male hatching eggs are removed from the incubation process. As a standard, eggs that are screened out of the incubation process (clear eggs: unfertilised or early dead) are picked up by a specialised firm that processes them into animal feed, or they are disposed of via Rendac[4] and destroyed. However, these are eggs that either contain no embryo, or where the embryo died prematurely during incubation. With in ovo sexing, the eggs that are removed contain a living embryo. In the Netherlands, these eggs are cooled, collected in a special container, and picked up by a specialised firm. The egg content is processed in animal feed, and the shells are used as a source of calcium in animal feed or as pecking stone.

With the current state of the technology, the invasive methods require approximately 3.5 hatching eggs per day-old female chick (i.e. 40% more than with the conventional approach). This is due to the higher embryonic mortality and the portion of hatching eggs producing no or no clear sexing result. To prevent cockerels from being born (and subsequently having to be reared), these eggs are also removed from the incubation process. This leads to an additional loss of 30% of day-old female chicks. With the current state of the technology, advancing the detection methods to 6 days would negatively impact precision, leading to even more eggs (embryos) being screened out due to unclear or no sexing results. The invasive methods can also be applied later than on Day 9 of the incubation process. The amount of allantois fluid in the hatching eggs increases with time, and the concentration in this fluid of the hormones/steroids used for sexing increases, up to 12-16 days of age (Wang et al., 2019). This improves sexing precision, leading to the loss of fewer hatching eggs, and therefore fewer hatching eggs being needed to produce one laying hen.

[4] Company collecting, processing and disposing of animal by-products and carcasses from commercial companies

***Table 6.1*** *Overview of in ovo sexing techniques currently in use commercially, with some specifications.*

| | Plantegg | 'In Ovo' / ELLA | Seleggt | AAT / Cheggy |
|---|---|---|---|---|
| Sexing age (incubation day) | Day 9 | Day 9 | Day 9 | Day 13 |
| Method | Puncture, fluid sample using a pipette | Puncture, fluid sample using a needle | Puncture, fluid sample using a pipette | Hyperspectral |
| Technology | DNA analysis/PCR | Protein analysis, mass spectroscopy | Elisa, hormone determination | Analysis of light reflection on embryo feathers |
| Analysis time | 60 min, separate waiting area | 2 min, in-line screening | 45 min, separate waiting area | < 1 second, in-line screening |
| Capacity/hour/unit | 3000 eggs | 6500 eggs | 3000 eggs | 20,000 eggs |
| Can be used for | All breeds | All breeds | All breeds | Brown, feather-sexing breeds |

The invasive in ovo techniques only produce relatively reliable results when used on hatching eggs from mother hens aged 30-55 weeks. Hatching eggs laid in the early days of a hen's laying period (21-30 weeks) and at the end of her laying period (55-72 weeks) turn out to produce relatively unreliable in ovo sexing results. Young mother hens (up to 30 weeks) produce smaller hatching eggs, leading to blood vessels laying comparatively closer to one another across the allantois fluid, with a higher risk that blood is extracted instead of allantois fluid.
In older mother hens, the in ovo procedure has so much impact that it negatively affects hatching percentages compared to younger flocks, resulting in a substantially higher percentage of dead-in-shell chicks (well-developed chicks that fail to hatch).
Steps are currently being taken to prolong the period during which sexing can be performed (up to over 60 weeks); there have as yet been no favourable results from performing sexing procedures earlier (than 30 weeks).

The additional costs of in ovo sexing using invasive methods are currently approximately €3.50 per day-old female chick. This amount covers equipment costs (including a potential additional waiting area: temporary incubator), the additional labour, and the sexing procedure. In ovo technique suppliers offer hatcheries various financial constructions, such as purchasing of equipment or payment per sexing procedure.
The costs would decrease if the sexing analysis time can be reduced, and sexing can be performed in-line. The costs of the AAT/Cheggy method, a non-invasive method that can be performed in-line, are currently €1.30 per female chick. In the longer term, further development of these techniques is expected to lead to lower costs.

### 6.2.1 Genetic manipulation

In ovo techniques depend on a certain stage of embryonic development; before this time, the chemical substance or development that is selected for is not, or not sufficiently, present yet. This makes it difficult to achieve the ultimate desired result with respect to selection in the egg, namely selection before the eggs are placed in the incubator.
A recent development may make this manner of sexing possible in the future. In December 2021, Douglas et al. (2021) published a study in which they used mice prototypes and succeeded in producing only males or only females. This new method involves a two-step genetic manipulation procedure that inactivates embryos shortly after fertilisation, as a result of which only the desired sex can develop. Not only did the method turn out to work with 100% certainty, but the number of mice (of the desired sex) born from a nest was also higher than in control nests (that produced both sexes).

This embryo sexing relies on a lethal sleeping gene carried by the father's X or Y chromosome and therefore inherited via the father. This lethal gene is activated by a second, trigger, gene carried by the mother. Embryos that inherit both genes will die, while those that only carry one of the genes will live. If the objective is to produce females only, the lethal gene is built into the Y chromosome of the father line (for mammals[5]). When combined with a mother line carrying the trigger gene, this leads to all male offspring (carrying XY chromosomes) having both the lethal and the trigger gene, and failing to develop.
Douglas et al. (2021) see opportunities for extending these gene techniques for managing offspring sex also to poultry. The researchers are currently talking to the Roslin Institute (UK) about setting up preliminary pilot tests (Mcdougal, 2021). However, it takes many years to build a gene into hybrid breeds that are currently in use.
Plus, the current EU legislation does not allow for genetic manipulation.

## 6.3 Rearing layer males

If culling day-old male chicks is no longer permitted, another alternative, besides in ovo sexing, is to hatch and rear the day-old male chicks up to 12 to 13 weeks (the KAT-requirement is minimum 70 days). The minimum living weight norm is usually approximately 1300 grams. In the Netherlands, there is at present no slaughterhouse that can slaughter such low-weight poultry. As a result of the German legislation, most day-old male chicks reared in Dutch hatcheries are slaughtered in Poland (and a limited portion in Belgium). To avoid as much as possible having to transport slaughter-ready animals over long distances, most of these cockerels are transported to Poland as day-old male chicks, and reared there.
This relatively long rearing period, combined with a low final weight, results in a highly unfavourable feed conversion ratio (approximately 3.5 to 4.0). This makes the rearing of day-old male chicks a loss-making option under the current circumstances. In 2021, the costs amounted to approximately €3.50 per reared day-old male chick, which is more or less equal to the costs of in ovo sexing (approximately €3.50 per day-old hen). Due to the increase in feed prices, these costs have in the meantime (May 2022) increased to approximately €4.00 per reared cockerel. The $CO_2$ production per kg of meat is 2.5 times higher for layer males than for regular broilers.

### 6.3.1 Age and weight

The various concepts and husbandry forms (for example KAT, BID, organic) specify different rearing ages. This also leads to differences in the animals' final weight. This is also affected by the type of animal being reared (organic, regular, white, brown). Table 6.2 offers an overview of the various initiatives and the norms they apply. This information is partly drawn from a review article by Krautwald-Junghanns (2021), supplemented with various figures from practice.

Brudertier-Initiative Deutschland (BID) has published figures from the Bauckhof Klein Süstedt company in Niedersachsen, where tests were conducted with various rearing periods (Andress, 2020). This company uses mobile henhouses with a Wintergarden (covered veranda), in accordance with the Demeter guidelines. The data are from the period from July to August 2018, and concern the Lohman-Brown-Plus breed (Table 6.3). Group size in the first test was 1500 cockerels. To compensate for the high feed costs, this company preferably feeds products unsuited for human consumption, such as triticale. The animals were kept to different ages, and their feed use, living weight, and carcass weight were recorded.
This company also ran a small test with varying group sizes, of 1500 and 500 chicks per group. When reared up to 20 weeks, the cockerels from the large group were substantially heavier than those from the small group (1.252 kg versus 1.436 kg carcass weight) (Andress, 2020).

[5] In mammals, males have XY chromosomes, and females have XX chromosomes. In birds, it is the males who are XX and the females YX, which means that the gene has to be built in differently for these species.

***Table 6.2*** *Overview of different initiatives[1)] for rearing layer males.*

| Initiative | Age | Weight | Comments |
|---|---|---|---|
| IG Bio-Initiative | 91 days | Min 1.6 kg | |
| BID, o.D. [2)] | 18-22 weeks | | Until 5 weeks together with the hens |
| KAT-Leitfaden (2021) zur Hahnen-aufzucht aus Legehybridlinien | Min. 70 days | Min 1300 gr | |
| Die Eiermacher, o.D. (Austria) | 9-10 weeks | 1 kg | Lohmann Sandy |
| Andersson (2013) | 80 days | 1528 gr | Organic production in a mobile henhouse, Lohmann Brown hens, 4 x 500 animals; compared to 70 days, a clear increase in living weight was observed in the last 10 days. |
| Müller et al. (2019) | 18 weeks | 2 kg | Lohmann Brown cockerels |
| Mayer, 2021 | 18 weeks | 1.9 – 2.1 kg | Lohmann Brown cockerels |
| Raiffeisen Ems-Vechte (Gnauk, 2020) | 12-15 weeks | 1500-1600 gr | White cockerels more likely to be reared up to 15 weeks, brown cockerels up to 12-13 weeks |
| Eilers (Waterloh, 2020) | 12-15 weeks | 1500 gr | Lohmann Sandy, 3.5 rounds per year, 1.5% average loss |
| Bicklhof | 18 weeks | | Biodynamic, until 8 weeks together with the hens, afterwards in a henhouse with Wintergarden and foraging area |
| Kudammhof - Ein Ei für zwei | | 1000-1300 gr | Organic |
| Eifrisch | 12-13 weeks | | Foraging area, with partial indoor aviary |
| Aldi Süd | 12-16 weeks | | Floor housing |
| Kipster | Min. 100 days | 1500 gr | Reared according to organic norms |
| Lankerenhof | 14-16 weeks | | Reared according to organic norms |

1) These initiatives vary in scope and some of the data are probably already somewhat dated, but there is a clear variation in age and weights; information obtained from Krautwald-Junghanns (2021), https://brudertier.bio/bruderhahn/andere-initiativen and interviews

2) BID=Brudertier-Initiative Deutschland

***Table 6.3*** *Growth and feed intake for various slaughter ages of organically reared Lohmann-Brown-Plus cockerels (Andress, 2020).*

| Slaughter age (weeks) | Feed conversion[1)] (kg feed/kg growth) | Feed intake (kg) | Living weight (kg) | Carcass weight (kg) | (%) |
|---|---|---|---|---|---|
| 12 | 4.1 | 4.54 | 1.108 | 0.581 | 52.44 |
| 14 | 4.3 | 5.81 | 1.352 | 0.784 | 57.97 |
| 16 | 4.7 | 7.71 | 1.640 | 0.975 | 59.48 |
| 17 | 4.8 | 8.22 | 1.714 | 1.070 | 62.45 |
| 18 | 5.1 | 9.46 | 1.854 | 1.107 | 59.73 |
| 20 | 5.3 | 10.60 | 2.000 | 1.252 | 62.62 |
| 22 | 5.4 | 11.85 | 2.194 | 1.390 | 63.36 |

1) Due to the use of different, less caloric feed compositions, the feed conversion may end up being higher than in other publications – see also Section 6.3.3.

### 6.3.2 Technical results

Damme (2017) gives a few general figures concerning the results of rearing layer males. Growth is determined mostly by genetic predisposition. In decreasing order of growth, he lists the following: specialised fast-growing broiler breeds (Ross 308 or Cobb 500), slow-growing broiler breeds (Hubbard JA757, Cobb/Sasso or Rowan Ranger), dual purpose breeds (LB Dual, Novogen Dual or Walesby Special), brown layer breeds (LB, Bovans Brown, ISA Brown, LB Plus etc.), and white layer breeds (LSL, Dekalb etc.). Layer breeds grow 12-20 grams per animal per day up to 20 weeks. Cockerels from brown layer breeds grow approximately 10% faster than white layer males. The feed conversion deteriorates with age in more or less linear fashion from 2.2-2.3 (brown cockerels) and 2.6-2.7 (white layer males) kg feed per kg growth at 7 weeks, up to and beyond 4.0 (brown cockerels) and 4.5 (white cockerels) kg feed per kg of growth at 20 weeks. Economically, the optimal slaughter age for cockerels of brown and white layer breeds, based on the EPI (European Product Index), is 8-9 weeks. The costs of rearing brown layer males up to 1350 grams at 10 weeks amount to approximately €3.50 per kg of living weight (2021 price index), which is approximately 50% higher than the costs of rearing organic cockerels from a slow-growing broiler breed.

Koenig et al. (2012) conducted an experiment with commercial broilers (Ross 308) and cockerels from different layer breeds of moderately heavy brown type (Lohmann Brown (LB) and Hy-Line Brown (Hyline)) and light white type (Lohmann Selected Leghorn (LSL) and Dekalb White (Dekalb)). The cockerels were reared on full litter and were fed ad lib with a standard feed. The broilers achieved the intended carcass weight of approximately 650 g after 19 days, the cockerels of the moderately heavy layer type after 47 days (LB, Hy-Line) and those of the light layer type after 49 days (LSL, Dekalb). The feed conversion ratio was calculated to be 1.2 for broilers and 2.45 for the laying types. The weights of valuable parts (aka breast, thigh) were higher for broilers than for layer males. The relative carcass composition did not differ among layer breeds.

## 6.4 Dual purpose chickens

The causation of the issue of 'the culling of day-old male chicks' (see Introduction) is the practice of breeding separate layer breeds (for efficient egg production) and broiler breeds (for efficient poultry meat production). The rearing of dual purpose chickens, i.e. chickens with a twofold function (egg and meat production), may lead to a decrease in egg production, but it also opens opportunities for more efficiently rearing the cockerels, which produce substantially more meat than those of regular layer breeds. This may make it possible to create a profitable rearing operation, related to a higher selling price for the meat on the market.

In Germany, various tests were performed with the Lohmann Dual. Lohmann reports that hens from this breed have a higher feed intake, a lower egg production, and a somewhat lower egg weight, all of which combines into a total decrease in profit of €6 per animal place per year, compared to the Lohmann brown. This negative result is compensated to a small extent by the increase in meat production in the cockerels.

Male chicks from layer breeds grow more slowly than those of broiler or dual purpose breeds. Tables 6.4 and 6.5 list the technical results of a German comparative study, as reported in Schütz et al. (2018). The first table lists the technical results of cockerels from a brown layer breed and a dual purpose breed, both reared up to 10 weeks, compared to the technical results of broilers slaughtered at 6 weeks. The second table displays the effect of a longer rearing period (10 versus 20 weeks) for organic layer males and dual purpose cockerels.

***Table 6.4*** *Production costs and minimal costs for cockerels of dual purpose, layer and broiler breeds (Schütz et al., 2018).*

| Type of animal | Lohmann Dual | Lohmann Brown | Broiler |
|---|---|---|---|
| Production duration | 10 weeks | 10 weeks | 6 weeks |
| # rounds/year | 4.73 | 4.73 | 7.43 |
| Feed conversion ratio | 2.0 | 2.4 | 1.6 |
| Living weight (kg/animal) | 2.54 | 1.53 | 2.59 |
| Carcass weight (kg/animal) | 1.52 | 0.82 | 1.86 |
| Chick price (per bird) | 0.37 | 0.25 | 0.35 |
| Costs (per animal place/year) | | | |
| Day-old chick | 1.75 | 1.18 | 2.60 |
| Feed [1)] | 5.57 | 3.58 | 9.61 |
| Other direct costs | 1.36 | 1.36 | 1.37 |
| Total direct costs (per animal place/year) | 8.68 | 6.13 | 13.58 |
| Labour costs | 0.32 | 0.32 | 0.32 |
| Housing costs | 1.30 | 1.30 | 1.30 |
| Total costs (per animal place/year) | 10.30 | 7.74 | 15.20 |
| Minimum costs (per kg/living weight) | 0.86 | 1.07 | 0.79 |
| Minimum costs (per kg/carcass weight) | 1.43 | 1.99 | 1.10 |
| Minimum costs (per animal) | 2.18 | 1.64 | 2.05 |
| Maximum selling price (kg living weight) minus minimum costs [2)] | 0.09 | -1.24 | 0.76 |

[1)] The differences in feed costs result on the one hand from differences in feed intake: faster-growing animals eat more. Furthermore, feed quality also affects the price: the lower a chick's growth potential, the better they can handle a poorer and therefore cheaper feed.

[2)] This concerns the real maximum price for fillet and sausages, averaged for March 2018, as requested by Schütz et al. (2018) from AMI (AGRARMARKT INFORMATIONS-GESELLSCHAFT).

The last line in Table 6.4 (maximum selling price on the market minus minimum costs, both per kg living weight) shows that, under the given assumptions, there is a remaining margin of €0.76 per kg (spread over the chain) for rearing broilers, and a limited margin (€0.09 per kg) for rearing Lohmann Dual layer males (dual purpose chickens), and that the rearing of layer males from a regular layer breed leads to a negative margin €1.24 per kg.

The last line in Table 6.5 (maximum selling price on the market minus minimum costs, both per kg living weight) shows that, under the given assumptions, the organic rearing of Lohmann Dual layer males results in a good margin, and that the same is true for the organic rearing of layer males from a regular layer breed, reared up to 20 weeks (with a final weight of approximately 2.6 kg). Consumers who purchase organically produced chicken meat are therefore prepared to pay a much higher price, whereby the broiler's weight plays an important role in being able to realise a margin.

In the current practice, layer males from regular layer breeds are not reared up to 20 weeks, because this can lead to aggression problems and the feed conversion in the last weeks is too unfavourable. At present, layer males are reared up to 12-14 weeks.

***Table 6.5*** *Production costs and minimum costs of organically rearing cockerels from dual purpose and layer breeds up to 10 and 20 weeks (Schütz et al., 2018).*

| Type of animal | Lohmann Dual | | Lohmann Brown | |
|---|---|---|---|---|
| Production duration | 10 weeks | 20 weeks | 10 weeks | 20 weeks |
| # rounds/year | 4.73 | 2.48 | 4.73 | 2.48 |
| Feed conversion ratio | 2.0 | 3.8 | 2.4 | 4.0 |
| Living weight (kg/animal) | 2.54 | 4.16 | 1.53 | 2.90 |
| Carcass weight (kg/animal) | 1.52 | 2.704 | 0.82 | 1.75 |
| Chick price (per bird) | 0.37 | 0.37 | 0.25 | 0.25 |
| Costs (per animal place/year) | | | | |
| Day-old chick | 1.75 | 0.92 | 1.18 | 0.62 |
| Feed [1)] | 9.76 | 15.15 | 6.27 | 10.46 |
| Other direct costs | 1.37 | 1.40 | 1.35 | 1.36 |
| Total direct costs (per animal place/year) | 12.88 | 17.46 | 8.80 | 12.44 |
| Labour costs | 0.32 | 0.32 | 0.32 | 0.32 |
| Housing costs | 3.41 | 3.41 | 3.41 | 3.41 |
| Total costs (per animal place/year) | 16.60 | 21.19 | 12.52 | 16.16 |
| Minimum costs (per kg/living weight) | 1.38 | 2.05 | 1.73 | 2.24 |
| Minimum costs (per kg/carcass weight) | 2.30 | 3.16 | 3.21 | 3.73 |
| Minimum costs (per animal) | 3.51 | 8.54 | 2.65 | 6.52 |
| Maximum selling price (kg living weight) minus minimum costs | 0 | 2.01 | 0.08 | 1.30 |

[1)] The differences in feed costs result on the one hand from differences in feed intake: faster-growing animals eat more. Furthermore, feed quality also affects the price: the lower a chick's growth potential, the better they can handle a poorer and therefore cheaper feed.

[2)] This concerns the real maximum price for fillet and sausages, averaged for March 2018, as requested by Schütz et al. (2018) from AMI (AGRARMARKT INFORMATIONS-GESELLSCHAFT).

Giersberg et al. (2019) compared the behaviour and performances of dual purpose hens (Lohmann Dual, LD) to those of a layer breed (Lohman Brown plus, LB+). To this flocks of 1850 not beak-trimmed hens were kept in aviaries. Over three laying cycles, the same pattern emerged: the LB+ had a higher egg production and better feed conversion ratio, but also a higher mortality and more feather and skin damage due to pecking. Röhe et al. (2019) studied the performances of Lohmann Dual hens fed with a standard feed and the same hens fed with a feed that was diluted by 10% in terms of energy and nutrients. The hens that were fed the diluted feed had a lower body weight, but a better feed conversion ratio, and a higher egg production. The results of both studies show that dual purpose chickens are not prone to injurious pecking behaviour and can handle a lower-energy feed. As also concluded by Giersberg et al. (2019), this may offer perspectives for using waste flows to feed dual purpose hens.

# 7 Other relevant aspects concerning the four routes

Chapter 6 describes the practical implementation of each route, while this chapter describes various related aspects.

## 7.1 Embryonic development in the hatching egg

A few studies have focused on embryonic development in the hatching egg, and more specifically on sensory development. From Day 0 of the incubation process, an embryo is a living being. However, its senses are still rudimentary, and its brain and nervous system have not yet started to develop. At some point, this development is sufficiently advanced to allow the embryo to notice stimuli from its environment. Rosenbruch (1997) indicates that sensory development does not suddenly occur from one day to the next, but is rather a sliding scale. In this context, the development of nerves and muscles cannot be seen separately from one another. After four days of incubation, spontaneous motor activities can already be observed, and electric activity takes place in the spinal cord. Before Day 6 or 7, a chicken embryo most definitely has no sensitivity. However, the sensory systems already start to function in the first half of the incubation process. The skin receptors for touch, pain, cold and heat start working from Day 7 onwards, and the first reflexes can be measured around the same time. The complexity of the nervous system strongly increases between Day 8 and Day 10. Specialised responses, such as opening the beak, closing the third eyelid in response to stimulation of the cornea, and eyelid movements following light stimulation, begin around Day 15. The author also indicates that reactions to light have been observed as early as Day 9. Finally, he indicates that the blood vessels formed by the egg outside the embryo do not contain any nerve conduction, and are therefore not sensitive.

Balaban et al. (2012) studied chicken embryos of different ages in a quiet environment, and in response to hearing specific chicken sounds that are important to chicks. They divided the embryos into age categories. In the age category of 15.5-16.5 days of incubation, they did not observe any higher brain activity in the embryos. These embryos did move, but there was no relation between movement and brain activity, and they did not respond to sound stimuli. In the category of 16.5-17.5 days of incubation, the authors did observe higher brain activity, and from 17.5 days of incubation onwards, all embryos displayed higher brain activity. At this stage, brain activity and movements were measured corresponding to REM and NREM sleep. The embryos also responded to administered sounds with changes in brain activity. This study suggests that although brain activity can be measured before 16.5 days of incubation, this is random activity, and that the embryo most likely does not yet display real stimulus perception. It is only after 16.5 days of incubation that signs of higher brain activity were observed, namely the processing of a sound stimulus.

In an extensive literature review, Bartels et al. (2020) provide an overview of embryonic development and, more specifically, nociception and pain perception in chicken embryos. Nociception is defined in this context as "the sum total of neural mechanisms that register harmful thermal, mechanical and chemical pain signals, and that cause motor, vegetative and behavioural responses in the central nervous system, such as muscle reflexes, increased blood pressure, or a breathing response." In general, it is considered that pain perception is only present once the nervous system is sufficiently developed, so when the nerve impulses can be led to the brain, but the authors indicate that there are some doubts concerning this. They indicate that the development of the central nervous system in the chicken embryo is a dynamic process that begins on Day 2 of the incubation process and continues until the chick hatches on Day 21. Spontaneous movements of the embryo can be registered starting from Day 3 of the incubation process, reactions to tactile stimuli occur starting from Day 6, but until Day 8, no skeletal muscle and EEG responses to administered stimuli could be observed, which points to the physiological incompleteness of the sensorimotor and neuromuscular circuits in most parts of the body at this point. Such responses were only observed between Day 8 and Day 10 of the incubation process. In this development phase, the locomotor activity of the embryo also increases, and starting from Day 10, electric discharges can be registered that point to an increase in muscle

activity, with head and eye movements, and some receptors can also be detected in vivo in domesticated chicken embryos. Taste and sound responses are observable starting on Day 12, facial responses on Day 18, and smell sensation on Day 20 of the incubation process. The authors indicate that this development line makes it difficult to define a specific moment when the embryo starts to experience pain sensations. They indicate that although the first sensory afferent nerves already develop in the chicken embryo on Day 4 of the incubation process, a synaptic connection with the spinal cord is not available until Day 7, pointing to the fact that pain perception is impossible until this day.

Based on this research, we can distinguish three phases:
1. 0 – 7 days of incubation: In this phase, researchers agree that the embryo is not sufficiently developed to have any stimulus perception.
2. 8 – 16 days of incubation: In this phase, there is some measurable brain activity, and in some cases a reflex to a stimulus can be measured. However, the researchers are not unanimous on whether this is an automatic reflex or a 'conscious' response and thus whether the stimulus actually reaches the brain.
3. 17 – 21 days of incubation: In this phase, there is higher brain activity in response to sound stimuli administered. In this phase, the embryo is therefore capable of actually noticing the administered stimuli.

## 7.2 Welfare

As a rule, animal welfare is only considered to be a factor once a chick has hatched. In the period before this, the chick grows from a few cells to an embryo and finally to a fully grown chick. Interventions on fertilised eggs therefore tend to fall under the ethical debate. However, once an embryo has a certain degree of awareness of external influences, welfare aspects may also become relevant.

With respect to animal welfare, the issue of the day-old male chicks involves a number of aspects that must be taken into consideration:

With respect to the embryos:
- Development of the embryo's perception
- Culling of embryos

With respect to the welfare of layer males:
- Culling of day-old male chicks
- Rearing of layer males
- Transport of layer males
- Slaughtering of layer males

With respect to the welfare of the other animals:
- Laying hens
- Bird shelters, zoos, raptors, reptiles
- Rodents (mice, rats, guinea pigs)

### 7.2.1 Embryos

Once embryos are older than 7 days, it cannot be excluded that they feel stimuli, and can therefore suffer in the process of dying (Rosenbruch, 1997; Balaban et al., 2012), see also Section 7.1.1. Techniques applied on Day 9 are less controversial than the AAT technique, which is performed on Day 13 or Day 14 of the incubation process. In that situation, the culling of embryos must therefore be done with care.
Bartels et al. (2020) indicate that according to the Institutional Animal Care and Use Committee (IACUC, 2020) the methods to be used for euthanising incubated eggs depend on the incubation phase. Embryos in eggs that are less than 80% incubated can be culled by exposing them for minimum 20 minutes to $CO_2$, cooling them to below 4°C for at least 4 hours, or by freezing them. For

embryos in eggs that are more than 80% incubated, euthanasia must be performed using an overdose of anaesthetic, minimum 20 minutes of exposure to $CO_2$, or decapitation.
Aleksandrowicz and Herr (2015) indicate that the usual method for ending experiments with incubated eggs is to freeze the egg. However, according to the 'American Veterinary Medical Association (AVMA) guidelines on euthanasia' quoted by the authors, this is not an accepted method for embryos from eggs that have been incubated for longer than 10 days. These eggs should be euthanised using an overdose of anaesthetic, decapitation, or long-term (> 20 minutes) exposure to $CO_2$. The last two methods each have their disadvantages, which is why the authors conducted a pilot with culling embryos by administering an overdose of Pentobarbital in the extra-embryonic bloodstream. After 5 minutes, 88% had died, but it took 20 minutes for all embryos to die. This method is therefore time-consuming and less suitable.
Zumbrink et al. (2020) investigated whether embryos could be anaesthetised using electricity. They used eggs incubated for 13 days, with a 110 Volt and 50 Hz current and two electrodes, which they attached to the top and bottom of the egg through the shell, thus bringing them into contact with the egg fluid. Electric current was administered for two seconds, which turned out to be enough to stun 99.3% of the embryos. This technique was integrated in the Stunny (Wenzlawowicz, 2021), which was developed by AAT and is currently operational. The device stuns embryos and then puts the eggs through a slicer, thus killing the embryos. The Stunny can process approximately 10,000 eggs per hour.

### 7.2.2 Layer males

***Culling of day-old male chicks***
The European Regulation 1099/2009 (E.U., 2009) indicates which culling methods are permitted for various animal species. Chicks up to 72 hours and embryos in the egg may be culled using maceration, which is described as 'immediate crushing of the entire animal', in which context the following is added: "This method leads to the immediate maceration and immediate death of the animals. The capacity of the device must be sufficient to kill all animals immediately, even when dealing with large numbers." For day-old chicks, other methods listed include $CO_2$, a mix of $CO_2$ and inert gases (Argon or nitrogen), or inert gases alone. In this context, requirements apply concerning the unit in which the animals are gassed (to prevent them being bruised or injured for example), and the gas concentration must be well monitored and registered, with an alarm system that goes off in case of a too low concentration. The measurement data must be retained for a minimum period of one year.
In the Netherlands, the culling of day-old male chicks is done using $CO_2$, which is generally considered to be the most animal-friendly method. This is done in accordance with the requirements set by the European Regulation 1099/2009 (E.U., 2009). The NVWA is responsible for monitoring this process. In addition to these rules, many hatcheries give their employees additional working instructions to avoid too many animals being gassed per unit, and to ensure that the required $CO_2$ concentrations are met, and the chicks are really all dead. Also, strict hygiene protocols are applied to prevent contamination (procedure and logistics at the hatchery).
In many countries, both methods (maceration and gas) are used. Although maceration is considered to be less animal-friendly, it is a highly effective way to kill the chicks very quickly. Not all countries euthanise the chicks in the same conditioned and controlled way as the Netherlands.

***Rearing of layer males***
The simplest housing used for layer males is a henhouse with 100% litter floor (as in a broiler house). This type of housing is often used for rearing day-old male chicks for a number of reasons:

- All the required equipment, such as feed and water lines, is already available, with only a few additional facilities being needed, such as A-frames with perches.
- As a result of the unfavourable market situation (in 2020/2021) as a result of the COVID-19 pandemic, broiler farmers (partly in the Netherlands, but mostly in Poland) were showing interest in rearing day-old male chicks.

These broiler houses are usually mechanically ventilated and have no Wintergarden and no foraging area. They therefore do not meet the requirements for organic farming (see Section 5.1). Although KAT requires perches and daylight, a transition period has been set for this (until 1-1-2023), meaning

that broiler houses that do not yet meet this requirement can still take part in KAT (for details, see Section 5.2).
Since layer males are much more active, and would in practice end up sitting on the water lines, there was at first a lot of damage to these lines, with pipes giving way under the cockerels' weight. KAT forbids the use of an electric wire to keep the cockerels off the lines, so that other solutions were sought and the pipes were strengthened.

As a result of shifts on the market, rising demand, and the partial transition of Dutch broiler farming to the production of BLk 1 Star, there are currently few $m^2$ of broiler house surface area available in the Netherlands for the rearing of layer males.

In principle, any type of housing used for rearing laying hens can also be used to rear layer males, such as rearing aviaries, NivoVaria/Jumpstart and litter/slatted floor houses. In 2020, Raiffeisen Ems-Vechte even used vacant duck houses. However, because of the lower number of feed and drinking water facilities in these houses, they were only used to house 8 animals/$m^2$ instead of the usual 18-19 (Gnauk, 2020).

According to the new EU organic regulation, mobile poultry houses can be used to rear layer males, on condition that they are frequently moved during the production cycle, so that the animals have continuous access to vegetation, and the houses are at the very least moved between two flocks of poultry (E.U., 2020).

Cockerels from layer breeds are active animals that differ in behaviour from the calmer broilers. They are quite stress-sensitive, and tend to be frightened easily. They have a tendency to smothering in a corner (drumming), leading to high mortality. Adjusting management to match their needs is crucial in this context. Practical experience has shown that the rearing of layer males requires different knowledge than the rearing of broilers: when ill, layer males tend to only display symptoms very late, so that one must intervene quickly to avoid things getting out of hand. The layer males' fearful attitude requires a different approach than with broilers. Around 9 weeks, aggression and pecking may arise. To prevent this, it is important to provide the right nutrition and some distraction materials.

The most important causes of mortality are aggression, smothering, and gut problems. If these problems can be prevented, the loss rate per flock can be very low. Over the entire rearing period, loss can remain below 5%.

The most important welfare problems in this type of farming are pecking, aggression, and drumming, and to a slightly lesser extent gut problems. To address these problems, requirements can be set for the following:

- Stocking density: Hands-on experts indicate that a stocking density of 18-19 animals per $m^2$ seems to work better to prevent pecking and aggression than the 20 animals/$m^2$ norm set by KAT.
- Design elements: Perches and platforms have a positive effect, with the animals showing a preference for platforms.
- Good-quality feed that is customised to the animals' age and needs prevents much aggression, and also has a positive effect on combating gut problems.
- Alfalfa or chopped straw may positively affect gut health. In addition, these materials work well as enrichment material, which is needed to prevent aggression and pecking.
- Preventing coccidiosis using coccidiostats or vaccines guarantees better gut health and a lower loss rate, and can also help reduce drumming.

Some aspects are hard to set requirements for, while being crucial in guaranteeing the layer males' welfare.

- Many sectors require a minimum light level. A good light level is also important for layer males. As long as there is insufficient knowledge concerning effective management to counter aggression and accompanying injuries and loss, it seems important to have an option for dimming the lights.

- Many welfare problems can be prevented if the poultry farmers have affinity with layer males and the right knowledge on how to rear them. Suppliers and advisors should also be knowledgeable about these things. Newcomers should acquire this knowledge before they start rearing layer males.

If, when applying in ovo sexing, male chicks are accidentally born, these day-old male chicks are reared up to 12 to 14 weeks. This procedure is an agreement with KAT and the buyers to be able to guarantee that no day-old male chicks will be culled in the production of OKT hens.
These day-old male chicks are reared as much as possible as a separate layer male flock in a rearing or broiler house. Rearing these layer males together with the (female) pullets leads to unrest among the pullets, and poses difficulties due to the different management style required for rearing layer males as opposed to rearing pullets. Rearing the layer males separately makes it easier to meet the specific requirements of this rearing practice.

In terms of behaviour, dual purpose chickens tend to be calmer than laying hens, but more active than broilers. Giersberg et al. (2019) indicate that the risk of feather pecking is lower in dual purpose chickens and that the cockerels are calmer than those of regular layer breeds. When rearing layer males from dual purpose breeds, it is also recommended to meet the above-mentioned requirements essential for guaranteeing the welfare of layer males, but problems are less likely to occur. For more information on dual purpose chickens, see Section 6.4.

***Transport of day-old male chicks and reared layer males***
Layer males are transported twice: once as day-old chicks from the hatchery to the rearing farm and once as reared layer males from the rearing farm to the slaughterhouse.
The transport of day-old male chicks happens in climate-controlled units closed off from the external environment. No water or feed is provided. For day-old chicks of broiler breeds, the literature indicates that providing feed and water immediately after hatching has a favourable effect: better digestion of yolk remnants, less weight loss, better immunity build-up, and a lower loss rate (de Jong et al., 2016)). EFSA (2011) indicates that the chicks can live on their yolk sac during transport for a period of 24 hours, on condition that transport takes place within 72 hours of hatching. This is why the European transport regulation sets this condition for chicks as well (E.U., 2005).
Part of the day-old male chicks are transported to rearing farms in the Netherlands, Germany, or to a lesser extent Belgium. The majority of the day-old male chicks are transported over a longer distance, usually to Poland.

The transport of reared layer males from the rearing farm to the slaughterhouse is done in crates or containers. These are put on trucks, where climate conditions are hard to control. No water or feed is provided if the transport time is shorter than the 12 hour-period set by the European transport regulation (E.U., 2005). If long-distance transport is required, it is therefore better to transport day-old male chicks than reared layer males, since climate conditions for the transport of day-old male chicks are easier to control than for reared layer males.
Once reared, the layer males are loaded and transported to the slaughterhouse. Only a small portion can be slaughtered in the Netherlands or in Belgium. Transport distances are limited in that case. However, most of the layer males reared in the Netherlands are transported to Poland to be slaughtered there. From an animal welfare perspective, it is preferable to minimise the transport distance for reared layer males. From this perspective, it is best to slaughter the cockerels in the country where they are reared. Assuming that hatching takes place in the Netherlands, rearing and slaughter in the Netherlands is the best combination, with the second-best option being transport of day-old male chicks to other countries, such as Poland, to be reared and slaughtered there.

### 7.2.3 Welfare of other animals

***Laying hens***
In ovo sexing involves applying techniques to all hatching eggs to establish the embryo's sex. One of these techniques is non-invasive, which means that nothing happens to the egg. Chicks from these eggs are the same as chicks from non-sexed eggs. The non-invasive sexing method can only be reliably applied around Day 13-14 of the incubation process.

In invasive sexing, a hole is made in the egg shell to extract some liquid from the egg. Theoretically, this could affect the quality of the chick and therefore its welfare. It could result in infections that enter the egg through the shell opening, or a negative influence on embryo development due to shell damage. Also, where sexing cannot be performed 'in-line', the eggs are placed in another, temporary incubator for the sexing procedure. Finally, there are eggs for which sexing yields unclear or no results. These eggs are not incubated further. This therefore also leads to the loss of female embryos. All in all, in ovo sexing leads to lower hatching percentages and therefore fewer day-old female chicks. This does not fall directly under chick welfare, but it does fall under ethical considerations.
At the moment, the impact of in ovo sexing on day-old hens after they hatch seems to be minimal, but this has not yet been independently studied at the time of writing this report. Hatcheries do report a higher loss rate (about 0.5%) of chicks in the 1st week of life. Due to initial estimation errors and the resulting hatching shortages, lower-quality chicks were less rigorously screened out beforehand. This led to poorer rearing results and perhaps lower-quality laying flocks. However, an adequate response to these experiences seems to have solved these problems.

***Zoo animals, raptors, wild birds***
Dead day-old male chicks are used as food animals for various zoo animals, raptor farms and shelters for injured/sick wild birds, and they play a crucial role in feeding wild animals in captivity. As animal feed, day-old male chicks offer some major advantages:

- Good, consistent composition
- Good acceptance (wild animals do not eat processed meat, but need to be given recognisable prey)
- Free of germs (salmonella)
- Stimulates natural animal behaviour

Zoo animals and raptors are usually non-domesticated animals, fed in the most natural way possible. Processed food is mostly poorly accepted, because the animals do not recognise it as food. This is especially an issue with raptors, both at raptor farms and in zoos and bird shelters. Offering these animals processed feed in the form of sausages is not an option, since they do not accept it, and weaken as a result. In the case of birds in bird shelters, this will result in their death. Switching to other food sources, such as mice, rats, or guinea pigs (if day-old chicks are no longer sufficiently available), therefore leads to acceptance problems.

***Rodents (mice, rats, guinea pigs)***
If day-old chicks are no longer available, other animal species will have to be used to meet the demand for small prey from zoos, raptor farms and bird shelters. These animals will have to be bred specifically for this purpose, leading to an increase in this type of farming. There are already applications for the creation of mice farms. To guarantee the same hygiene status, these companies have to work at SPF level. There are so far no regulations for this type of farming. There are as yet no environmental requirements and no guidelines with respect to health and hygiene. To guarantee these animals' welfare, farming, feeding, and management must be adjusted to their needs. Rearing them up to a usable weight (approximately 20 grams) takes approximately 12 weeks.
In terms of weight, it takes two mice to replace a day-old chick. Due to variation in diet and growth, mice are a less uniform product than day-old male chicks.
Once they reach their desired weight, they must be transported and culled in an as animal-friendly way as possible.

## 7.3 Sustainability/Environment

An article in DGS (Bessei, 2021) addresses the environmental aspects of rearing layer males, compared to regular broilers.
Table 7.1 offers a comparison of the key figures for rearing to the same final weight.

Compared to broilers, the author comes to the conclusion that layer males lead to 3-4 times higher NH3 emissions, and 3 times higher $N_2O$ emissions. Based on the assumptions below, the author calculates emissions per animal of 48 g NH3 and 0.3 g $N_2O$ for the rearing of layer males, compared to 14.39 g NH3 and 0.09 g $N_2O$ for broilers. Due to the higher feed intake, the rearing of layer males

leads, compared to broilers, to up to 2.5 times more $CO_2$ production per kg, expressed in CO2 equivalents (resp. 3.09 and 1.22 $CO_2$ eq per kg). If all day-old male chicks from layer breeds in Germany were to be reared, this would lead, according to the author, to an increase in $CO_2$ production of 334,000 $CO_2$-equivalents, an increase in land use of 60,000 ha, and an increase in water use of 4.69 million $m^3$.

***Table 7.1*** *Basic comparison data of layer males and fast-growing broilers for the same final weight.*

| Reference | Broiler | Layer male |
|---|---|---|
| Production duration (days) | 32 | 90 |
| Final weight (living), g | 1,755 | 1,750 |
| Carcass weight (%) | 72 | 58 |
| Raw protein of whole animal (%) | 19.6 | 22.5 |
| Feed conversion ratio (kg/kg) | 1.56 | 3.43 |
| Feed intake (g/animal) | 2737.8 | 6000 |
| Feed intake of Starter (g/animal) | 1,218.8 | 250 |
| Feed intake of Grower I (g/animal) | 1,519 | 1,500 |
| Feed intake of Grower II (g/animal) | 0 | 4250 |
| Raw protein of Starter (%) | 22.5 | 20.5 |
| XP-Grower I, % | 20.5 | 19.5 |
| XP-Grower II, % | - | 18.5 |
| Stocking density (kg/$m^2$) | 39 | 35 |
| Rounds/Year | 9 | 3.6 |
| Number of animals per $m^2$ and year | 198 | 72 |

Other assumptions (for example 2500 gram at 40 days for broilers and 1300 gram at 84 days for layer males) would have an even less favourable effect on emissions per animal per round (than appears from this table) and only strengthen the author's conclusion concerning sustainability.

The author also indicates that rearing layer males instead of culling day-old male chicks requires an increase in water use and more housing surface area. All in all, rearing layer males has a negative effect on various environmental aspects.

## 7.4 Logistics, planning, and organisation in the chain

### 7.4.1 The logistics of hatcheries

For many years now, logistics have been an essential aspect of incubating eggs, and they are becoming increasingly complex due to the growing number of factors that must be taken into consideration, and the fact that decisions must be made increasingly early.
OKT has added a number of extra elements to the logistics of the already complex incubation process (Figure 7.1). The first of these is of course in ovo sexing, which will not be performed on all eggs. First of all, the organic sector has indicated that it does not intend to approve this procedure, opting instead for the rearing of cockerels. Secondly, in ovo techniques cannot be used on the eggs of young and older mother hens. These eggs are therefore incubated normally, so that in the event of a ban on culling day-old male chicks, these cockerels would have to be reared as yet (or the eggs would have to be incubated abroad).
When using sexing, for a portion of the eggs, it is impossible to determine whether they contain a male or female embryo. This 'undecided' category can still be allowed to hatch to a greater or a lesser degree. If one applies a strict selection, fewer cockerels will be born, but some hens will also be erroneously removed from the incubation process. If one applies a less strict selection, fewer hens will be erroneously screened out, but more cockerels will be born. Irrespective of the selection level, a certain number of cockerels will be born.
The reason for this is that sexing also has a certain margin of error. This means that a number of cockerels will be born anyway. To avoid being confronted with too many cockerels to be reared, the chicks are also sexed by hand at the hatchery.

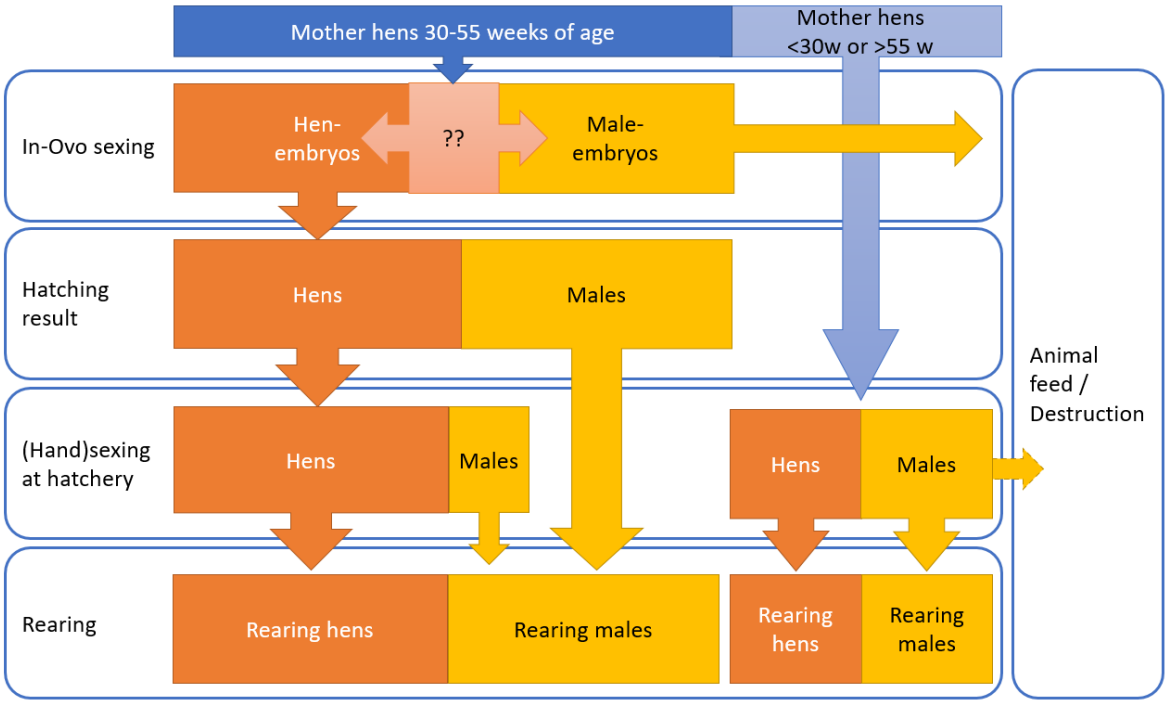


***Figure 7.1*** *Logistics at the hatchery.*

With the new demand for OKT laying hens, a number of logistics aspects play a role:

***Enough pullets***

As a rule, when sexing after hatching, you need 2.5 hatching eggs to produce one laying hen. This has to do with the hatching percentage in the incubator, selection after hatching, and the fact that 50% of the chicks are male.

Within ovo sexing, the production of one OKT laying hen requires 3.5 hatching eggs. This additional hatching egg is needed for three reasons:

- Sexing reduces the hatching percentage of the hatching eggs (this does not apply to AAT).
- In some hatching eggs, sexing produces unclear or no results, and most of these eggs are removed from the incubation process.
- Sexing has a certain margin of error. This means, on the one hand, that a certain number of cockerels are born, and, on the other hand, that a certain number of hens are erroneously removed from the incubation process.

This means that the hatchery has to know beforehand whether a flock will have to be sexed in ovo. If the answer is yes, they have to place more hatching eggs in the incubator. In the early days, hatcheries were not sufficiently aware of this, with the result that too few female chicks were born to produce the required number of hens. To compensate for these shortages, lesser quality eggs were screened out less stringently. There is now more awareness around this matter, but because of more variation in hatching than previously, the risk of having too few or indeed too many female chicks remains. Too many female chicks can also be a problem, if the maximum stocking density is reached during rearing, and euthanising is no longer permitted.

Another disadvantage of OKT is that it is less easy to shift rearing flocks around. For example, if poultry farmer A needs some rearing hens in the short term, he could previously select them from any of the available rearing flocks. Now, some of these flocks are OKT and some MKT (Mit Kücken Töten). If poultry farmer A has already agreed to sell OKT eggs, he can only choose from the available OKT flocks, since the MKT flocks are not an option. A poultry farmer who wishes to have an MKT flock has equally limited choices: available OKT rearing flocks are so much more expensive that they cannot reasonably be purchased to produce MKT eggs.

***Rearing of layer males***
It is not possible to meet the current German OKT requirements simply by performing in ovo sexing on hatching eggs. An alternative, partly imposed by the insufficient capacity of the selected in ovo technique, is to hatch all eggs and rear the cockerels. The hatchery then has to find a solution for the cockerels: either rear them themselves, or have them reared elsewhere, either in the Netherlands or abroad.
The German market requires in the case of OKT hens that the actual brothers of these hens be reared, so not an equal number of cockerels from a random other flock. This imposes logistic limitations. In addition, the hatchery has to produce a certificate for the hen flock, in accordance with KAT regulations, specifying that the cockerels were correctly reared or not born.
Even with in ovo sexing, some cockerels will still be born. These may not be culled and therefore have to be reared. The incubation process will therefore always involve the production of some cockerels. This means that the hatchery has to rear these cockerels (or have them reared). In addition to the costs of in ovo sexing, hatcheries also have to bear the costs of rearing the cockerels.

***Costs of pullets***
The OKT technique costs money, and rearing cockerels also costs money. This must be compensated for with a higher pullet price. A poultry farmer therefore has to pay higher costs per pullet, in exchange for which he will want proof that the hens really are OKT, since he will need this proof to be able to sell his eggs. Since poultry farmers are not always able to pay these higher costs straight away, in practice, financial arrangements are made. These arrangements are partly made by egg packing stations, but partly also by hatcheries.

***Export***
A substantial portion of day-old hens hatched in the Netherlands are exported (see Section 4.4), mostly to Africa, where they are reared to produce eggs for the local market. For the export, a surcharge for OKT chicks is not realistic, since the buyers will be unwilling or unable to pay it. These chicks are therefore produced as MKT. If OKT production is made compulsory, this export from the Netherlands will stop. Some Dutch hatcheries already have hatching capacity abroad (for example in Belgium) or are planning to create such capacity (for example in Hungary or Turkey). The expectation is therefore that they will continue to produce MKT chicks abroad if the Netherlands imposes a ban on the culling of day-old male chicks. In case of a European ban, this operation might relocate outside Europe.

***Interchangeability***
In producing chicks, hatcheries have to take into account a number of aspects:
- Per laying hen farmer, a newly reared flock should be drawn as much as possible from a single flock of parent animals;
- The animal type should match the laying hen farmer's requirements (white/brown laying hens, breed);
- The date on which the laying hen farmer needs the new flock;
- The available rearing capacity should match the demand both in terms of number of chicks and in terms of rearing system;
- Any other wishes of the layer poultry farmer (rearing system, rearer, feed, vaccines).

All these wishes make it quite a puzzle to match demand and supply. This is further complicated by disruptive factors, such as poultry farmers needing pullets earlier, due to AI culls or other calamities, or poultry farmers who cannot purchase the pullets they ordered, for example due to a barn fire. The more interchangeable the flocks, the easier it is to make the puzzle fit. OKT is a complicating factor in this context. Since OKT hens are substantially more expensive than MKT hens, OKT and MKT flocks are not interchangeable.

### 7.4.2 Logistics of egg packing stations

In trading eggs, egg packing stations have to distinguish not only between white and brown eggs, but also between eggs from different origins (husbandry system), and with different quality labels. With respect to the production system, there are legal provisions to be met, and the code of the production system is stamped on the egg, to avoid batches of eggs being accidentally exchanged, and to make it

possible to track them in case of problems. In addition to these legal requirements, various private quality labels also impose their own requirements. To some extent, these requirements overlap and can be combined (for example IKB and KAT), but every quality label also has its own specific requirements.
Depending on the requirements imposed by a label, the cost price of an egg goes up or down. OKT is a particularly expensive operation, because the cost price of the hens is substantially higher than for MKT hens.
Theoretically, there should be no objection to bringing eggs from a stricter quality label into the standard circuit, but doing so means that the higher costs for this stricter label will not be reimbursed. This is why this is only done in case of an emergency, for example in case of an error in estimate and a resulting surplus of eggs from a more expensive quality label. This does however require packing stations to correctly estimate what the market wants. This is hard to do, because agreements with laying hen farmers usually have to be made many months before the eggs are produced. In the case of OKT, this is even more extreme, since these agreements have to be made before the chicks are born. This therefore requires even more insight into the market, and it involves an even higher risk for the packing station. This implies a greater need for fixed, long-term partnerships, so that the planning involves fewer unknowns.

#### 7.4.2.1 Labels and logistics

Eggs are sold under various labels. With respect to the various forms of husbandry, there are European and national laws that determine what conditions must be met to sell products under a given label (for example barn system, organic).
In addition, private labels have been created that focus on animal welfare, nutrition, the environment, or other aspects (for example KAT, BLk, vlOG, IKB).
Appendix 1 provides an explanation of the most important labels. For packing stations, it is important to make sure that the egg flows produced according to these labels are actually sold under these labels. Some exchange between flows is possible: eggs that meet stricter label requirements can be sold under a less strict label. However, this is only done when there are shortages or surpluses, and usually leads to less financially attractive constructions. This requires efficient logistics. Every new label not only adds a new logistics flow, but also makes it harder to exchange eggs between various flows.

## 7.5 Shifts in the egg market

The German OKT regulations forbid the culling of day-old male chicks. However, this only applies to chicks incubated in Germany, not those incubated abroad. This means that German layer poultry farmers who wish to sell MKT eggs can still purchase MKT laying hens, but they have to do so abroad. It also means that the Netherlands can still export MKT hens or eggs to Germany.
Just as in the Netherlands, German laying hen farmers produce some table eggs, and some eggs for the industry. Since the industry is not yet interested in OKT, they will presumably not be willing to pay a surcharge for such eggs. This leaves German laying hen farmers who produce industry eggs with two options: Import MKT hens and continue to produce industry eggs, or switch to OKT and produce table eggs. The expectation is that a large portion of these farmers will opt for producing table eggs for the German market. This means that part of the Dutch export of table eggs will disappear and be replaced by the production of OKT table eggs by German poultry farmers. On the other hand, this will create more room on the German market for Dutch MKT industry eggs. Another development in Germany concerns the increase in local sales (doorstep sales and village shops) of cheaper eggs, without OKT requirements, which requires importing MKT animals.

Dutch farms that cannot meet the requirements for the production of table eggs (usually somewhat older farms) are currently producing industry eggs. We do not expect an OKT surcharge to be charged for industry eggs. Since these companies do not, in the event of a ban, have the option of purchasing OKT hens, they will have to source MKT hens from abroad. The same applies to poultry farmers who have not been offered a suitable agreement for the purchase of OKT eggs, or who do not wish to take the additional risks inherent in this kind of purchasing agreement.

## 7.6 Financial risks in the chain/revenue model

### 7.6.1 Risks for layer poultry farmers

Layer poultry farmers usually order their next flocks a long time before the current laying hen flock reaches the end of its production period. After all, new hens first have to be hatched and reared. This covers a period of 20 weeks, excluding preparation time (negotiations with the hatchery, space at the hatchery, space for rearing). The decision to replace a flock is linked to a number of aspects:

- The current flock's performance; if it is good, the flock can be kept on longer.
- Feed and egg prices: if feed prices are high and egg prices low, a flock needs to be replaced sooner; if egg prices are high, the hens can be kept on longer.
- Contract with the egg trade.

When ordering a new flock, the above-mentioned factors are partly known (flock performance, current feed and egg prices), but in part, these are future expectations that are hard to predict.
The introduction of OKT/MKT makes it even harder for poultry farmers to make decisions, and they have to do so at an even earlier stage. The reason for this is that the decision for OKT or MKT depends on the type of contract the farmer can sign for his eggs. Whereas he would normally sign this contract once the rearing has already begun or the eggs are in the incubator, he now has to do it even sooner. After all, the decision for OKT or MKT involves a financial difference that is too big to be able to decide without a purchase guarantee. Egg packing stations, which operate on the international market, already find it hard to guess what the future of OKT/MKT might look like; poultry farmers find it much harder still, while in most cases they are the ones who bear the financial risks.

If a poultry farmer decides to produce MKT eggs, he still has to arrange for these eggs to be sold. Here too, the question is whether the packing stations can use his eggs and want to offer him a contract. Although MKT carries fewer financial risks, this will no longer be the case if too many Dutch poultry farmers opt for this route and the market is flooded.

The cost price of a day-old hen (and therefore of a laying hen) whose brothers are not euthanised on Day 1 at the hatchery, is €3.50 to €4.00 higher than in the conventional method.
This increase in costs means that a layer poultry farmer would have to pay more or less double the current purchase price for a 17-18 weeks pullet. For an average-size company (approximately 40,000 laying hens), this represents, assuming €4.00 per hen, additional costs of €160,000 per round. Assuming a production period of approximately 18 months, for an average-size company, this amounts to over €100,000 of additional yearly costs per poultry farmer. The replacement market in the Dutch layer sector requires approximately 20 million laying hens per year. In case of a full transition from culling day-old male chicks to in ovo sexing or rearing layer males, the additional costs for the entire Dutch layer sector, based on €4.00 per hen, would amount to approximately €80 million per year.

To compensate for these additional costs (and accompanying risks), the market should structurally increase the price of an OKT egg by a minimum of 1½ euro cent. In the early days of OKT requirements from the German market, it was mostly the periphery (egg traders and hatcheries) that bore the financial risks by taking the costs of in ovo sexing or the rearing of day-old male chicks on their account. These financial risks are gradually shifting to the primary producers: the poultry farmers.

The need to meet the OKT requirements, in combination with this construction (earning back the additional costs via the egg price), means that poultry farmers are confronted with substantial risks, such as:

- The need to make timely agreements about the purchasing of OKT or MKT hens and price agreements about the sale of OKT eggs (even before the hatching eggs of the next flock of laying hens are placed in the incubator).
- The risk, in case of a disappointing production, of a higher percentage of type 2 eggs, or deviant egg weights (relatively longer period too small eggs in the beginning, or relatively soon too heavy eggs at the end of the laying period) that cannot be sold as OKT eggs.

- The risk in case of salmonella infection of an OKT laying flock (downgrading to industry eggs, without OKT prices). There is no regulation to cover these risks, other than that poultry farmers can insure themselves against it. However, such insurances are expensive, and therefore also involve an increase in costs.
- In case of a cull in response to an A.I infection of the OKT laying flock at his company. Although the value tables used for culls have been adjusted for this, the poultry farmer faces a greater risk of a longer vacancy period before a new OKT flock becomes available. There is no reimbursement for vacancy as a result of culling.
- In case of a long-term requirement to keep birds indoors due to the threat of avian flu, it is unclear whether eggs from OKT hens can be sold at the usual price, or whether they have to be partially or completely depreciated, potentially leading to an even greater difference in price.
- If OKT eggs sell less well than expected, and OKT-produced eggs have to be depreciated, it is unclear whether the purchasing agreements will still hold, or whether the poultry farmer will not, or not sufficiently, be compensated for the additional costs incurred.

Furthermore, if a general ban is imposed, there is a real risk that buyers of OKT eggs will see the additional requirement (of not culling day-old male chicks) as a legal precondition for negotiations, so that poultry farmers will not or only partly be reimbursed for the additional costs.

### 7.6.2 Egg packing stations

For egg packing stations, specifically, the following applies: to be able to respond flexibly to customer demand, packing stations need to be able to shift between different egg types, of course, to the extent that this is allowed by the legislation, for example by depreciating BLK* eggs (barn system with covered veranda) to barn eggs. The difference in purchasing price is substantially smaller in this case than the difference in purchasing price between OKT and MKT eggs. In case of depreciation from OKT to MKT, the costs of depreciation are high.

### 7.6.3 Hatcheries

Hatcheries are confronted with high costs for purchasing in ovo equipment. In addition, they have had to invest in logistic solutions, and face less flexibility in rearing flocks (OKT and MKT rearing). In the event of a ban on the culling of day-old male chicks, this limitation will not disappear, since they will continue to produce MKT flocks in their foreign branches.
The extent to which the national government financially supports in ovo innovators and users differs greatly per country. The German and French governments offer substantial financial support.

### 7.6.4 Egg-processing industry

For the egg-processing industry, OKT eggs are not an option, because the additional costs cannot be earned back, since there is as yet no demand for processed products containing OKT eggs. The egg-processing industry will therefore continue to purchase MKT eggs, at the lowest price available. If these eggs are not or not sufficiently available on the Dutch market, they will import them from abroad.

## 7.7 Processing of male eggs

Eggs that are marked as male via sexing are removed from the incubation process. As a rule, these eggs are homogenised and almost entirely transported to a specialised company to be processed into products such as pet food. A small part is destroyed. In the Netherlands, in ovo techniques are used that are applied at Day 9 of the incubation process. There are no further specific measures for killing the embryos; the eggs are simply cooled down and offered for further processing. Eggs that are removed from the incubation process using the AAT method have been incubated for 13 days, so that the embryos are already quite well-developed. These eggs are treated using the Stunny method. This device sends electric current through the egg via two needles attached to the egg's top and bottom.

This stuns the embryos. The Stunny is linked to a homogeniser (a 'crusher'), that crushes and homogenises the hatching eggs.

## 7.8 Sales of meat from layer males

The sales of cockerel meat is slow to take off. The cockerels usually do not have enough meat for parts production. They therefore have to be sold either as separator meat or as whole cockerels. There is at the moment more or less no demand for whole cockerels. The layer males of regular layer breeds do not have enough meat and are too expensive to be able to compete with broiler meat. There is a limited market for organically reared cockerels, but this is a niche product, and is expected to remain so. Interesting lessons could potentially be learnt from this limited market that can be translated to a larger scale if demand increases.

The German Rewe supermarket is selling products with cockerel meat. The Lidl also sells products with cockerel meat.
Since Germany has imposed the requirement that reared brother cockerels must be used for human consumption, they are, in case of not enough market demand, exported at a lower price to Africa, to be sold on the local market as whole cockerels. However, this hampers the local poultry meat production.

## 7.9 Selling dead day-old male chicks to zoos and as pet food

As indicated in Section 4.3, a large portion of day-old male chicks euthanised in hatcheries are sold as animal feed. The majority goes to raptor farms and bird shelters, and a smaller portion to zoos and the pet food industry.
Day-old male chicks (of 40-45 grams) are very much wanted and needed as food animal for shelters for wounded/ill wild birds, various zoos, and raptor farms, for a number of reasons:

Animal welfare:
- Offering prey (of which the skin must be broken) allows raptors to display natural behaviour; it is an enrichment of these animals' living conditions, and failing to offer such prey may lead to divergent behaviour such as stereotypy.
- Acceptance of prey, as natural food, by these animals plays an important role. Zoo animals and raptors are usually non-domesticated animals, fed in the most natural way possible. Although Kiezebrink is experimenting with special sausages for these animals, the raptors' degree of acceptance of this product remains very limited. By nature, these animals are not likely to eat anything that they do not recognise as food. They have to be very hungry to try different food sources. Especially in bird shelters, this is undesirable, since these animals ended up at the sanctuary due to health problems, and are already severely weakened. It is important to provide these animals with the most natural diet possible, so that they start eating straight away and can regain their strength. In such cases, poor food acceptance might mean death. If these animals can no longer be fed day-old male chicks, shelters will have to switch to other natural food sources, such as mice, rats, or guinea pigs, which would have to be bred especially for this purpose.

Nutrition:
- The composition of a chick precisely meets these animals' natural needs, both in terms of content (fat, protein, energy) and in terms of structure (skin, muscle, organs, sinews, and bones).
- Since the chicks have never been fed, they are a very uniform food source, compared to for example bred mice that were fed for 12 weeks to reach a weight of 20 grams. As diet differs from company to company, so does the composition of the mice.
- Chicks are easy to divide into portions, if necessary.

Health and hygiene:

- Zoos, raptor farms and bird shelters must remain germ-free at all times, and avoid as much as possible the introduction of pathogens. This is not only important to protect their image, but also because they must avoid at all times zoonotic pathogens being introduced via animal feed and spreading. The level of animal health in Dutch livestock farming is high, including a nearly entirely salmonella-free status for day-old chicks in the layer sector. This makes day-old male chicks an extremely safe and hygienic food source.

If day-old chicks are no longer available, the buyers have a number of alternatives for animal feed:

- Import from other countries: the disadvantages of this option are less certainty regarding the chick's health (for example salmonella) and a higher $CO_2$ footprint due to longer transport distances.
- Replacement food animals: this will lead to an increase in the breeding of mice, rats, and guinea pigs as animal feed. In an effort to guarantee a germ-free production, there are already applications for SPF mice farms. It takes about 2 to 3 mice to replace one chick. One disadvantage of mice is variation in composition, since the animals have to be fed for some time. This therefore requires more calculations from zoos and bird centres to offer their animals the right nutritional composition.

## 7.10 Export of day-old chicks

A large portion of hatched day-old female chicks is exported, reared elsewhere, and kept for egg production. Some are exported to other European countries, but most of them go to African countries. These are all hens whose brother cockerels were euthanised at the hatchery. In the event of a Dutch ban on the euthanising of day-old male chicks, the export hens will also become more expensive, since they will have to meet OKT requirements. These additional costs will not be borne by the international buyers, because they would be unable to recoup them through selling the eggs and, especially in African countries, would not have the financial means to cover these additional costs. As a consequence, export from the Netherlands will disappear. A number of Dutch hatcheries already have branches abroad (for example in Belgium), or are considering creating such branches, for example in Hungary or Turkey, in the event of a ban. The hens intended for export will then be hatched in these international branches, where the cockerels will be euthanised. In the event of a Dutch ban on the culling of day-old male chicks, ultimately, the number of exported and euthanised chicks will not differ from the current situation; the only thing that will change is the country where they are produced. Since these countries often have less strict requirements for the euthanising method, this could mean, from a global perspective, a worsening of the chicks' welfare, unless the Dutch hatcheries abroad retain the good practices acquired in the Netherlands.
With the production of day-old female chicks relocating to other countries, the Netherlands will lose an economic activity, with negative consequences for employment and the export balance.

## 7.11 Economic aspects

***In ovo***

In ovo sexing of eggs brings additional costs. A number of cost aspects play a role:

- Sexing requires expensive equipment.
- More hatching eggs are needed for the same number of pullets.
- Depending on the method used, you may need equipment for correctly finishing off the male embryos[6].
- Depending on the time required for the sexing procedure, it can take place in-line, or a special waiting area has to be created for the hatching eggs.
- With methods that cannot be performed in-line, sexing takes more time. This also means that more capacity is needed to process the entire day production of a hatchery.

[6] There is as yet no legislation specifying for which eggs this is required.

The costs for in ovo sexing (with the available invasive methods on Day 9) are still relatively parallel to the costs of rearing layer males and amount to €3.50 per pullet. Further developments in in ovo techniques may in time reduce these additional costs.

***Cockerels***

As shown in Table 5.4 and Table 5.5, the costs of rearing layer males of regular layer breeds are not compensated by the revenues from the meat. For organic cockerels, the costs may be compensated, but this depends on the sales, which are as yet extremely limited.

The costs of rearing cockerels are now compensated via a surcharge for the pullets, meaning that the layer poultry farmer has to recoup the higher purchasing price of the pullets via a surcharge on the eggs during the laying period.

Since the rearing of cockerels is currently a loss-making operation, good management is not stimulated, as this only increases the costs and therefore also the loss. Unfortunately, poor management leads to more loss of cockerels, and therefore less financial loss. Many cockerels are reared in Poland, where costs are lower, but where there is also more variation in company quality, and therefore in the animals' living conditions, than in the Netherlands or in Germany.

Figure 5.1 offers a schematic overview of the links in the chain, as it was before Germany introduced a ban on the culling of day-old male chicks. Figure 7.2 below illustrates the situation in the event of a Dutch ban on the culling of day-old male chicks. The in ovo sexing and rearing of cockerels options are included in the same figure. Flows and options that are no longer available in the new situation are indicated with red crosses.

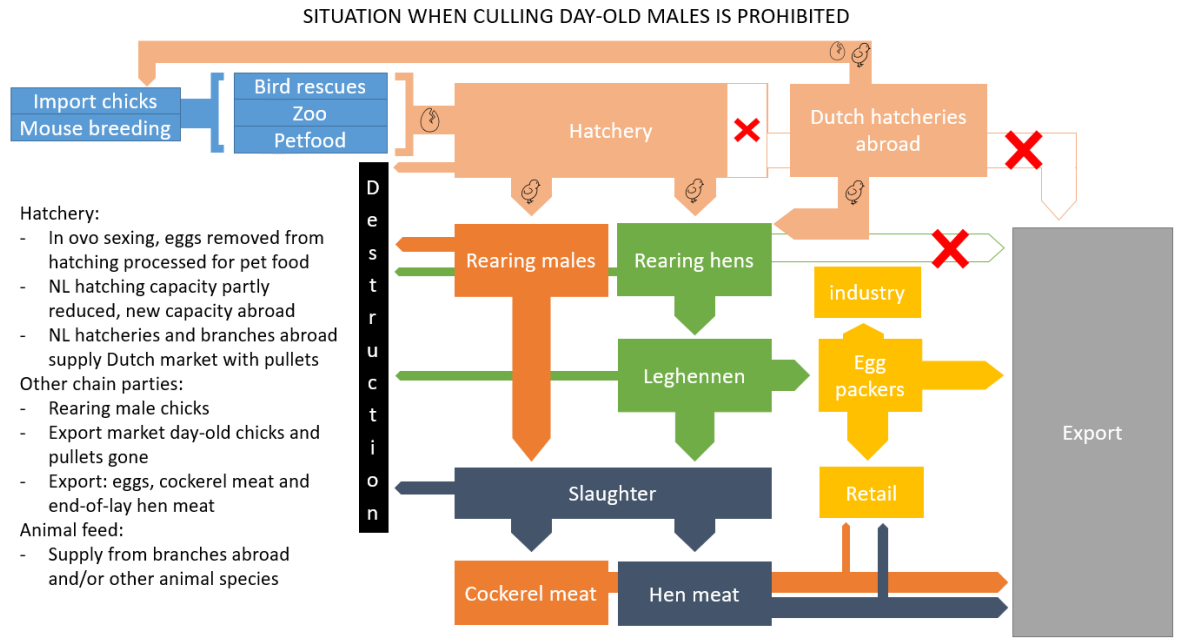


**Figure 7.2** *Schematic overview of the links in the chain in the event of a Dutch ban on the culling of day-old male chicks (see Figure 5.1 for a comparison with the 2019 situation).*

Slaughterhouses also produce slaughter material to be used as animal feed, and some dead animals resulting from the breeding, laying and slaughtering process are destroyed. These lines have been left out for reasons of clarity.

# 8 Possible scenarios and their consequences

In this Chapter, we present for consideration a number of scenarios for addressing the dilemma of 'the culling of day-old male chicks'. For each scenario, we indicate the consequences for all parties involved: the poultry sector (primary producers and periphery) and buyers of eggs, the day-old female chicks, and the culled day-old male chicks.
The various scenarios are then described in further detail. Based on a number of guiding principles and assumptions, we then calculated the numbers of day-old male chicks the various scenarios apply to.

## 8.1 Possible scenarios

**A) Dutch ban on the culling of day-old male chicks, without exceptions, hereafter referred to as 'general ban'**

The estimated consequences of adopting and implementing a general Dutch ban on the culling of day-old male chicks are as follows:

1) No day-old male chicks will be euthanised at hatcheries in the Netherlands, with the exception of screened out, non-viable chicks.
2) Not all purchasers of Dutch-produced eggs do impose OKT requirements, like the industry and buyers of table eggs, among them retail companies in the Netherlands and abroad. These buyers will therefore not be prepared (at first) to pay the additional costs of OKT. Dutch poultry farmers without a market for their OKT eggs will anticipate this by purchasing day-old hens or pullets, at a substantially lower purchasing price, in other countries (import) that still allow for the euthanising of day-old male chicks. This is linked to negative aspects such as the risk of introducing animal diseases. Furthermore, it means that more animals will be transported (over long distances), requiring more logistics and organisation. In Germany, a development is already taking place whereby approximately 30% of the egg production consists of MKT eggs, originating from imported laying hens. Changes in the market demand may cause a further shifting (there is no legislation forbidding MKT eggs from being brought to the market).
3) Current purchasers of culled day-old male chicks will be confronted with the disappearance of a food supply that forms an essential part of the diet of some animal species. See Chapter 7.9. These purchasers will seek alternatives, such as purchasing bred and then culled mice. In the Netherlands, the first companies have already been launched to meet this demand. Another option involves importing culled day-old male chicks. This import will partly come from countries with less stringent requirements regarding the euthanising of chicks and a lower health status (for example with respect to salmonella).
4) Thanks to their high quality, Dutch day-old hens (future laying hens) are in high demand in many countries around the world. In case of a ban on the culling of day-old male chicks, the female chicks will become unaffordable for buyers (including African countries). These hens play an important role within the purchasing countries; after being reared locally, they are used to efficiently produce eggs and provide the local population with protein. Most of the current international purchasers of this Dutch animal material will most likely seek alternative suppliers: foreign competitors or international branches of Dutch companies. In this scenario, production will therefore shift to other countries, where there is no ban on the culling of day-old male chicks. Some of these countries impose less strict requirements regarding animal health, animal welfare, and the environment than the Netherlands.
5) The situation described under A4) (relocation of production) will also, in the event of a ban, extend to Dutch branches of breeding companies that supply breeding or parent stock for sustainable protein production around the globe. This development undermines the international position of Dutch poultry farming and of the Dutch poultry sector as a whole. In Germany, the legislation has already led to the relocation of breeding activities to other countries.

6) One option is to bring day-old male chicks alive across the border to countries where culling is permitted, and euthanise them there.

A ban on the culling of day-old male chicks could raise awareness concerning laying hen farming that focuses too much on egg production. This could provide an incentive to further experiment with new production methods, such as dual purpose chickens. The rearing of dual purpose chickens represents a different approach to the production of meat and eggs than the current, efficiency-oriented production methods.

With Scenario A, chick production will therefore shift to other countries, day-old male chicks will no longer be euthanised in the Netherlands, but euthanising will take place in equal or similar numbers in other countries, with potentially less favourable circumstances for the chicks. In addition, this scenario will lead to the import of MKT day-old chicks or MKT pullets.

**B) Dutch ban on the culling of day-old male chicks, with exceptions for specific purposes, hereafter referred to as 'partial ban'**

An alternative to a general ban is a partial ban, which allows for specific exceptions. As described in Chapter 5, the French legislation allows for the following exceptions:

- Chicks from breeding or parent stock
- Chicks intended for scientific research, in particular for the pharmaceutical industry, or for veterinary diagnostics
- Chicks intended for animal feed
- In case of regulated animal diseases
- Chicks and embryos that are screened out as non-viable at the hatchery
- Animals that are wounded or suffer from a disease that causes them intense pain or suffering, and where there are no other practical solutions for relieving this pain or suffering
- Chicks that failed to be detected using the applicable methods[7]. This refers to cockerels born due to imperfections (sexing errors) in the in ovo technique applied.

The Austrian legislation allows the culling of day-old male chicks intended for use as animal feed.

In this report, looking at the Dutch situation, we have opted for the following four variants of this scenario (see also schematic overview in Table 8.1):

Variant B1) Dutch ban on the culling of day-old male chicks, with the exception of day-old male chicks intended for a specific purpose (animal feed): including pet food, zoos, bird shelters, and falconries (variant as legally established in Austria and included in the French legislation).

Variant B2) Dutch ban on the culling of day-old male chicks, with the exceptions listed in the French legislation (see above).

Variant B3) Dutch ban on the culling of day-old male chicks, with the exception of day-old male chicks with a specific purpose (animal feed, variant B1), and with the exception of day-old male chicks whose sister hens are exported.

Variant B4) Dutch ban on the culling of day-old male chicks, with the exceptions as set out in the French legislation (variant B2), and with the exception of day-old male chicks whose sister hens are exported.

In implementing the possible variants of a partial ban (B1 through B4), assuming a constant demand for euthanised day-old male chicks, the consequences of Scenario A (general ban) do not apply, or only to a limited extent, and the process described in Scenario C can unfold regardless.

[7] One of the areas for improvement in in ovo sexing is the need to reduce the percentage of hatching eggs that produce an unclear or no result. These eggs are now usually removed from the incubation process, to prevent some of them hatching into a layer male that would have to be reared. However, removing these hatching eggs also leads to the loss of eggs that would ultimately have produced a hen. One solution might be to allow all of these eggs to hatch, and allow for the euthanising on Day 1 of any cockerels born of these hatching eggs (as a result of errors in in ovo sexing).

**C) Decision concerning a Dutch ban on the culling of day-old male chicks after evaluation.**

Background: imposing a general ban has advantages and disadvantages. For example, in addition to the expectation that the culling of day-old male chicks will remain constant at European level, since it will relocate abroad, the odds are high that poultry farmers will in the long run be unable or insufficiently able to recoup the additional costs of OKT eggs, because OKT will be seen as a legal precondition. There are however also many uncertainties regarding other potential developments, such as the response of the retail sector, consumer behaviour, and the extent to which in ovo techniques are developed further, potentially resulting in lower costs.
To work towards the intended goal (a reduction in the number of culled day-old male chicks) in a broadly supported and constructive manner, and in the context of the current poultry sector, among other things, a more structural solution is when consumer awareness around this debate is raised, and offering consumers the choice of purchasing MKT or OKT eggs in the supermarket. If they opt for OKT eggs, they will have to pay a higher price. Solid purchasing and price agreements can be used to guarantee that poultry farmers are actually reimbursed for the additional costs of producing OKT eggs.

This scenario presupposes a gradual process, in the first instance without a legal ban (although possibly involving stricter regulations on aspects such as the treatment of screened out incubated eggs) and on the precondition that an evaluation is carried out after three years, followed by a decision concerning the potential need for a general or partial ban. The criteria to be assessed for the evaluation and the accompanying parameters can be defined in due course. In view of the objective, the most important criterion is already known, namely 'a reduction in the number of culled day-old male chicks'.

In case of a ban, this would allow for a more careful consideration of the ban's structure, phasing and design, in line with the situation at that moment. In addition to improving the technical aspects (for example further developing in ovo techniques), efforts will also be made to give consumers the opportunity to more consciously purchase food products, and all parties involved will make efforts to create financial constructions to ensure that primary producers are rewarded fairly for adjusting their production process. This approach is closely aligned with the request to benefit animals, farmers, and consumers. This process can be initiated in the organic sector.

Even without a Dutch ban, the Dutch poultry sector is already undergoing a real shift in terms of not culling day-old male chicks. A large portion of the eggs exported by the Netherlands (80%) are sold to Germany. In response to the introduction of the German ban on the culling of day-old male chicks on 1 January 2022, and the demand from the German retail, the Dutch poultry sector has made efforts, under great pressure, to meet the new requirements of this important sales market: concerning technical developments in in ovo sexing, the rearing of layer males, and the organisation/logistics of hatcheries and the egg trade. As a result of the German legislation, already in 2022 approximately 40% of the laying hens kept in the Netherlands are expected to be produced without culling of day-old male chicks, either thanks to in ovo sexing, or by rearing the layer males. With the requirements set by foreign buyers (via legislation), the shift towards no longer culling day-old male chicks is already occurring on its own for a substantial part of the Dutch laying hen stock.

This scenario makes it possible to respond to developments in surrounding purchasing countries, and potential developments on the Dutch consumer market. The requirements set by the purchasers determine how we produce food. The financial consequences of adjustments in production methods are borne by the consumer, who makes specific choices. An example in this context is the transition, driven by welfare considerations, from cage farming to barn housing. Long before the introduction of the European ban (in 2012), the vast majority of Dutch layer poultry farmers had already made this transition, with the supermarkets playing a guiding role, under pressure from consumers, by making choices in a selective choice of table eggs offering as early as the start of this century. A similar process occurred concerning the trimming of beaks: before any legislation was imposed, and in response to German market requirements, many Dutch farmers already kept laying flocks with intact beaks.

Poultry farmers can, in collaboration with hatcheries and egg traders, meet a tailormade demand. However, solid financial agreements must be made to ensure compensation of the additional costs and to cover risks. All chain partners have an important responsibility in this context. Poultry farmers need to achieve a stronger sales position, in collaboration with egg packing stations and retail. The government must provide room for producers and buyers to reach joint agreements on this matter, and can help accelerate the transition. From a position of collaboration, efforts can be made to raise consumer awareness and guarantee a fair revenue model for poultry farmers.

The evaluation term could be set at three years, and this period could be used for the following:

- Raising consumer awareness by providing information on this issue and implementing a transparent surcharge for OKT eggs; to be worked out in further detail, not included in this report.
- Creating a fair revenue model for poultry farmers, with sufficient compensation for the additional costs of OKT; also to be worked out in further detail, not included in this report.
- Conducting additional research, for example into the age at which an embryo first experiences pain signals (and therefore the last day in the incubation process when in ovo sexing may be performed) or into the need to treat the screened out hatching eggs.
- Making a broad inventory of research results in this field (in ovo sexing, dual purpose chickens, etc.).
- Monitoring the consequences (in the Netherlands and abroad) of foreign legislation of a ban on culling day-old male chicks on the requirements set by the retail and on consumer behaviour.
- Promoting alternatives, such as the use of dual purpose chickens, with both hen and cockerel being optimally used, and stimulating research into the use of waste flows to feed these animals, in an effort to reduce the $CO_2$ footprint.

Depending on the results of the evaluation, it may be decided to apply Scenario C or to impose a general or partial ban after all, including a set transition period, for example two years, so that the total period available to further develop in ovo techniques is five years, which is seen as a realistic time frame for optimising these techniques (fewer errors, more broadly applicable, higher capacity; applying the techniques before Day 7 of the incubation process will probably require more time).

The consequences of this scenario are as follows:

1) A gradual process will take place, making it possible to respond to developments in the surrounding purchasing countries, and potential developments on the Dutch consumer market. Consumers will be able to consciously choose which eggs they wish to purchase, and all parties involved can work to make sure that the additional costs of the OKT requirements are covered, with the right margin distribution.
2) The Dutch poultry sector will independently meet the requirements set by purchasers; in this context, a development towards no culling of day-old male chicks has already been initiated in 2022 for approximately 40% of the Dutch laying hen stock.
3) In this scenario, poultry farmers may, in consultation with their hen suppliers and egg buyers, decide for themselves which market they wish to produce for. A partial or general ban, on the other hand, would greatly limit this choice. For example: in the event of a ban, producing eggs for the industry would no longer be an option in the current situation (unless a farmer imports MKT hens), because the additional costs, of approximately €3.50 per hen, would not be covered by the industry paying a higher egg price (see also A2).
4) If an egg purchaser sets no OKT requirements, this scenario makes it possible to euthanise the day-old male chicks – on Day 1 at the hatchery, as is currently the practice, in accordance with a strict protocol, in a responsible way – and sell them to current purchasers such as zoos, bird shelters, falconries, and pet food. This would prevent the creation of a new intensive farming sector, for example breeding mice as food for reptiles and raptors. In addition, it would prevent the import of day-old male chicks or pullets from countries with potentially less strict requirements concerning hygiene and animal welfare.
5) If a foreign purchaser of day-old female chicks sets no OKT requirements, this scenario makes it possible to euthanise the day-old male chicks from these batches that hatched and sell them to the current purchasers (see the advantages listed under 4) above).

6) If the Netherlands ultimately decides to refrain from imposing a ban, there will be no need to create a monitoring system in the Netherlands. In the current situation, this monitoring comes from the market (including the German market). If OKT requirements are set by other purchasers, such as the Dutch retail industry, this can be realised through commercial arrangements between the various parties.

## 8.2 Considerations concerning the various scenarios

In terms of additional Dutch legislation, one might think of conditions for in ovo sexing (for the portion of sales for which purchasers impose OKT requirements):

- Imposing a maximum age (days of incubation): the amount of allantois fluid would probably be the limiting factor in this context.
- Depending on this age: prescribe what should happen to the screened out hatching eggs. The question is at what age the embryo can experience pain, making anaesthesia a desirable requirement. A proven method for treating incubated eggs involves 'stunning' them with electric current, as is done by AAT with the Stunny.
- Making an exception and allowing the culling of day-old male chicks (on Day 1 at the hatchery) that hatched due to imperfections in in ovo sexing (to the extent that this is permitted in the purchasing market party's country).

The choice for specific in ovo methods is not included in this report.

In Table 8.1, based on the classification in the French legislation, we list per scenario for which poultry subtypes culling of day-old male chicks would be allowed. In this report, we assume that the last three exceptions (in italics in the Table) will continue to be permitted in the Netherlands, regardless of the chosen scenario.

***Table 8.1*** *Overview of the various scenarios [1)].*

| | Scenarios | | | | | |
|---|---|---|---|---|---|---|
| **Features of scenarios** | **A** | **B1** | **B2** | **B3** | **B4** | **C** |
| Ban on the culling of day-old male chicks | x | x | x | x | x | |
| **Culling of day-old male chicks allowed for:** | | | | | | |
| Chicks from breeding and parent stock | | | x | | x | x |
| Chicks used for scientific research, in particular for the pharmaceutical industry or veterinary diagnostics | | | x | | x | x |
| Chicks intended to be used as animal feed | | x | x | x | x | x |
| Chicks that failed to be detected using the applicable methods | | | x | | x | x |
| Chicks intended for export | | | | x | x | x |
| *In case of regulated animal diseases* | *x* | *x* | *x* | *x* | *x* | *x* |
| *Chicks and embryos that are screened out as non-viable at the hatchery* | *x* | *x* | *x* | *x* | *x* | *x* |
| *Animals that are wounded or suffer from a disease that causes them intense pain or suffering, and where there are no other practical solutions for relieving this pain or suffering* | *x* | *x* | *x* | *x* | *x* | *x* |

[1)] In this report, we assume that the last three exceptions (in italics in the Table) will continue to be permitted in the Netherlands, regardless of the chosen scenario.

The question that arises is how many day-old male chicks will be euthanised (in the Netherlands or abroad) in these various scenarios. This question is not easy to answer because, depending on the chosen scenario, all kinds of developments will take place in the Netherlands around the culling of day-old male chicks.

To what extent will the Dutch hatching capacity shrink (in other words, to what extent will it relocate to other countries)? With this relocation, will the total export of day-old female chicks from Dutch companies remain constant? To what extent will Dutch retailers and other purchasers, other than German retailers, impose OKT requirements on eggs? Will egg sales shift more to the local market (which is possible with MKT hens)? To what extent will Dutch layer poultry farmers purchase day-old hens or young hens from other countries? To what extent will the Dutch poultry stock shrink in size? To what extent will developments take place in other European countries with respect to legislation? Will EU legislation be implemented, and if so, within what time frame? The answers to these questions affect the outcomes of all the scenarios described.

In an effort to produce an indicative calculation, we describe the various scenarios in further detail below. In each case, we describe the starting points and assumptions that affect this calculation.

In this report, the term 'hatching capacity' is used to refer to the capacity for hatching day-old hens. When applying in ovo sexing, the required physical hatching capacity (number of hatching machines needed) is determined by the choice for a given in ovo technique, such as the effect of reliability and losses on the number of hatching eggs to be placed in the incubator, and the age when sexing is performed. The number of required hatchers will decrease, and the effect on the number of incubators will vary, while remaining overall limited[8].

For all scenarios (A, B1 through B4, and C), we made the following assumptions:

- A constant and stable replacement market of Dutch laying hens of 20 million per year.
- A constant and stable Dutch layer poultry stock size; some impact is to be expected, although this is difficult to quantify, especially in relation to other ongoing debates, such as the nitrogen dossier.
- A constant and stable export of day-old hens from Dutch hatcheries.
- A constant (or almost constant) market of purchasers who impose OKT requirements, so no effect of the choice of scenario for market demand.
- A constant and stable number of culled day-old male chicks sold from the Netherlands as animal feed, of approximately 44 million per year. A potential shift towards offering culled mice to be used as animal feed has not been included in this calculation.

This calculation does not take into account figures arising from specific aspects of breeding, whereby male or female chicks are euthanised, depending on the 'line' (male or female line)[9] from which they originate.

For Scenario A (general Dutch ban), we assumed the following:

- The import of 12 million MKT laying animals with which Dutch poultry farmers sell to markets that do not impose OKT requirements on the eggs. Of these 12 million laying animals, the day-old male chicks are euthanised in the country of production.
- Complete relocation from the Netherlands to other countries of the production of day-old hens, under the flag of Dutch entrepreneurs, for export. The day-old male chicks from these batches that hatched are euthanised in the country of production.

In the long run, in this scenario, further developments in in ovo techniques will probably lead to almost no layer males (brothers of day-old hens produced in the Netherlands) being born and reared, with the exception of some niche markets, and possibly the organic sector, where there is a market for layer males.

[8] After sexing, one will need far fewer incubators, and these newly available incubators can be used for a new flock of hatching eggs. Depending on the sexing age, the incubators will become available sooner or later. With in-line sexing, no additional incubators are required to act as a 'waiting area'.

[9] Breeding requires a certain percentage of cockerels to produce fertilised hatching eggs. When combining breeding lines to create layer parent animals, in some lines, only the cockerels are used, and in others only the hens.

For Scenario B, we assumed the following:

- In the Netherlands, 40% of the laying hen stock for the Dutch replacement market (20 million) will consist of OKT hens (in the long run resulting mostly via in ovo sexing): 8 million.
- For the remaining 12 million MKT laying hens on the Dutch replacement market, the day-old male chicks will be euthanised in the Netherlands.

The B1 and B2 variants have been combined in the calculation, because both options (Austrian model and the options listed in the French legislation) make an exception for the culling of day-old male chicks intended for use as animal feed, and therefore have a similar effect on the number of euthanised day-old male chicks. This number in turn affects the maximum number of day-old male chicks euthanised in the Netherlands, in relation to the hatching capacity.

The B3 and B4 variants have also been combined, because the exceptions described in these variants do not lead to significantly different figures, under the available hatching capacity in the Netherlands and abroad.

For Scenario C, we also assumed the following:

- In the Netherlands, 40% of the laying hen stock for the Dutch replacement market (20 million) will consist of OKT hens (in the long run resulting mostly via in ovo sexing): 8 million.
- For the remaining 12 million MKT laying hens on the Dutch replacement market, the day-old male chicks will be euthanised in the Netherlands.

Our calculation gives an indication of whether, and if so to what extent, the various scenarios affect the Dutch hatching capacity and a potential relocation of production to other countries. It also clarifies the number of day-old male chicks euthanised in the various scenarios, under the above-mentioned starting points and assumptions.

In Table 8.2, the terms in the first column have the following meaning:

- *Total hatching in the Netherlands*: Total hatching of day-old hens (and therefore day-old male chicks) in Dutch establishments
- *Replacement market in the Netherlands*: Number of laying hens replaced on a yearly basis in the Netherlands (in this calculation, we assume that these animals are hatched in Dutch establishments)
- *of which, proportion euthanised in NL*: Number of day-old male chicks from this replacement market euthanised in the Netherlands
- *Replacement market NL/MKT*: Number of laying hens that would, in the event of a general Dutch ban, be purchased abroad (import as day-old hen or as young 17-18 weeks hen) to produce MKT eggs in the Netherlands for buyers that do not impose OKT requirements
- *of which, proportion euthanised elsewhere*: Proportion of these MKT laying hens whose brother cockerels are euthanised as day-old chicks abroad (if permitted in the country in question)
- *Export of NL day-old hens from the Netherlands*: Number of day-old hens produced in Dutch establishments and exported (including breeding and parent stock)
- *of which, proportion euthanised*: Number of layer males euthanised in the Netherlands as day-old chicks, as part of the export of day-old hens from Dutch establishments
- *Export of NL day-old hens from abroad*: Number of day-old hens, produced for export in foreign branches of Dutch companies
- *of which, proportion euthanised*: Number of layer males euthanised abroad as day-old chicks, as part of the export of day-old hens from foreign branches of Dutch companies
- *Proportion of chicks euthanised in the Netherlands*: Total number of day-old male chicks euthanised in the Netherlands
- *Proportion of Dutch chicks euthanised elsewhere*: Total number of day-old male chicks euthanised in foreign branches of Dutch companies
- *Total proportion of euthanised chicks*: Total number of day-old male chicks euthanised in the Netherlands or at foreign branches of Dutch companies

The 2nd column illustrates the 2018 situation, as described in Chapter 4.4, with the following distribution of total hatching of day-old hens (44 million): 6 million breeding and parent stock and 38 million laying hens (20 million for the Dutch replacement market and 18 million for export).

This calculation does not include the day-old hens already being produced in international branches of Dutch hatcheries (without implementation of one of the scenarios) and intended primarily for export.

This calculation does not include the potential shift within the Dutch organic sector towards refraining from using in ovo sexing, and opting instead for rearing the layer males. If the organic sector was to fully transition to rearing cockerels, this would apply to approximately 1.2 million animals (6% of the 20 million intended for the annual replacement market) and would in all scenarios lead to an equivalent decrease in the number of cockerels euthanised in the Netherlands.

***Table 8.2*** *Number of day-old male chicks (equal to the number of day-old female chicks), in millions, in the current situation (2018) and under the various scenarios (A, B1 through B4, and C).*

| | Situation 2018 | Scenario A | Scenario B1/B2 | Scenario B3/B4 | Scenario C |
|---|---|---|---|---|---|
| Total hatching in the Netherlands ♀ | 44 | 8 | 44 | 44 | 44 |
| Dutch replacement market ♀ | 20 | 20 | 20 | 20 | 20 |
| of which, proportion euthanised NL ♂ | 20 | 0 | 12 | 12 | 12 |
| Replacement market NL/MKT ♀ | | 12 | | | |
| of which, proportion euthanised elsewhere ♂ | | 12 | | | |
| Export of NL day-old hens from the Netherlands | 24 | 0 | 24 | 24 | 24 |
| of which, proportion euthanised ♂ | 24 | 0 | 24 | 24 | 24 |
| Export of NL day-old hens from abroad | - | 24 | - | - | - |
| of which, proportion euthanised ♂ | - | 24 | - | - | - |
| Proportion of chicks euthanised in the Netherlands ♂ | 44 (20+24) | 0 | 36 (12+24) | 36 (12+24) | 36 (12+24) |
| Proportion of Dutch chicks euthanised elsewhere ♂ | - | 36 (12+24) | - | - | - |
| Total proportion of euthanised chicks ♂ | 44 | 36 | 36 | 36 | 36 |

A general Dutch ban (Scenario A) would lead to a dramatic decline in the Dutch hatching capacity; the relevant companies will have to relocate this hatching capacity to other countries (for example Belgium, Turkey, and Hungary) and export similar volumes of day-old hens whose brothers are euthanised in these countries (and possibly exported as food animal to the Netherlands) from these countries. A general Dutch ban would also lead to the import of MKT laying hens (whose brothers will be culled abroad).

Under any other scenario, the Dutch hatching capacity is expected to remain globally the same, with only relatively minor shifts.

Compared to the 2018 situation, all scenarios lead to a decrease in the number of euthanised day-old male chicks, from a total of 44 million to 36 million. This decrease is already happening (2022), aided by the introduction of OKT legislation in Germany. The German legislation has already led to a drop of 8 million, as apparent from the calculations of Scenario C.

Scenario B (including all four variants) and scenario C lead to the same number of day-old male chicks being euthanised in the Netherlands. At the European level, the number of euthanised day-old male chicks would remain constant, irrespective of the chosen scenario (so also in case of a general Dutch ban), on the understanding that a general Dutch ban would lead to the euthanising of day-old male chicks relocating from the Netherlands to surrounding countries with potentially less strict rules in this respect than in the Netherlands.

For a further discussion of these indicative figures, see the Discussion chapter.

# 9 Discussion

## 9.1 General

Our assignment was to outline a number of scenarios (and their consequences) for implementing a ban on the culling of day-old male chicks. In carrying out this project, it turned out, based on the information obtained from interviews, that this assignment involves an unprecedented number of underlying aspects, adding multiple dimensions to the original question.

The many interviews we held provided us with a lot of useful information, from different perspectives. With respect to the poultry sector, the interviewees reported that the general German ban resulted in a ratio of OKT to MKT hens of 70% to 30% in Germany. They also unanimously concluded that the current German and other market requirements have already led to a substantial change in the Netherlands. The question is therefore to what extent a Dutch ban would lead to changes in the Dutch ratio.

Having carried out some calculations (see Table 8.2), it also became clear how the various scenarios would lead to shifting production (from the Netherlands to other countries) and how they would lead to a relocation of the euthanising of day-old male chicks (also from the Netherlands to other countries).

With these observations and the results of our calculations, combined with the many uncertainties surrounding other potential developments (such as the attitude of the retail, consumer behaviour, and the extent to which in ovo techniques are developed further, thus leading to lower costs), we have therefore opted to also describe Scenario C: reaching a decision about imposing a Dutch ban on the culling of day-old male chicks after an evaluation period (of three years).

During the project, it also became clear that a ban would seriously affect Dutch companies in the poultry sector (primary producers and supplying and purchasing industry) and Dutch purchasers of euthanised chicks (bird shelters, etc), as well as foreign, in particular African, purchasers of Dutch animal material.

Within the assignment, this report describes how to deal with one aspect of the current practice, i.e. the culling of day-old male chicks of layer breeds, in view of the motions submitted by the House of Representatives. According to Leenstra et al. (2008), the case of the day-old male chicks can also be used to initiate a broader discussion around poultry farming, whereby the choices of the frameworks, tailored to current poultry farming or from a broader perspective, play a role in defining choices of potential solutions. The choices of frameworks are however also determined by the time and space available for implementing transitions within a given sector. In this context, legal frameworks and market opportunities in the Netherlands and abroad determine to a large extent the possibilities and impossibilities, and the transition rates. Partly in view of the specific formulations of the parliamentary motions, and the time frame within which a decision must be reached concerning this aspect, a broader perspective is beyond the scope of our assignment, and the issue of the culling of day-old male chicks is therefore considered in this report within the framework of current livestock farming practices, with specialised animal breeds for egg and meat production, and the way in which the sector is presently structured, with interlinked chains. The investigation into scenarios for addressing the issue of the 'culling of day-old male chicks of layer breeds' in this report therefore primarily focuses on whether there are alternatives to culling day-old male chicks within current specialised laying hen farming, with dual purpose chickens as a potential alternative. The results must also be seen within this context.

## 9.2 Shifts/Risks

### 9.2.1 Relocation of the euthanising of day-old male chicks to other countries

The calculation in the Scenarios chapter (Table 8.2) makes it clear that a general Dutch ban (Scenario A) would end the culling of day-old male chicks in the Netherlands, but that this procedure would subsequently relocate to other countries, with the total number of euthanised day-old male chicks at the European level remaining the same as in the other scenarios (B1 through B4 and C). In the other scenarios, a portion of day-old male chicks would be euthanised in the Netherlands, and the relocation of this procedure abroad would be more limited. Dutch legislation (a partial or general ban) would therefore lead to a relocation of the euthanising of day-old male chicks to other countries, with the attendant risk of this procedure being performed under less strict conditions than in the Netherlands.

This relocation of the euthanising of day-old male chicks and the accompanying hatched day-old hens affects various markets supplied by Dutch hatching organisations (with and without international branches):
1. Part of the Dutch replacement market (for Dutch layer poultry farmers who would start producing MKT eggs)
2. For the export of day-old hens to places like Africa

We cannot exclude the possibility that in countries that impose a ban on the culling of day-old male chicks, these animals would be transported to another country, where euthanising of day-old male chicks is permitted.

Our calculation is based on the assumption that if Scenario A is implemented (general ban), this would lead to a large-scale relocation of Dutch hatching capacity to other countries. Although this is a decision with far-reaching consequences, it is a realistic expectation in view of the shifts that have already taken place in Germany, and the reactions we heard in the interviews.

### 9.2.2 Relocation of export of day-old hens

In the event of a Dutch ban, current foreign purchasers of Dutch day-old hens would, as a result of the additional costs of OKT, seek alternative suppliers: foreign competitors or international branches of Dutch companies. In Scenario A, production would therefore be relocated to other countries that do not impose a ban on the culling of day-old male chicks. Some of these countries impose less strict requirements regarding animal health, animal welfare, and the environment than the Netherlands. This relocation will lead to a more or less complete disappearance of an economic activity, with the accompanying loss of employment.

### 9.2.3 Shift of export of breeding and parent stock

Dutch breeders supply breeding and parent stock to countries around the world to ensure sustainable protein production in the purchasing countries. In the event of a general Dutch ban, these breeders would, following the example of Dutch hatcheries, relocate their hatchery activities to other countries. With the relocation of the production of day-old female chicks to other countries, the Netherlands would lose an economic activity, with negative consequences for employment and the export balance. In Germany, the legislation has already led to the relocation of breeding activities to other countries.

### 9.2.4 Financial risks in the chain

In writing this report, a number of financial aspects emerged that apply to all scenarios: both in the event of a general or partial ban, and in Scenario C. These are described in Chapter 7.6. It is clear that OKT requirements on the part of purchasers lead to substantial financial risks and that these risks must be covered via agreements that provide enough security and are complied with by the various parties involved, also in the event of disappointing developments, such as consumers not purchasing enough OKT eggs from the shops.

### 9.2.5. Price level for consumers

The surcharge for an OKT egg for the consumer amounts to four to five euro cents per piece, on the shop shelf. This is a substantial surcharge on the current average egg price (of up to 10 to 30%) which could, in the event of a decline in purchasing power, affect buying behaviour. In the coming months, it will become clear (in Germany) whether consumers are willing to start or continue to pay this surcharge, or whether they will switch to purchasing MKT eggs from another supplier. Due to rising food prices, a clear decline can currently be observed (June 2022) in German consumers' purchasing of eggs from the higher price segment (organic, free range, and OKT eggs).
In April 2022, WUR calculated the consequences of rising food prices and OKT requirements for the cost price of the poultry farmers. The increase in price, depending on how the market in raw materials develops, amounts to four to six euro cents per egg, off the farm (Vermeij, 2022).
In France, in an attempt to protect the consumer, the government has opted for legislation whereby the additional costs are limited via financial support for hatcheries who apply a non-invasive in ovo sexing method on Day 14 of the incubation process (see Chapter 5.3).

## 9.3 Day-old male chicks

Because of the speed with which the German legislation was introduced, the Dutch poultry sector has had to shift very quickly in order to meet the OKT requirements of the German market. In ovo techniques were still in their infancy, and the available capacity was still limited. For hatcheries, it was not easy to choose a certain in ovo technique, especially in view of the substantial investments involved. For this reason, over the past one to two years, many hatcheries opted for meeting the German OKT requirements by rearing day-old male chicks, mostly in Poland.

### 9.3.1 Sustainability of rearing cockerels

The interviews we held provided us with a lot of information on the rearing of layer males (of regular layer breeds) with respect to housing, feed, lighting, behaviour, technical results, sustainability, economics, availability of poultry house surface area, available slaughterhouses, and sales.
Overall, the interviewees were of the opinion that the rearing of layer males, with the exception of specific niche markets, should be viewed as a temporary solution, and that in future, OKT requirements would be met as much as possible by applying in ovo sexing. The arguments put forward for this position were as follows:

- With a feed conversion of 3.5 to 4.0 (kg feed per kg growth), this is a highly inefficient form of meat production, compared to broilers.
- The $CO_2$ production per kg of meat is 2.5 times higher for layer males than for regular broilers[10].
- The final product (1.3 to 1.5 kg of living weight) has little meat (proportionately a lot of carcass), and the demand for it is very limited, and not expected to increase. Table 6.3 shows that a layer male of 14 weeks (with 1352 grams of living weight) amounts to a carcass weight of 784 grams; this example illustrates the limited sales possibilities.
- A large portion of the layer males are used as separator meat or sold at dumping prices, primarily to African countries, leading to a disruption of the local market.
- The required selling price cannot (yet) be achieved on the market.
- The poor economic prospects may interfere with the motivation to rear layer males in an animal-friendly way.
- The majority of layer males are slaughtered in Poland, which means that either the day-old male chicks or the reared layer males have to be transported over a long distance.
- Due to the COVID-19 pandemic, the market for broilers collapsed, and many broiler houses stood empty for part of 2020 and 2021. These houses were used to rear cockerels. Now that the market is recovering, there is less space available (at broiler farms); it is economically

[10] The problem raised by layer males is similar to that of slower-growing broilers, which also have a less favourable feed conversion and $CO_2$ footprint than regular broilers.

more attractive to once again grow regular broilers. The shift to BL 1 Star broilers in the Netherlands is also putting more pressure on the existing poultry house capacity.
- Due to the current war in Ukraine, the raw materials for animal feed have become even more scarce, raising the question of how responsible it is to deploy scarce raw materials to produce a final product for which there is little to no demand.
- A number of interviewees indicated that, in fact, the rearing of layer males results in the addition of a new form of intensive livestock farming to an already criticised sector, while the culling of day-old male chicks is not perceived by these interviewees as a welfare problem.

One advantage of rearing layer males (as opposed to in ovo sexing) is that it requires fewer hatching eggs per day-old hen (with no need for additional mother hens to produce the extra hatching eggs required for in ovo sexing) and a better estimate can be made of the number of eggs that need to be placed in the incubator in relation to the required number of day-old hens.

### 9.3.2 Concepts for day-old male chicks

A number of initiatives have been launched to promote cockerel meat by informing consumers and trying to interest them in this product, which could potentially lead to developments on the market (rising demand). These initiatives can be divided into autonomous initiatives, and initiatives in combination with dual purpose chickens. After all, the cockerels of dual purpose breeds grow more meat, which makes them more suitable for fattening. Dual purpose chickens, where the cockerels are kept for meat and the hens for eggs, are considered by the Swiss organic sector as an ideal solution for the future. The Dutch organic sector is also very interested in this development, which fits within the ideology of organic production. If the European organic sector was to move towards the fattening of layer males, within or outside of a dual purpose concept, this could amount to a reasonable market share. However, this would take time, and is not something that can be expected to happen in the short term.

## 9.4 Food animals

### 9.4.1 Importance of day-old male chicks

Day-old male chicks turn out to be of great importance for feeding wild animals in captivity. If day-old male chicks are no longer available on the Dutch market, they will probably be imported from other countries. Companies such as Kiezebrink, which specialise in selling food animals, are already operating on the international market. Although day-old male chicks would become more expensive for bird shelters, raptor centres, and zoos, they will probably still represent the best option in terms of price and quality. However, due to the rise in feed costs, bird shelters and zoos would find it even harder to make ends meet.
Since the demand for day-old male chicks would remain, the total number of day-old male chicks culled in hatcheries would probably not decrease. The current purchasers of day-old male chicks might however implement some changes that could lead to a decrease in demand for day-old male chicks, such as replacing them with other food sources, or a decrease in the number of animals, for example reptiles kept as pets.
Since not all countries impose equally strict hygiene policies, there might be a higher risk of pathogens being introduced. These could be salmonella variants that are harmless for humans, but it could also be zoonotic variants. In particular in the case of zoos (with their many visitors), this should be avoided at all costs.

### 9.4.2 Emerging alternatives

In the event of a ban on the culling of day-old male chicks, a market might emerge for alternative food animals. There are already applications for the creation of mice farms. To guarantee the same hygiene status, these companies have to work at SPF level. This means that this kind of production will be subject to many requirements, thus driving up the costs. It is to be expected that smaller

producers will also start supplying food animals at a lower price, but also with a lower hygiene status. This might increase the risk of zoonoses.

However, the question is to what extent these mice farms really have a future as long as it is still possible to import day-old male chicks from other countries. Food animals such as mice have a number of important disadvantages, compared to day-old male chicks:

- For the purchasers, the mice are a less uniform product than day-old male chicks because they are fed for 12 weeks, with variations in diet at company level. As a result, their composition is less constant than that of day-old male chicks.
- The hygiene status of farmed mice should be strictly monitored to prevent diseases being introduced. The question is whether this is always possible.
- Due to the high requirements imposed on the mice's hygiene status, the production costs will be high, and the bred mice might not be able to compete in terms of cost prices with imported day-old male chicks.

Another aspect is that by rearing alternative food animals we are creating a new form of intensive livestock farming. There are as yet no environmental requirements and no guidelines with respect to health and hygiene. In terms of housing and welfare, these animals would probably fall under the experimental animals legislation (which already includes husbandry requirements for mice, guinea pigs, etc.). Environmental requirements could then be drawn up, but the question remains whether it is a good idea to create this new form of livestock farming.

Separately from the question of whether breeding alternative food animals is possible or desirable in terms of costs, hygiene, and legislation, there is also an ethical consideration: Is it ethically responsible to swap the culling of day-old male chicks for the culling of another animal species? More precisely still, the question could be: Is it responsible to swap the culling of day-old male chicks for the culling of another animal species, that would have to be bred especially for this purpose?

## 9.5 Further developments in in ovo techniques

With the current state of in ovo techniques, more hatching eggs are needed per hatched day-old hen than in the conventional approach, see Chapter 6.2. Further developments in in ovo techniques may reduce this difference, but not eliminate it altogether.

Further technical developments in in ovo techniques are essential to improve results, and therefore reduce the loss rate (from erroneously screened out hatching eggs) and the costs of in ovo sexing. The various suppliers of these techniques are working hard, in collaboration with hatcheries, to realise these improvements. The innovation power already displayed by innovators and users would not be strengthened further with the introduction of a Dutch ban. The current situation with the German legislation (without additional Dutch legislation) already puts a lot of pressure on innovation speed, partly because of competing suppliers operating on the market.
None of the techniques are as yet capable of reliably sexing an egg before Day 6 (German requirement starting from 2024). Although analysis techniques using PCR can in principle be applied at a young age, the amount of allantois fluid in eggs that have incubated for less than nine days is very limited (Chickscope, 1998), raising the question of how accurate and reliable a sexing procedure on or before Day 6 could ever be in future. Suppliers indicate that they expect little progress in this respect in the coming years. With respect to the 'In Ovo'/ELLA and Seleggt techniques, it is extremely unlikely that these could be applied at a younger age, because the levels of the bio-markers to be measured must first increase to reliably establish the difference between cockerels and hens.
The German legislation states that, as of 1 January 2024, the maximum age at which in ovo sexing may be performed should be lowered to 6 days, if this is technically possible. The legislation does not clearly describe the consequences if this turns out to be technically impossible; potential options in that case include continuing to allow in ovo sexing on Day 9, or forbidding in ovo sexing: the day-old male chicks would then all have to be reared.

In ovo sexing is a method that has only recently become possible on a large scale, and it is in many ways still in its infancy. There are at present four techniques that can be used in practice: Seleggt, Plantegg and Cheggy/AAT, and 'In Ovo'. A number of other methods are in the test phase or still being developed. Some of these techniques will never evolve into a ready-for-use system, others will. In the long term, it is therefore imaginable that the number of practical applications will increase. Optimising processes and logistics at hatcheries will increase the speed, as well as the capacity per machine, while diminishing losses, thus leading to lower costs for in ovo sexing.
However, experts do not yet agree on whether the requirement imposed by German law that in ovo sexing be performed no later than Day 6 is technically feasible. They do agree that this is almost certainly not possible within the short term proposed by the German legislation (starting from 2024). These concerns regarding technical feasibility are based on the fact that at such a young age, the amount of allantois fluid in the egg is very limited, making it harder to take a sample from an egg. It is therefore very unclear whether techniques based on sexing a sample of allantois fluid can be applied this early in the incubation process, with acceptable reliability.

Techniques that scan the egg for feathers or genital growth are bound to the age at which these features start developing in the embryo. With the current state of the technology, these methods can only be applied at a later stage in the incubation process. As it is, we are still a long way from being able to apply in ovo sexing at a very young age.
In ovo techniques that use an invasive method in particular can lead to a disruption of the incubation process, and therefore damage the embryo. This is currently reflected in a lower hatching rate. The expectation is however that the techniques will develop further, such that this problem will largely or completely disappear. Already, the punctures in the egg shell are closed at some hatcheries, leading to a lower risk of infection. One could perhaps administer some substances during the puncture of the egg shell, which would positively affect the embryo, such as vitamins or vaccines.

At the moment, all in ovo sexing methods carry a certain margin of error. With sexing, some of the hatching eggs sampled produce unclear or no results, for example because of too little allantois fluid. To avoid having to rear cockerels as yet, these hatching eggs are removed from the incubation process. This therefore also leads to the loss of embryos that would have produced a hen.

Another problem is the age of the mother hens whose hatching eggs are suitable for in ovo sexing. With hatching eggs from young mother hens (up to 30 weeks) and older mother hens (older than 55 weeks), in ovo sexing is more likely to produce unclear results. Thanks to recent improvements, this age limit is already shifting from 55 weeks to 60 weeks and beyond. There are as yet no favourable results to report concerning earlier sexing (before 30 weeks).

We can conclude that the suppliers of in ovo techniques need at least another five years to further develop these techniques into systems that can be applied at a large scale and with great speed, with a much lower loss rate than at present, and hopefully with the option of sexing very young embryos.

The ability to sex hatching eggs before they are placed in the incubator can be seen as the ideal ultimate goal of sexing. If such a method was to become available, one could opt to not allow any male chicks to hatch, the incubation process would not have to be interrupted (since it would not have started yet), and therefore, the current loss of hatching eggs could be prevented. The resulting 'male eggs' could potentially still be used as eggs for consumption. Once sexing can be performed at this early stage, the approach used in the relevant method will determine whether it is acceptable to all parties involved.

## 9.6 Time frame for introducing legislation

In this section, we assume that a Dutch ban will be imposed at some point. Below we provide arguments for what we consider to be a realistic time frame for this. The 'Conclusions and Recommendations' chapter covers the discussion on the usefulness of and need for a Dutch ban.

The interviews held made it clear that the speed with which the German legislation on the culling of day-old male chicks was introduced led many experts to conclude that this legislation had not been thought through carefully enough. In combination with the speed at which the legislation was introduced, this has led to much uncertainty in the poultry sector, and extreme efforts being made to meet the OKT requirements at such short notice. In ovo techniques were still in their infancy and required a lot of further development in terms of accuracy, speed, and available capacity. The consequence was that millions of day-old male chicks were reared as layer males, primarily in Poland. Periphery stakeholders and poultry farmers had very little time to acquire experience in this new line of business. The sales market was and remains problematic.

After approximately two years of practical experience, the interviewees involved in choosing between in ovo sexing and rearing layer males unanimously agree that the rearing of layer males, with the exception of specific niche markets, must be seen as a temporary measure, and that, to the extent that OKT requirements apply, in ovo sexing should be used as much as possible. In various chapters in this report, we have indicated which aspects, such as incubation day, and which areas for improvement, such as reducing the number of hatching eggs required, need to be further optimised in this context. Technical developments may lead to improvement of the sustainability and reduction of the costs of in ovo sexing.

These further developments cost time, probably approximately five years, and will not happen sooner in the event of a Dutch ban being implemented. The current German legislation is already creating a need for these further developments. In the meantime, innovators and users are given the opportunity to gain experience with the techniques and make the right choice (technologically and financially). Once in ovo sexing is applied more broadly, the rearing of day-old male chicks can be phased out.

A period of five years preceding a ban on the culling of day-old male chicks might be an option and could be used for the following:

- Conducting additional research, for example into the age at which an embryo first experiences pain signals (and therefore the last day in the incubation process when in ovo sexing may be performed) or into the need to treat the screened out hatching eggs.
- Monitoring the consequences (in the Netherlands and abroad) of foreign legislation of a ban on the requirements set by the retail and on consumer behaviour.

One can also imagine that during this period, developments will occur with respect to new techniques, making it possible to sex an egg before it is placed in the incubator (for example with genetic manipulation), that such a method could technically be used to avoid culling day-old male chicks. However, should such a technique become available, a number of aspects would have to be considered (such as legislation and ethics), with all parties involved submitting their input.

It is also possible that during this period, developments occur concerning the selling of cockerel meat/OKT eggs that seem promising in terms of resolving the issue of 'the culling of day-old male chicks'.

In the event of a general ban on culling day-old male chicks, part of the hatching capacity will relocate from the Netherlands to other countries, for lack of an export market for OKT chicks produced in the Netherlands. This means that some of the Dutch hatching capacity will become unusable before the end of its economic depreciation period (15 years). A compensation scheme should be formulated to accommodate this.

## 9.7 Dual purpose chickens / longer laying period for laying hens

### 9.7.1 Dual purpose chickens

Dual purpose chickens seem to provide a good compromise for the dilemma of day-old male chicks: the hens lay eggs, and the cockerels produce enough meat. However, along with the advantages, such as less feather pecking among the laying hens and calmer cockerels with fewer welfare problems, there are also some potential problems:

- The hens of dual-purpose breeds lay substantially fewer eggs than pure layer breeds, so that the potential profit from these hens is lower, unless these eggs can be sold at a higher price.
- Dual purpose chickens are selected for high meat production in the cockerels. However, this also affects the hens, which means they are more robust than those of pure layer breeds. This is reflected in a higher feed intake. Especially at times of high feed prices, this has a substantial economic effect, the degree of which depends on the possibility of using other, cheaper raw materials to feed dual purpose chickens.
- So far, it has turned out to be remarkably difficult to find a market for cockerel meat, and even though the dual-purpose cockerels produce more meat than those of layer breeds, they remain less efficient than broilers selected for their meat.

Leenstra (2013) conducted research on dual-purpose breeds. She describes the situation as follows: "With the current layer breeds, the total egg production of a laying hen (250-300 eggs) and the rearing of her brother for consumption require in total less feed than the egg production and the rearing of a cockerel of a dual-purpose breed. Since feed costs are by far the most important cost item, this is economically more attractive."
Due to the above points, the concept of dual purpose chicken is not at the moment seen as a realistic option by the regular sector. Concerning the hens, their egg production is approximately 20% lower than in regular layer breeds and the feed conversion is more than 10% higher. Concerning the cockerels, Leenstra (2013) indicates that the differences between the brothers of a regular laying hen and those of a dual purpose chicken are limited when it comes to slaughter and consumption quality. For the cockerel as a one- to two-person portion, a dual purpose chicken has little added value in terms of experience and taste, while still driving up the cost price of the eggs. The market for this type of meat is still very limited, and in terms of efficiency, dual purpose cockerels cannot compete with specialised broilers, not even those from slower-growing breeds.

Is there a future for dual purpose chickens? This will primarily depend on the price that consumers are willing to pay for the eggs (and the meat from layer males). The question is whether, with the current level of egg production, the required higher price can be realised on the market. If the answer is 'yes', the breeding of dual purpose chickens, at the current level of egg production, could gain momentum. If not, selection for a limited increase in egg production might be an option worth considering. How far this can be done is a real item for debate, since selection should not result in a new 'layer-like' breed. As a rule, selection for more eggs is diametrically opposed to selection for higher meat production. Selecting for slightly more eggs while retaining current meat production will therefore be a challenge for breeders, but it may be a real option for giving the dual purpose chicken a serious chance of succeeding on the market.
A complicating factor is that there are only a few breeders, which operate worldwide. This market consists primarily of countries where high production efficiency is the most important sales argument. To retain this global market, breeders cannot afford to devote too much energy to the dual purpose chicken, because there is only limited demand for it on the global market, and this would be at the expense of the room they have for improving the breeds representing their largest market share.

There may, in the first instance, be possibilities for keeping dual purpose chickens in the organic sector. Consumers who purchase organic products tend to be more willing to pay for a concept. This creates opportunities for opening a market share for cockerel meat, possibly in a combination package consisting of eggs and meat. There are calls within the organic sector to embrace the dual purpose chicken. As a result of the ban on cage housing and the ban on beak treatment for all Dutch laying

hens, there is now less difference between regular and organic hens. The dual purpose chicken might make a difference in this respect.

Enquiries at Bionext concerning the dilemma of 'the culling of day-old male chicks' revealed that the organic sector has not yet reached a consensus concerning in ovo sexing or the rearing of layer males, because both directions have advantages and disadvantages (see Section 4.3.1). Under the current circumstances, dual purpose chickens are primarily seen as an opportunity for a niche market. If the dual purpose concept develops well into a niche market, dual purpose breeds may in future play an important role across the entire organic poultry sector. The reason for this is that the use of dual purpose breeds could be an interesting development of articulating the ideological principles of the organic sector concerning care, ecology, health, and fairness in a more ambitious way. More specifically, dual purpose chicken breeds might positively affect the welfare of organic laying hens and offer a better solution for the issue of 'the culling of day-old male chicks'. In the longer term, the European Organic Regulation might include requirements concerning the organic layer breeds that may be used (as is already the case for organic broilers regarding growth speed).

Bio-suisse, the Swiss organic sector organisation, is also positive about the dual purpose chicken route (Frommelt, 2021). They wish to move towards a future in which animals are not bred for a single purpose, so that the distinction between meat and layer breeds fades away. This would allow for optimal use of hens and cockerels, one for the eggs, the other for meat. In addition, Bio-suisse is not in favour of in ovo techniques, because in their current state, these techniques cannot guarantee that the embryos experience no pain. Reithmayer et al. (2021) and Reithmayer and Mußhoff (2019) conducted a study on consumer preferences for the type of solution for male chicks. They conclude that consumers prefer in ovo sexing to culling day-old male chicks, but that sexing loses credit when it is performed at a later age, or has a greater margin of error. Some of their respondents reported choosing products in the shop mostly based on the adopted solution for cockerels, and not on price. People who purchase organic products tend to be conscious consumers, willing to pay more for an animal-friendly and sustainable production. The concept of dual purpose chickens may not yet be profitable, but it does offer prospects for the future. If the hens can be induced to lay more eggs through genetic selection, while retaining the cockerels' current meat production level, the hens would generate enough profit to compensate for the costs of rearing the cockerels. The cockerels produce enough meat to realise a marketable product. This could potentially be marketed as a 'package deal', whereby consumers or retailers commit to purchasing not only the eggs, but also the meat.

One aspect that may work to the advantage of dual purpose chickens is the robustness of the animal, in terms of health and tolerance to food components. Breeders are already working on creating robust layer breeds that can be kept under sub-optimal conditions in African countries. For this market, a maximum egg production is not the most important aspect. In particular the lower hygiene status and lack of available high-quality food raw materials would, with regular layer breeds, lead to a higher loss rate and lower production, making these breeds less suitable. The more robust animals bred for these countries have higher disease resistance, and a greater tolerance for less than optimal feed. These animals, or grandparent lines, are partly or fully used to breed dual purpose chickens. This makes them suitable for example for producing on other, less high-quality raw materials, or even on waste flows, which would not be nutritious enough for regular layer breeds. Leenstra (2013) also indicates this: "When producing organic eggs, it might be financially attractive to use a somewhat heavier hen, since such a hen can handle cheaper feed." This could on the one hand reduce feed costs, and on the other hand help shift the $CO_2$ footprint to an acceptable level.
In this way, the dual purpose chicken could also be part of a circular economy. These arguments could be used to create a separate market for dual purpose chickens.
Low-quality feed or fluctuating food raw materials (waste flows) may contribute to more feather pecking and cannibalism in laying hens (Van Krimpen et al., 2005; Lambton et al., 2013; Nicol et al., 2013). Giersberg et al. (2019) provide another argument for why dual purpose chickens might be interesting after all. They compared three rounds of 20-71 weeks of Lohmann Brown Plus (LB+) laying hens with Lohmann Dual (LD), both in semi-commercial aviary housing. The LB+ showed a higher production, but the LD had much less feather damage and only sporadic wounding as a result of pecking. The effects observed were consistent in all three rounds. The authors indicate that the LD may have a future on a farm with untreated laying hens. With a laying hen type that is less prone to

pecking, moreover, possibly fewer pecking problems are to be expected if the hens are given low-quality or variable feed.

The creation of a separate market for dual purpose chickens will not happen automatically. Creating a market for a new product takes time and effort. The organic sector is the designated candidate for this, but they too, are unable to make it happen in the short term. A few pioneers might be able to take a first step in this direction, with the help of a supermarket chain or a catering company. Depending on their experiences, this will create more or fewer options for a follow-up. It is not to be expected that this market will be realised within the next five years.

### 9.7.2 Longer laying period for laying hens

Another potential development in reducing the number of layer males involves lowering the replacement frequency of laying hens. This can be done by keeping laying hens longer. Breeders have been working for some time on improving the hens' laying performance so that they can maintain a high production for a longer period of time. Whereas laying hens used to be kept for up to 76 weeks, they are now often kept until 85-90 weeks, and the objective is to increase this further up to 100 weeks. This concerns a single laying period without the animals being moulted. If the hens are moulted, they can go through a second, and potentially even a third laying period, so that the period in which they are kept can be prolonged even further. Moulting is considered to be an animal-unfriendly procedure, because it is usually induced by withholding from the hens feed, water, and light. There are, however, more animal-friendly methods, in which the animals are brought to moult using only a low-calorie feed and a shorter daytime period. To what extent this is truly a more animal-friendly method, whether it brings about a good moulting, and to what extent the resulting flocks can really handle a good second and potentially third laying period, are all questions that require further investigation.

## 9.8 Effects on poor countries

Besides the described negative effect of the sales of cockerel meat on developments especially in African countries (see Chapter 7.8), shifting from the euthanising of day-old male chicks to other options (in ovo, rearing layer males, or dual purpose chickens) has another negative effect on poor countries: it makes raw materials more scarce and therefore more expensive for them. The reason is that all three options involve a higher feed intake: in ovo sexing requires more hatching eggs, and therefore more mother hens, the rearing of layer males will take up a serious amount of available raw materials, and dual purpose chickens have a higher feed intake than regular layer breeds. The higher feed intake in European countries where these developments occur (or will occur) will lead to increased scarcity on the global raw materials market, which will negatively affect poor countries. In addition to this effect, other discussions are also taking place, the results of which may affect the global requirements for raw materials, such as: a reduction in human consumption of meat and an increase in human consumption of plant-based foods, and even better use of waste flows for animal feeds.

# 10 Conclusions and recommendations

## 10.1 Conclusions

Our investigation of the issue of 'the culling of day-old male chicks' has led us to the following conclusions:

With respect to the four routes described:

1. Traditionally, the male chicks of layer breeds are euthanised on Day 1 at the hatchery by means of $CO_2$ gassing. The euthanising of day-old male chicks in Dutch hatcheries is subject to a strict prescribed protocol; its implementation is monitored by NVWA. Experts do not consider the euthanising of day-old male chicks (if done correctly) to be an animal welfare problem; this is an ethical matter. The large majority of euthanised day-old male chicks is intended for use as animal feed, a small portion (<0.5%) is destroyed; this refers to the selection of chicks marked as Cat1 material[11].
2. To prevent as much as possible layer males from hatching, suppliers of in ovo techniques and users (hatcheries) have in the past two to three years worked on developing techniques for determining the sex of an embryo inside the hatching egg. The costs of this kind of procedure are approximately €3.50 per hen. Further development of in ovo techniques is required to increase this sexing procedure's efficiency and reduce its costs.
3. The rearing of day-old male chicks has many disadvantages, which can be summarised as follows: it is an inefficient form of meat production, which, assuming the cockerels come from regular layer breeds, results in a hard-to-sell final product. Attention should therefore be devoted to potential solutions. The rearing of day-old male chicks is considered by the interviewees to be a temporary solution. As in ovo techniques develop further, hatcheries can increase their capacity in this respect, and the rearing of day-old male chicks can be phased out. This will remain an option for day-old male chicks that are born as a result of imperfections in in ovo techniques or as part of a concept (for example, organic husbandry) and for day-old male chicks for which, as a final product, there is already a sales market or one can be created, for example as layer males of a dual purpose breed.
4. Dual purpose chickens: For the regular market for eggs for consumption, a dual purpose chicken is not a real option. The inferior revenues from eggs and the costs of rearing the cockerels would lead to more expensive eggs and expensive cockerel meat. Within a niche market, a small portion of buyers would be willing to pay the higher price for this product. Switching to dual purpose chickens seems to be an interesting option in the long term for the organic sector to distinguish itself from regular free range hens. The lower feed conversion and therefore less favourable $CO_2$ footprint of dual purpose chickens can be compensated for by using feed from lower-quality raw materials. Not only is this type of animal better able to maintain a constant production level on low-quality raw materials than regular layer breeds (Röhe et al., 2019), it is also less prone to featherpecking (Giersberg et al., 2019). However, the conditions for this are that the dual purpose chicken should have a slightly higher egg production than is now the case, while at the very least retaining the cockerels' current meat production level, and that the consumer should be willing to pay more for the eggs and the cockerel meat. In the longer term, the European Organic Regulation might include requirements concerning the organic layer breeds that may be used (as is already the case for organic broilers regarding growth rate). Right now, the implications and complications involved are still too great.

[11] Animal by-products are divided into three categories, established in the European Animal By-products Regulation (Regulation (EC) no 1069/2009) and based on the risk for public and animal health. Per category, there are provisions on how the material should be destroyed, or can be processed or used.

With respect to the relocation (from the Netherlands to other countries) of the euthanising of day-old male chicks and the export of animal material (laying hens and selection and breeding animals):

5. A partial or general Dutch ban on the culling of day-old male chicks will lead to the almost complete relocation of the euthanising of day-old male chicks to other countries, with the risk that this procedure is performed under less strict conditions abroad than in the Netherlands. This will result in the import of MKT chicks or pullets. Irrespective of the chosen scenario, at European level, the number of day-old male chicks euthanised in Dutch enterprises (including their international branches) will remain constant.
6. Thanks to their high quality, Dutch day-old hens (future laying hens) are in high demand in many countries around the world. In the event of a general Dutch ban on the culling of day-old male chicks, the additional costs for OKT will become unaffordable for the buyers (including African countries). A large portion of the current international buyers of this Dutch animal material will, in the event of a Dutch ban, seek alternative suppliers: foreign competitors or international branches of Dutch companies. We can realistically expect Dutch companies to anticipate this development by establishing new companies abroad where these day-old female chicks can be produced (and the male chicks euthanised). In the event of a general Dutch ban, there will therefore be a large-scale relocation of hatching capacity to other countries. Some of these countries impose less strict requirements regarding animal health, animal welfare, and the environment than the Netherlands.

With respect to animal feed:

7. For many reasons, euthanised day-old male chicks form an essential element in the diet of raptors in bird shelters and falconries, various animal species in zoos, and privately kept exotic animals/reptiles.
8. If the Netherlands imposes a general ban, the supply of euthanised day-old male chicks from Dutch hatcheries would disappear. This would leave two options:
    a. Using alternative food sources, such as mice, from nurseries.
    This would lead to the emergence of a new form of intensive animal farming (or an increase in an existing, but so far limited form of farming) that is as yet subject to very few to no rules regarding matters such as animal welfare, animal health, and the environment, and that would have the same purpose as day-old male chicks: culling and use as animal feed.
    b. Importing euthanised day-old male chicks, which may imply, depending on the country of origin and the hygiene status of the supplier, higher risks concerning animal health (introduction of pathogens). In addition, it is unclear whether euthanising would be done in the same, protocolled way as in the Netherlands. Transport over potentially long distances is moreover less environmentally friendly than the short transport distances within the Netherlands.

With respect to the market/consumer:

9. As a result of the German legislation, even without a ban, the Netherlands is already witnessing a substantial shift to OKT hens: in 2022, approximately 40% of Dutch laying hens produced OKT eggs, and 60% MKT eggs. In Germany, with a ban, the new ratio is 70% of OKT hens to 30% of MKT hens. However, due to rising food prices, a clear decline can currently be observed (June 2022) in German consumers' purchasing of eggs from the higher price segment (organic eggs, free range eggs, and OKT eggs).
10. The surcharge for an OKT egg for the consumer amounts to four to five euro cents per piece, on the shop shelf. This is a substantial surcharge that cannot easily be charged on to the consumer. As purchasing power drops, the price pressure will increase further, with the risk that the additional costs are not, or not fully paid.
11. It is as yet unclear how the market will develop further. Will more retail parties, in the Netherlands and abroad, impose OKT requirements? Will consumers continue to be willing to pay the surcharge (4-5 euro cents per piece), or will they opt for MKT eggs? For example, by purchasing directly from the producer (doorstep sales) or from a local shop selling agricultural products. Or will overall egg consumption decrease? And how will the demand for OKT eggs develop in the food production industry?

12. Even if the Netherlands imposes a general ban on the culling of day-old male chicks, part of the Dutch egg production will continue to consist of MKT eggs. These eggs will then be produced using imported laying hens (day-old female chicks or pullets) from countries where euthanising day-old male chicks is still allowed.
13. By shifting from the euthanising of day-old male chicks to other options (in ovo, rearing layer males, or dual purpose chickens), aside from the negative effect of selling cockerel meat on the developments in particular in African countries, there is also another negative effect for poor countries: it will lead to raw materials being more scarce and therefore more expensive for them. This is because all three options lead to a higher feed intake. The higher feed intake in European countries where these developments occur (or will occur) will lead to increased scarcity on the global raw materials market, which will negatively affect poor countries. In addition to this effect, other discussions are also taking place, the results of which may affect the global requirements for raw materials, such as: a reduction in human consumption of meat and an increase in human consumption of plant-based foods, and even better use of waste flows for animal feeds.

With respect to sustainability/the environment:
Although we have not yet calculated sustainability across the entire egg chain for all scenarios, the following negative aspects of OKT requirements are already clear:

14. In ovo sexing using invasive methods requires an average of 3.5 hatching eggs per hen. With the conventional approach (euthanising on Day 1), you only need 2.5 hatching eggs. To produce this higher number of hatching eggs, more mother hens have to be kept.
15. When rearing day-old male chicks, the feed conversion ratio (kg feed per kg meat) is high and the $CO_2$ production per animal, expressed in $CO_2$ equivalents, is up to 2.5 higher than with regular broilers.
16. In the event of a general ban, the production of day-old chicks will moreover relocate to other countries. This implies transport of Dutch hatching eggs to other countries, and transport of animal material, such as euthanised day-old male chicks and MKT day-old hens or pullets from other countries to the Netherlands.

Final conclusions:

17. The financial risks for the poultry sector (since the risks have largely shifted to poultry farmers, this affects them particularly) have increased substantially with the introduction of OKT requirements. This is already the case now, with these requirements being imposed on the German market. With the potential inclusion of OKT requirements as a basic condition (because of the applicable legislation), a situation may arise in which all the risks and financial burden will come to rest on the shoulders of poultry farmers. In this context, see also Chapter 10.2: Recommendations.
18. All the scenarios described, including Scenario C, lead to the same number of euthanised day-old male chicks at the European level. The choice for specific Dutch legislation does not lead to any changes in this respect. The legislation on the culling of day-old male chicks that applies in some European countries at present tends to be very diverse. With this observation, it is safe to assume that it is unlikely that a uniform European legislation concerning the culling of day-old male chicks will be adopted anytime soon. However, experience has also shown that over time, countries can shift on these kinds of dossiers, and it is possible that a European ban will be introduced after a number of years. Germany and France recently opened the debate on this matter. This aspect may play a role in deciding on a time frame for reaching a final decision concerning a ban, or the duration of the transition period should a ban be imposed. The reason is that this aspect plays a role in the potential relocation of production capacity (and therefore also the euthanising of day-old male chicks) to other European countries.
19. The ability to sex hatching eggs before they are placed in the incubator can be seen as the ideal ultimate goal of sexing. If such a method was to become available, one could opt to not allow any male chicks to hatch, the incubation process would not have to be interrupted (since it would not have started yet), and therefore, the current loss of hatching eggs could be prevented. The resulting 'male eggs' could potentially still be used as eggs for consumption. Once sexing can be performed at this early stage, the approach used in the relevant method will determine whether it is acceptable to all parties involved.

## 10.2 Recommendations

The issue of 'the culling of day-old male chicks' is complex and involves many facets. In choosing a specific scenario, thorough consideration of the consequences is warranted.

In formulating and adopting legislation concerning the culling of day-old male chicks, attention should be devoted to the following:

1. The mentioned consequences, see Chapter 8, Scenario A, in short:
    a. The relocation of hatchery activities, of both breeders and layer hatcheries, to other countries, in order to produce day-old hens for export there.
    b. The relocation of the euthanising of day-old male chicks to other countries.
    c. The effect on the availability of day-old male chicks to be used as animal feed.
    d. The emergence of a new form of intensive livestock farming, namely the rearing of layer males.
    e. The emergence of new forms of intensive animal farming (or extension of existing, so far limited forms of farming) such as the breeding of alternative animal feed sources, for example mice (with attention to potential issues such as animal diseases, zoonoses, and environmental impact).
    f. The import of MKT animals for the production of MKT eggs in the Netherlands
2. In the various scenarios, three situations are mentioned that warrant exemption from a potential ban on the culling of day-old male chicks:
    a. In case of regulated animal diseases
    b. Chicks and embryos that are screened out as non-viable at the hatchery
    c. Animals that are wounded or suffer from a disease that causes them intense pain or suffering, with no other practical solutions for relieving this pain or suffering.
3. In the various scenarios, a number of specific situations are mentioned that require special attention when formulating a potential ban on the culling of day-old male chicks:
    a. Chicks from breeding or parent stock
    b. Chicks intended for scientific research, in particular the pharmaceutical industry or veterinary diagnostics
    c. Chicks intended to be used as animal feed
    d. Chicks that failed to be detected using the applicable methods (sexing errors at the hatchery).
4. The time frame for the entry into force of legislation: a minimum period of five years is required to give the sector time to make a solid transition: further development and practical implementation of in ovo techniques, the availability of additional research results, monitoring of the market, etc. In addition, one should take into account the economic depreciation of hatcheries and hatching equipment, which is usually considered to have a time frame of 15 years. A compensation scheme should be instituted for premature depreciation of equipment/buildings that can no longer be used. Incidentally, the workings of the free market also lead to a transition with economic consequences, which also requires a transition period, to be agreed upon between market parties.
5. Control over the market and limiting risks for poultry farmers, including compensation schemes in case of mass culling and new initiatives, such as the creation of a national fund that farmers can appeal to in case of a situation that cannot be insured against, and which leads to the depreciation of OKT eggs (for example, a substantial drop in production or high mortality).

Possible additional regulations may be drawn up concerning the following:

6. Structural financial construction to compensate for additional costs as broad support for the transition of the Dutch sector, including a compensation scheme for hatcheries for any vacancies arising from the implementation of one of the scenarios.
7. Promoting the use of dual purpose chickens and/or developing other initiatives, for example, creating market demand for dual purpose chickens.
8. Regulations for new sectors, such as the rearing of layer males and food animal breeding (husbandry and environment).
9. Facilitating the discussion on the use of breeds for laying hens in case of a future revision of the European Organic Regulation.

In addition to potential legislation and regulations for supporting the transition to an OKT layer poultry sector, a number of research paths deserve attention:

10. Further development of in ovo sexing, ideally to be performed on Day 0 (before the eggs are placed in the incubator)
11. Maximum age for in ovo sexing in relation to the development of the embryo and its corresponding state of awareness
12. Effects of in ovo sexing on embryo development, chick quality, and further development/output during the production period
13. Ethically and humanely responsible treatment of the male eggs removed from the incubation process
14. Initiatives with dual purpose chickens, for example gaining more knowledge and experience with dual purpose breeds
15. Options for keeping laying hens longer
16. Animal-friendly moulting of laying hens
17. Risks of food animal breeding (for example mice) with respect to the transmission of pathogens to other forms of animal farming and/or humans (zoonoses).

If the decision is made to implement Scenario C, the precondition is that an evaluation is carried out after three years, on the basis of criteria and associated parameters to be defined at that time. In view of the objective, the most important criterion is already known, namely 'a reduction in the number of culled day-old male chicks'. Based on this evaluation, one could potentially decide to introduce a general or partial ban that would enter into force after a set transition period, for example two years, leading to a total period for further technological developments of in ovo techniques of five years, as in Scenarios A and B. In this scenario too, one could take into account the 15-year economic depreciation period for hatching capacity.

If a decision is made to implement Scenario A or B, we also recommend that an evaluation be carried out before establishing a final legislative text. This creates the opportunity to fine-tune the law to match the current situation.

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# Appendix 1 Statutory and private-law regulations

## Statutory regulations

***Egg coding***
Egg cartons list labels, such as 'organic', 'free range' and 'barn'. These labels are regulated by law. The law also makes it obligatory to stamp all eggs with an egg code, consisting of digits and letters. The egg code indicates the country of origin, the husbandry system, and the individual producer. This makes tracing possible, should something later prove to be wrong with the eggs.

***Skal***
Skal is an independent association, that organises and implements the monitoring and certification of organic laying farms. Organic laying farms are required to join Skal.

## Private quality labels

***IKB/ICM***
IKB/ICM stands for Integrale Ketenbeheersing (Integral Chain Management), a private quality system owned by Stichting Avined. IKB Egg is a private quality system for the production of eggs. Participation in the scheme is on a voluntary basis. The scheme applies to all the chain links involved in the production of eggs for consumption, from hatcheries, grandparent and parentstock companies, rearers, laying hen companies, to collectors and packing stations. Participants provide guarantees on production method, quality, and origin. By participating, they also meet a number of Dutch and European statutory requirements in the field of hygiene, food safety, animal welfare, and marketing standards. Of all eggs produced in the Netherlands, more than 90% meet the IKB Egg requirements.

***BLK***
The Beter Leven Keurmerk (Better Life quality label) covers animal welfare requirements, among others for laying hens. The label has three levels: 1, 2, or 3 stars. This scheme was initiated by the Dierenbescherming (Animal Protection Society). The maintenance and monitoring of the Beter Leven Keurmerk falls under the responsibility of the Beter Leven Keurmerk Foundation.

***KAT***
The German KAT quality scheme stands for 'Kontrollierte Alternative Tierhaltungsformen' (Controlled Alternative Husbandry forms) and is a private German quality system.
KAT includes provisions for laying pullet farms, barn farms, free range farms, organic farms, and brother cockerels (see Section 5.2). These include provisions arising from German and European legislation, but also additional requirements, for example with respect to animal welfare.

***VLOG***
VLOG stands for 'Verband Lebensmittel Ohne Gentechnik' (Organisation Foodstuff without Gentechniques) and is a German branch organisation that represents food producers and traders. VLOG promotes production and food products prepared without using genetically modified resources. For Dutch laying hen farmers who want to meet the VLOG requirements, this means primarily that the feed of the laying hens should not contain any genetically modified raw materials.

***OKT***
OKT stands for 'Ohne Kükentöten', which means 'without chick culling'. Eggs that bear this label come from hens from a hatch of which the cockerels were not killed. This could mean that the cockerels were not born thanks to in ovo sexing, or that the layer males were reared.

To explore the potential of nature to improve the quality of life

Wageningen Livestock Research
P.O. Box 338
6700 AH Wageningen
The Netherlands
T +31 (0)317 48 39 53
E info.livestockresearch@wur.nl
www.wur.nl/livestock-research

Wageningen Livestock Research creates science based solutions for a sustainable and profitable livestock sector. Together with our clients, we integrate scientific knowledge and practical experience to develop livestock concepts for future generations.

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