

EXECUTIVE SUMMARY

Introduction

The purpose of the study on *the impact of genetic selection on the welfare of chickens bred and kept for meat production (hereafter: broilers)* was to gather appropriate information for the preparation of a report from the European Commission to the European Parliament and to the Council.

The report of the Commission follows a scientific opinion of EFSA¹ on the influence of genetic parameters on the welfare and the resistance to stress of commercial broilers. According to EFSA, genetic improvement of broiler performance has been accompanied by an increase in welfare problems, and EFSA advised the breeding companies to apply balanced breeding programmes. In addition, EFSA² published a scientific opinion on the welfare of grand-parent and parent stocks raised and kept for breeding purposes. EFSA recommended that birds requiring less feed restriction should be used as future breeders.

In order to develop the report to the Parliament and Council, the European Commission requested a team of experts to analyse the impact of genetic selection on the welfare of chickens bred and kept for meat production, to determine the current and potential role of breeding companies to improve welfare of broilers, and to explore the socio-economic and environmental impacts of a baseline scenario and of possible solutions aiming at the improvement of broiler welfare in commercial production.

Methodology

The material for this report was collected from scientific and non-scientific literature, in face-to-face interviews with breeding companies and multiplication companies, in face-to-face interviews with Swedish and Danish authorities, in consultation with national competent authorities by e-mail, and in on-line consultation with organisations involved in broiler breeding, broiler production, poultry meat processing and with related stakeholders, like suppliers, NGOs, and a representative of the retail industry.

In addition to the analysis of the current situation, the impacts of a Baseline scenario and of three Alternative scenarios were assessed. The assessment of the Baseline scenario is a forecast of the situation within 15 years without any EU policy change. The aim of Scenario 1 is to achieve a better match between breeds/lines and the environment. Scenario 2 is related to the maintenance of genetic diversity in poultry lines. The starting point of Scenario 3 is to better monitor welfare indicators in selection and multiplication farms as well as in the slaughterhouse. The impact assessment of the three alternative scenarios included an analysis of the effects on animal welfare, effects on other EU policies, environmental effects, regional effects, and effects on the price of poultry meat and risks of market distortion.

The legislative context

Chickens kept and bred for meat production are part of the food production chain. All food production in the EU is subject to the General Food Law (EU 882/04). It covers any stage of production, processing and distribution of food. Public authorities and private operators should pay attention to safety management and the other legal issues encompassed in the Food Law, namely: protection of consumers' interests, fair practices and, where appropriate, the protection of animal welfare including health, plant health and the environment. Council Directive 98/58/EC forms the EU basis for protection of animals kept for farming purposes. With regard to breeding and selection this Directive states that "no animal shall be kept for farming purposes unless it can be reasonably expected, on the basis of its genotype or phenotype that it can be kept without detrimental effect on its health or welfare". Council Directive 2007/43/EC lays down minimum rules for the protection of chickens kept for meat production. The impact, or potential impact,

¹ EFSA, 2010a. Scientific opinion on the influence of genetic parameters on the welfare and the resistance to stress of commercial broilers. EFSA Journal 8, 1666

² EFSA, 2010b. Scientific opinion on welfare aspects of the management and housing of the grand-parent and parent stocks raised and kept for breeding purposes. EFSA Journal 8, 1667.

of genetic selection on welfare of chickens is directly related to this Directive that has been implemented by EU Member States. However the Council Directive does apply only to holdings with broilers. For broiler parent or grandparent, great grandparent and pedigree breeding stock of chickens, Council Directive 98/58/EC applies and some countries have developed additional national legislation that applies to parent or grandparent stock of broilers. Moreover, Council Regulation (EC) No 882/2004 also set obligations for Member States to monitor and visit sites in the food production chain and give inspectors the judicial authority to carry out audits at all levels of the breeding pyramid.

The Common Agricultural Policy (CAP) is the largest EU common policy, both in terms of budget and in terms of policies and regulations. As many poultry farmers in the EU own no land, or just a small area of land, the impact on them of CAP is limited. Directly relevant for poultry farmers within CAP are import tariffs, additional (safeguard) duties and export refunds to facilitate the adjustment of supplies to market requirements.

At EU level also, there are policies related to conservation of poultry genetic diversity. The EU is Party to the Convention on Biological Diversity and, in the context of agricultural biodiversity, also has to address conservation of poultry genetic resources. In the context of the implementation of the FAO Global Plan of Action for Animal Genetic Resources, Member States are developing and implementing national strategies and action plans for animal genetic resources, poultry included. Council Regulation (EC) No 870/2004 specifically focuses on the conservation, characterisation, collection and utilisation of genetic resources in agriculture.

According to the information in the global database DAD-IS a substantial proportion of all poultry breeds is endangered. While commercial poultry pedigree stocks are in the hands of a limited number of breeding companies, rural poultry are kept by a variety of breeders. In many countries in Europe both in vivo and in vitro conservation of local poultry breeds is supported and carried out by a variety of stakeholders.

The EU zoo-technical legislation aims at the promotion of free trade in 'breeding animals' in general, considering the sustainability of breeding programmes and preservation of genetic resources. However, poultry are not covered by this EU legislation and genetic selection related to broiler welfare is not specifically addressed in national legislation.

Rural development objectives and regulations in the European Union are particularly relevant to support conservation of farm animal genetic diversity. Paragraph 5 of Article 39 of Council Regulation (EC) No 1698/2005 specifies that support may be provided for the conservation of genetic resources in agriculture. Council Regulation (EC) No 1804/1999 establishes rules for organic production using bovine, ovine, caprine, equine and poultry species, and recommends maintaining indigenous breeds and strains that have adapted to local conditions.

[The broiler selection and multiplication process](#)

Broiler breeding consists of genetically selecting purebred lines for desirable characteristics and multiplying and crossing these lines in three to four steps to breed commercial broilers. Genetic selection, based on performance of the bird itself and of relatives, takes place at pedigree breeding sites. Multiplication and crossing takes place at multiplication sites, where only birds with visible abnormalities are rejected. This structure is referred to as the broiler breeding pyramid.

Commercially produced broilers are always crosses of at least three or four lines. The lines to be crossed and the order of crossing are carefully evaluated and chosen on ability to meet market demands. The structure to produce the large number of crossbred broilers is traditionally represented as a breeding pyramid, indicating that the number of birds in the genetic selection programme at the top of the breeding pyramid is very small compared with the number of crossbred broilers that are eventually produced after three or four steps of multiplication. Annually about 7,500 million broilers are reared in the EU27. To produce these broilers about 60 million broiler breeders are required. These birds are produced by three different breeding companies. Each breeding company has its own set of pure lines

(paternal lines and maternal lines), referred to as pedigree stock. The pedigree stock of each breeding company is housed on multiple, geographically spread breeding sites used for genetic selection. From pedigree stock, great grandparents and grandparents are produced at multiplication sites controlled by the breeding companies. The breeding companies sell mostly grandparent stock. There is no exchange of purebred lines between breeding companies. The breeding goal of each purebred line depends on the market requirements for the types of crossbred produced with the purebred line. These market requirements are ultimately dependent on customer, consumer and retailer demand. Determining the breeding goal is inherently a subjective process, although animal welfare, societal, economic and marketing aspects are generally taken into account. Each company has one type of commercial crossbred broiler (broiler product) that dominates in the market.

Pedigree stocks are kept, and the main biological characteristics are recorded at highly biosecure sites. In addition, major traits of relatives of the pedigree stock are recorded in a production environment that is not biosecure and resembles broader commercial conditions. Challenge testing for a robust performance of relatives and crossbred progeny of pedigree stock occurs in a variety of environments. The values for traits measured on the bird itself and on its relatives kept in different environments are entered in a selection index that contains weighting factors for all these traits. Pedigree stock birds are ranked according to their selection index value.

Genetic selection is the process of identifying the most appropriate birds to become the parents of the next generation. The group of birds destined to replace the birds in the pedigree flocks are generally selected in such a way that the average genetic relatedness within the group is as low as possible and the average value for the selection index is as high as possible. This maximises the genetic gain, while minimising the rate of inbreeding in the specific pure line. Selection in the pedigree stock is followed by the multiplication process: i) pure-line multiplication, ii) crossing animals of pure lines to produce the crossbred parent stock, and iii) crossing crossbred parent stock birds to produce commercial broilers). Among birds in the multiplication process usually birds with visible abnormalities are rejected, but no further selection takes place.

[The broiler breeding selection industry and the production chain](#)

Three companies dominate worldwide the market for poultry meat breeding stock. These are in alphabetical order: Aviagen Broiler Breeders, Cobb-Vantress and Hubbard. These companies have subsidiaries in many parts of the world and keep their pedigree and multiplication stock on different continents for safety and marketing reasons. In general, pure lines and great grandparents are completely company-owned and are not sold. Trade flows or values of pedigree or great grandparent stock do not exist. Grandparent stock might be in a joint venture between the breeding company and a local distributor. Broiler parent stock is, in general, not owned by the breeding company.

Broiler breeding companies distribute grandparent stock or parent stock to almost all European countries. There are no independent, detailed data available on international trade flows of individual companies. However, Eurostat data give insight in the economic value of international trade flows of grandparent and parent stock between and from EU countries.

All three breeding companies have pedigree breeding stock on sites in the EU and the USA. Sites with great grandparent stock are generally part of, located in, or close to a site with pedigree breeding stock. Most sites and birds of great grandparent or grandparent stock are located in the UK and France, followed by Germany and the Netherlands.

Sites for pedigree stock are isolated and highly biosecure sites. The number of pedigree breeding sites in any country would include information of just a single company and is therefore not published. The size of pedigree, great grandparent and grandparent flocks varies considerably, but the size generally increases with the layer of the breeding pyramid from pedigree flocks to parent stock flocks.

Production and trade of poultry meat

In 2010 the global poultry meat production was 97 million tons. This corresponds with about 70,000 million broilers. Global poultry meat production is rapidly increasing. In poultry meat production the USA, China, Brazil and the EU-27 ranked in the first four positions. Other large producers are Russia, Mexico, India, Argentina, Iran and Japan. The total share of the EU-27 in poultry meat was 12.1% in 2010. The production in other countries is increasing more rapidly compared with EU-27. The ten leading poultry meat exporting countries share 88% of the total export volume. The largest exporters, the USA and Brazil, contribute 56% of the global exports. In 2010 the EU was the third largest exporter of broiler meat, with a share of 9%. The leading importers of poultry meat are China, Russia, Japan, Saudi Arabia and some EU countries.

In the EU-27, total poultry meat production in 2011 was around 12 million tons, of which total broiler meat production in 2011 was 9.6 million tons. This quantity corresponds with about 7,500 million broilers. Seven broiler meat producing countries in the EU have a production of more than 0.6 million tons each. The UK is the largest producer of broiler meat, followed by Poland, Germany, France, Spain, Italy and the Netherlands. In recent years the total EU production was only slightly growing. However, the situation is different per country with increasing production in Germany and Poland.

Within the EU the Netherlands dominates broiler meat export with a share of 29% of total EU exports followed by France and Belgium. Germany and Poland follow with an increasing amount of export in recent years. Intra-EU trade is mainly based on export and import of fresh poultry meat. The four leading importing countries are the Netherlands, UK, France and Germany. These four countries account for 62% of all broiler meat imports in the EU. Besides the intra-EU trade, large amounts of broiler meat were imported into the EU from Brazil and Thailand.

There are two main organisational models for broiler meat production chains in Europe: i) independent links in the broiler production chain, and ii) integrated production. In Italy, France, UK and Spain, the integration model is mainly used. In the Netherlands and Belgium the production is organised with independent links. In Germany both models exist.

In general broilers achieve the target market size in around 5 to 6 weeks with a live weight of 2 to 2.5 kg. The specific broiler live weights farmers produce depend on the market in a specific country, region or the market segment that has to be supplied. The vast majority of broilers are kept in large groups in closed, controlled housing systems. The common commercial broiler products are crosses of genetic lines that are selected for rapid growth. Slower-growing genotypes (2.2-2.5 kg in 56-81 days) also exist and are generally used in free-range and organic production. The number of farms with free range or organic production is small, except in France.

In the EU, it is estimated that 2-5% of the broilers are slower-growing birds. Outside the EU, there is little demand for slower growing birds. Two of the three breeding companies indicate that slower-growing broiler products make up less than 1% of the company's turnover. For both organic and outdoor broiler production it is expected that the market will only slightly increase. There are similar expectations for the so-called 'intermediate' market segment or certified broiler production, with broilers reaching the target weight in at least 56 days.

Socio-economic context of the broiler breeding industry

There are no detailed data available on international trade flows of grandparent stock or parent stock per company. Pedigree and great grandparent stock are not sold and stay within the breeding company. Eurostat data, however, give insight about the international trade flows of grandparent and parent stock from EU countries. The total export value of broiler breeders is 273 million euro. The total value of intra-EU trade is 157 million euro and the trade with countries outside the EU (extra-EU) is 116 million euro. The trade with countries outside the EU accounts for 46% of the total value. The largest exporters of broiler breeders and grandparent stock together, are UK, Netherlands, Germany, France and Hungary. Export outside the EU is mainly to countries in Eastern Europe (Ukraine, Belarus and Russia), North Africa

(Morocco, Algeria and Egypt), the Middle East (Iran and Saudi Arabia) and Asia (Bangladesh, Thailand and Indonesia).

The broiler breeding and production sector in the EU has a substantial socio-economic and export value. The EU market of broiler breeders, however, is gradually losing importance in the global market, because other regions grow more rapidly. Each company has one broiler product that dominates the company sales: Ross 308 for Aviagen, Cobb 500 for Cobb and Hubbard Flex for Hubbard. These broiler products have in common that they are suitable for a wide range of production environments, suitable for the world market and highly feed efficient. All three large breeding companies are economically dependent on their turnover and profits in fast-growing broiler products.

Feed conversion rates have a major impact on the profitability of a broiler production company. The prices of broiler parent stock and broilers are extremely elastic for feed conversion rate and the feed conversion is a crucial economic factor. Feed cost account for 60 to 70% of the total production costs. The performance of a crossbred product in terms of feed conversion ratio could determine whether a breeding company stays in business or not.

Breeding companies employ a combination of well-educated animal scientists and technical specialists. Aviagen Broiler Breeders employs a total of 1,300 people in the breeding and selection process and the Aviagen Group in total 2,600 people. Cobb-Vantress has about 1,700 employees employed globally. The owner of Hubbard, Groupe Grimaud, also employs about 1,700 people.

The genetic selection process and its impact on broiler welfare

Animal welfare is influenced by a mixture of genetic background, housing system, climate, disease challenges, feed, stocking density and stockmanship. Breeding companies consider welfare as trouble-free production, absence of abnormalities that hamper production, low mortality and good performance in the range of customer production environments. They look at animal welfare in the context of the specific market, not on their own.

There is ample evidence in the scientific literature and in practice that a genetic predisposition to specific welfare problems may be masked by the favourable conditions in the higher levels of the breeding pyramid, but expressed in commercial production systems that are less well-controlled. To account for this, breeding companies generally test purebred birds in commercial conditions, too, in order to breed robust broiler products that thrive in a wide range of acceptable production conditions. They also provide customers with detailed management guides on housing, health care and nutrition to improve the conditions for the birds. There are limits to the extent to which specific genetic lines of broilers can be produced for specific production environments.

Genetic selection for production traits does not inevitably lead to increased welfare problems. The reviewed genetic correlations between welfare traits and production traits were all in the range of -0.30 to +0.30, indicating that both groups of traits can be improved simultaneously, by including welfare traits in the breeding goal. All breeding companies include aspects of skeletal strength, heart and lung function and contact dermatitis in the genetic selection process. The weighting of these traits aims at maintaining or slightly improving the current levels. The weighting of welfare traits in the breeding goal is largely determined by the demand in the market and is evaluated regularly. All companies showed evidence of a history of genetically improving some of these traits in at least some of their lines. For example, ascites and sudden-death syndrome are no longer considered to have a problematic incidence in commercial production. The companies also showed that many of the EFSA recommendations are already common practice in broiler breeding.

Breeding companies include characteristics of broiler production, breeder reproduction and broiler welfare in the breeding goal. Chicks of pedigree flocks and some male chicks in multiplication flocks are subject to broilerisation. This means that they are fed and reared for 6 weeks as if they were broilers. Breeding companies use present-day index methods and technology to identify the best birds in pedigree breeding flocks to be parents of the next generation. In the multiplication steps, birds are visually

evaluated for the presence of any known disorder that might affect the health and welfare of the bird. Any bird carrying such a visible disorder is rejected for breeding. A selection index of estimated breeding values is the common way to select among the birds in the pedigree flocks, after rejecting any birds with visible disorders. Two of the three companies claim that they use 'genomic selection' and 'genetic markers' to increase the selection accuracy at an early age and to create new opportunities to select for traits in pedigree lines that are mainly expressed in commercial broilers. The breeding companies expect that the selection methods will change only slightly in the next 15 years.

All three breeding companies are currently selecting for leg strength, heart and lung fitness and against contact dermatitis and they are culling birds with a family record or signs of any genetic abnormalities. For some companies and some traits, this has been practised for over 25 years. Breeding companies can show meaningful genetic progress figures for the main welfare traits.

The breeding companies seek a balance in the breeding goal between reproduction traits, welfare traits and broiler production traits by reviewing the breeding goal regularly, taking into account the commercial information from the broiler production chain and routine customer feedback. The relative weighting of all the welfare traits in the breeding goal combined varied from 18% to 33% across breeding companies. All breeding companies indicated that it is possible to achieve a faster rate of progress in welfare traits, but only at the expense of progress in economically important traits. Changes in the breeding goal in favour of welfare traits can only be justified by a change in market requirements. In general, breeding companies have no access to any welfare indicators that commercial flocks may collect. They do receive feedback and complaints from clients, but these do not necessarily provide a representative sample of commercial broiler production.

It takes approximately six to ten years to develop a novel crossbred broiler product. Testing a new marketable crossbred broiler product takes two years, after developing the new crossbred broiler product from existing pure lines that takes another four years. If additional development of the pure lines is necessary before developing the new crossbred product, it takes another four years. The interaction between genetic selection schemes and the diversity of housing and management systems is of practical significance for broiler breeding companies. They address the issue in three ways. The most important method is to select for robust lines that thrive in the entire range of acceptable customer production environments. It is common practice for breeding companies to use additional selection environments that are similar to commercial production environments, by testing birds given different diets, on different continents, in flocks with a varying disease burden, at various levels in the breeding pyramid and in flocks with optimal versus suboptimal management. The next method is to adjust the customer production environment to the target environment through providing manuals, feed specifications, health management protocols and technical support. The third method is to match the specific customer environment with an appropriate crossbred broiler, but this method is considered feasible by only one breeding company. Developing lines for specific environments is very expensive. The breeding companies consider their gene pool as their most important asset. Therefore they keep sufficiently large populations, and limit the rate of inbreeding within all of their main lines to 1% per generation, conforming to recommendations of the FAO. Each of the three breeding companies retains more than 30 different commercial, control and experimental lines. Information about the exact make-up of their pool of genetic lines is not available, but it was estimated that 8-12 lines per company are used for commercially available broiler products. Breeding companies store genetic material in vivo with populations generally being double-banked in pedigree programmes and great-grandparent operations across the world.

Baseline scenario: not changing any EU policy

The Baseline scenario is a forecast of the situation within 15 years without any EU policy change. For the purpose of this study, possible evolution given the current situation and likely trends and actions was analysed, based on i) the review of the current selection and multiplication process, ii) the analysis of the impact of the genetic selection process on animal welfare indicators and iii) autonomous developments in the broiler meat production chains. It was assumed that the international legal framework in this area will not change in the near future.

Global poultry meat production is expected to grow at 2.4% per year over the next 20 years. An estimated 75% of the global growth for the next decade will be in emerging markets. The markets in Europe and the United States are saturated. As the production in the EU-27 will grow little, the share of the EU in global production will reduce. The consumption of poultry meat in the EU will increase driven by the relative price-competitiveness and advantages in convenience for poultry meat compared with other meat products. It is expected that the total volume of slower-growing broilers and other niche products will increase but remain relatively low, because of the substantially higher cost of production, a higher environmental burden and a much higher demand for arable land for feed cropping. However, a change in public demand could alter this. Focus on animal welfare is greatest in North-West Europe. In Asia the interest in animal welfare is lowest compared with most countries. In the EU, the consumer demand for welfare-friendly produced broiler products is expected to increase.

Breeding companies indicate that they will continue to improve welfare issues in commercial production with genetic selection. The main aspects of broiler welfare are currently included in their genetic programmes. Besides the overall selection programme on performance of the pedigree bird itself and its relatives, all chickens reared to become a breeder are evaluated for visible disorders at any level in the breeding pyramid. The breeding companies showed long-term improvements in welfare indicators, like incidence of TD, leg disorders, foot pad dermatitis, hock burns, O₂ pressure in the blood and mortality. They indicated that they will continue along these lines.

The breeding companies have no ready access to welfare indicators that may be available to commercial broiler producers for their own flocks. The weighting given to welfare traits in the selection process will be largely determined by the market conditions. The breeding companies seek a balance in the breeding goal between reproduction traits, welfare traits, including those of health, and broiler production traits for market reasons. The breeding companies use multiple selection environments that reflect the variation in customer production environments as well as possible. They aim to select robust animals and observe that broiler products perform well in different parts of the world, in different climates and in a variety of production systems. Different crossbred broiler products are more targeted to different market segments than different production systems, unless there is a lasting market demand for broiler products specific for a set of deviating production systems. The slower growing broilers for free range and organic production are an example.

Breeding companies aim to maintain genetic diversity within and between their main populations in a careful manner. Without any EU policy change, the genetic diversity among the broiler breeding companies is not at risk of diminishing. The genetic diversity between broiler pedigree populations, however, is only a fraction of the genetic diversity across all poultry lines and breeds in the EU.

Stakeholders related to the poultry sectors expressed different views in the on-line consultation on the need to improve the welfare of broilers. The opinion of representatives of the breeding industry is that the breeding companies take welfare seriously, whereas NGOs claim that there is substantial room for improvement. Stakeholders from the poultry meat processing industry and broiler production industry say that it needs attention but substantial changes are not necessary at the moment. Some stakeholders, including NGOs have specific worries with respect to broiler welfare in which they see insufficient progression. It was suggested that breeding companies could publish more details of their approach and achievements, so that this topic can be discussed on the basis of facts instead of beliefs.

The vast majority of broilers in the EU originate from genetic lines of the three main breeding companies. The genetic selection applied changes the genotype of all these broilers. Welfare of commercial broilers, however, is determined by the interaction between genetic predisposition and risk factors in the production environment. It is therefore very difficult to predict for how many birds in commercial production the actual welfare will be improved because of the on-going genetic selection. Genetic selection facilitates, but does not guarantee, improved welfare of broilers.

If breeding companies place more emphasis on genetic selection for welfare aspects at the expense of feed conversion and slaughter yields, improvement of broiler welfare as part of the sustainability

objectives will be higher, whereas improvement of environmental impact will be somewhat lower. The impact of improving broiler welfare through changing from fast-growing lines and production systems to production systems for slower-growing lines is strongly unfavourable for environmental impact. However, improving broiler welfare in itself is likely to be positive for sustainability of poultry production, as more birds survive, fewer birds are condemned at slaughter, less feed is wasted and less medication is needed. Selection of animals in multiple environments will ensure a gradual adaptation of the animal populations to climate change. More emphasis on welfare aspects in broiler breeding may facilitate this process.

With the likely trends and increased emphasis on animal welfare, food security in the EU will not be affected, but the EU may become more dependent on imports. Chicken is and will remain a relatively affordable type of meat. Employment in rural areas will keep benefitting from the continuation of broiler breeding and production, although the breeding companies do not employ a large number of people.

Steady improvements in health of broilers and food safety through management and genetic selection may be expected. The aim of breeding companies is to continue to deliver breeding stock free of salmonella, leucosis, mycoplasma and various other diseases and to contribute to decreasing use of prophylactic antibiotics, not only at the selection level, which is already antibiotics free, but increasingly also at commercial level. Improving broiler welfare through changing to free-range systems may cause certain diseases to re-emerge.

All three leading breeding companies are world players and are operating in most parts of the world. The competition between the companies is severe in every country, on every continent and at every level of integration by all three parties. This situation will remain the same in the foreseeable future. Growth in company turnover will come from growing markets, like Asia, Africa and South-America. The breeding companies do not expect a change in competitive position of the three breeding companies if there is no EU policy change with respect to broiler welfare or fast growing versus slow growing production.

The Southern American and Asian countries are increasing their production on a high quality level. At this moment Europe is already a substantial export market for frozen poultry meat from Brazil. Canada is not a significant player on the world export market and its broiler production has no impact on the trade with the EU. Based on current trends, even if breeding companies put more emphasis on broiler welfare in genetic selection, we do not expect a substantial impact on the trade between the USA and the EU in the baseline scenario.

In conclusion, without a change of EU policy on broiler welfare or changing market pressure, a substantial change in emphasis on welfare aspects in the breeding goal will only happen in response to market pressure. Without any change in market pressure, the actual improvement of broiler welfare in commercial flocks will be limited. Breeding companies are capable of improving welfare aspects faster, but refrain from doing so because they fear lagging behind the competition on economically important traits. If independent information of broiler welfare in commercial production were available, breeding companies might put more emphasis on welfare traits.

Scenario 1: a better match between breeds and environment

The alternative Scenario 1 aims to achieve a better match between the breeds or lines and the environment, aiming at reaching a better balance in selection programmes between welfare and broiler production traits. Scenario 1 would require transparency of breeding companies about their approach and the results of testing birds in different environments. Genetic selection may be balanced for production and welfare traits in the selection environment, but welfare may still be impaired in the production environment. EFSA stated that genotype by environment interaction exists for nutrition, ambient temperature and management systems. According to EFSA, bird welfare will be improved if they are tested and selected to their rearing and production environments.

Several stakeholders, but not related stakeholders such as NGOs, said in the on-line consultation that they expect that Scenario 1 may negatively impact the competitiveness of the broiler production and breeding sector. Breeding companies assumed that Scenario 1 would significantly shift the weighting in the

breeding goal from reproduction and broiler production traits to welfare traits. It would require segmentation in the breeding programme. If EU-bred lines diverge genetically from non-EU lines, this would result in reduced competitiveness compared with broiler production outside the EU. The breeding companies do not believe that such a scheme would improve the welfare of the broilers reared for the EU market in the long run. They feel that the market should drive the design and emphasis of the genetic programme, not a mandatory scheme. Breeding companies recognise their responsibility in breeding for better welfare and indicate their aim to be transparent in explaining their breeding strategy. However if a mandatory scheme were introduced, there is a chance that breeding companies would move pedigree breeding out of the EU. In that case Scenario 1 would not be effective to improve the welfare of broilers, because welfare of broilers in countries outside the EU can often not meet the EU standards. It is unlikely that external constraints on the means of the genetic programme actually results in better welfare for commercial broilers. It would be better to set the objectives and monitor the outcome in the full range of commercial conditions.

In addition, Scenario 1 implies that EU or third-party officers visit the pedigree breeding and multiplication sites regularly to audit the genetic programme. Breeding companies stress that any additional visit increases the risk of introducing a pathogen or a zoonosis, so they would like to keep the number of visits by non-company people to the absolute minimum. If a pedigree breeding site breaks down with for example salmonella, it is a loss of genetic diversity or even a pedigree population as it is the top of the breeding pyramid. A second issue with visiting pedigree sites is the potential leaking of intellectual property. All breeding companies have developed their own methods of measuring, testing and rearing broiler breeding stock. They have no means of protecting their intellectual property, except being secretive about it. A third issue is leaking of trade secrets. Breeding companies would have to give information about the exact make-up of their commercial crossbreds to allow meaningful inspection. There is a risk of this information being shared with a competitor inadvertently. If breeding companies outside the EU will not be exposed to such inspections and sharing of information, they will have a competitive advantage compared with the EU-based companies. Moreover, it is generally also difficult to meaningfully assess breeding programmes and breeding decisions with occasional inspections, and only very experienced people are capable if they visit pedigree breeding sites regularly. In comparison with the Baseline scenario, Scenario 1 will result in a obligatory shift of emphasis in the breeding goal towards welfare aspects and at the same time the improvement rate of environmental aspects will be lower. After a number of generations, the EU bred pedigree populations will be lagging behind non-EU bred pedigree flocks in terms of cost of production and environmental impact. This scenario will not directly reduce or increase genetic diversity of broiler pedigree flocks, but it may cause a relocation of such flocks to countries outside the EU.

If the shift of emphasis in the breeding goal is not supported by the market, retailers will source poultry meat with the lowest cost of production, hence outside the EU. This would directly affect the competitiveness of the EU broiler production and goes against the CAP objectives of improving the sustainability of the poultry sector. A contraction of the EU broiler production is likely to have a detrimental regional impact on the viability of the rural areas where poultry production or breeding currently takes place.

Scenario 2: maintaining genetic diversity

The aim of Scenario 2 is to maintain the genetic diversity of the genomes of the poultry lines currently available in the EU. Breeding companies have a responsibility to maintain genetic diversity between and within breeding lines and this is reflected by scenario 2. Scenario 2 is based on the statement of EFSA that genetic diversity should be maintained by breeding companies, in order to meet future market demand and to develop lines that can withstand challenging environments. In such a mandatory scheme the breeding industry will have to provide information regularly on how they maintain genetic diversity within and between breeds or genetic lines. The breeding companies maintain substantial pools of 30+ genetic lines.

Stakeholders in the on-line consultation expect that this scenario will have a negative impact on the competitiveness of all parties in the sector: multiplication farms, hatcheries, broiler producers and slaughterhouses.

The breeding companies are not prepared to share information on their genetic pools as it is their main asset for future product development and have no other means of protecting their intellectual property and trade secrets. If such a scheme were introduced, they may move their pedigree stock out of the EU. Breeding companies indicated that they already manage and maintain their genetic resources in a sustainable manner and that they are duly prepared for any future market requirements for broilers with their current sets of genetic lines. Scenario 2 may be a solution to a supposed problem that does not exist in reality at the level of the breeding companies.

If pedigree breeding remains in the EU, scenario 2 is unlikely to have a significant impact on other EU policies, such as the CAP, or policies related to sustainability, environment, employment, food safety and food security. In conclusion, a mandatory scheme under Scenario 2 would have a negative impact in comparison to the Baseline scenario.

Scenario 3: routine monitoring of broiler welfare

The aim of Scenario 3 is to monitor the welfare of chickens by measuring welfare indicators in selection and multiplication farms as well as in slaughterhouses. There is a lack of independent data on the welfare of commercial broilers in the EU. Implementation of a mandatory scheme would yield routinely and independently collected data in the commercial environment at a national level. Since those welfare indicators are affected by both breeding and management, this information can be used to enhance the breeding and selection process of breeding companies and to improve management, nutrition and other environmental factors. According to EFSA there is a need to monitor trends in the major issues of broiler welfare in commercial flocks to confirm that expected improvements are genuine and lasting, and to identify new welfare problems. There should be standardised objectives in monitoring of welfare in commercial flocks. The monitoring system should be practical and harmonised across countries, to assess phenotypic trends of various traits as well as the impact of genetic selection on these traits.

Council Directive 2007/43/EC outlined the potential use of records of mortality, dead on arrival at the slaughterhouse and post mortem inspection controls carried out at the slaughterhouse, such as contact dermatitis, parasitism and systemic illness. This Directive indicates that Member States should monitor broiler mortality rates that are related to regulating stocking density. Moreover, Council Regulation (EC) No 882/2004 also sets obligations for Member States to monitor and visit all sites in the food production chain and give inspectors the judicial authority to carry out audits. Directive 98/58/EC already requires that mortality rates be recorded regularly on all sites with animals kept for commercial purposes. However, mortality itself does not directly reflect animal welfare. Different animal-based indicators have been suggested which could be collected on broiler parent and broiler farms or at the slaughterhouse.

Welfare indicators of broilers in commercial conditions are routinely collected in Sweden, Denmark and Canada. The monitoring schemes in Sweden and Denmark involve inspections of broiler and broiler grandparent or broiler breeder farms (the latter only in Sweden) and sampling in the slaughterhouse of all batches of broilers slaughtered in the country for foot-pad dermatitis. Foot-pad dermatitis scores were reduced substantially after the start of the monitoring programme in the course of about three years and have remained stable since at about 10% of the birds with severe lesions. There is currently no discussion about the cost of the monitoring schemes and model calculations showed that the revenue of the improved welfare exceeds the cost of monitoring. Also in Canada, the condemned birds in the slaughterhouse are routinely monitored and information stored in a central database. Feedback is provided to individual farmers and there are examples of favourable trends, e.g. in leg disorders and ascites. None of the three countries provide feedback to individual broiler breeding companies nor any other supplier to broiler farms. An exception is Denmark, where data on foot-pad dermatitis are averaged for hatchery and feed manufacturer and accessible for the production chain.

Stakeholders responding to the on-line consultation expect some negative impact of Scenario 3 on the competitive position of EU broiler production. It has a cost price and production costs increasing effect that in turn may negatively impact the competitive position of the broiler production chain.

The monitoring of welfare indicators in the breeding pyramid would require allowing third-party officers on the breeding sites. As explained for Scenario 1, this is a potential risk for broiler health and food security and there is a risk that intellectual property and trade secrets are leaked to competitors. At the same time the advantages of a mandatory monitoring scheme for breeding sites will be limited. There would be an additional risk of monitoring welfare indicators in the breeding pyramid, especially if the collected information is used to set targets. While the breeding and multiplication companies need a challenging environment to allow expression of any genetic predisposition for welfare problems, breeders say that a focus on reducing the expression of such a genetic predisposition on pedigree breeding or multiplication sites, could actually result in more welfare problems in commercial broiler production.

On the other hand, monitoring welfare outcome indicators in the slaughterhouse and on commercial broiler production farms has no negative impact on the competitive position of the breeding companies. If the data collected in slaughterhouses or on production farms is analysed by genetic broiler product and published, this may create a market drive for placing more emphasis in the breeding goal on welfare of commercial broilers. This approach would provide an equal challenge to EU-based and non-EU based breeding companies to improve the performance and welfare of their products in commercial broiler herds.

Welfare outcome indicators need to be defined carefully and utilised throughout the broiler meat production chain. Breeding companies would welcome routine monitoring of appropriate welfare indicators in the slaughterhouse and on broiler production farms, even if the analysed results were published by breeding company, feed supplier and integration, provided that there is a balanced and proper discussion of indicators and targets.

Scenario 3 has potentially a high impact on the number of commercial broilers with improved welfare and the level of welfare of commercial broilers. While monitoring of welfare indicators on breeding farms will not have a positive impact on the welfare of commercial broilers, monitoring welfare indicators in the slaughter house or on production farms is generally welcomed as long overdue in the EU. Welfare should be measured as an animal-based measure in the commercial environment, providing information by farm, integration, veterinary group, feed product and genetic product. The first step would be to obtain a set of meaningful welfare indicators that are usable throughout the links in the broiler production chain.

A system with a properly defined and standardised set of welfare traits is considered to be highly desirable as customers buying broiler breeding stock should be properly informed about the improvements of the various products at market level, and be aware of any problems and how to avoid them. The breeding companies also expect a positive impact of welfare data collection on welfare of broilers in commercial slaughterhouses and on broiler production farms compared with the Baseline scenario. An EU-wide monitoring and evaluation scheme would be ideal in this respect.

Monitoring welfare aspects in commercial slaughterhouses or on broiler production farms may have a slightly unfavourable impact on CAP objectives if the cost of the monitoring scheme is too high. If Scenario 3 increases the cost of production, it may increase the retail price and decrease the consumer demand for poultry meat inside and outside the EU, since the meat price has a high price elasticity. This would affect affordability and food security. On the other hand, it will have a favourable impact if it prevents a negative image of the broiler industry and if broiler producers succeed in using the welfare data collection to improve welfare and reduce mortality, condemned carcasses, variation in end weight and wasted feed, which is favourable from an environmental perspective.

Conclusions

Genetics and broiler welfare

- There is a well-established association between genetic selection of breeding stock by breeding companies and the welfare of broilers at the level of commercial broiler producers. Intensive selection on production traits may create welfare problems, as it has done in the past. This association is not inevitable and an undesirable impact can be repaired and avoided with balanced genetic selection. Genetic predisposition for welfare problems may not be expressed in the more favourable environments at the pedigree or multiplication level. In addition, differences in broiler welfare are only partly due to genetics, with heritabilities generally less than 30%.
- Animal welfare is influenced by a mixture of different factors such as genetic background, housing system, climate, disease challenges, feed, stocking density and stockmanship. Welfare at the broiler production level is determined by the interplay of genetic predisposition and the presence of a risk environment. The breeding companies say that the genetic predisposition allows the broilers to produce in average housing and management conditions throughout the world without significant welfare problems.

Broiler breeding and production

- Currently the EU produces 12.1% of the global poultry meat production. However, the relative importance of the EU production volume in the global market is declining, because other regions are growing more rapidly.
- The majority of global broiler production systems and international markets demand fast growing broilers. Product segmentation in broiler production is limited. In some regions, including Europe, the demand for slower growing broilers is expected to further increase, although the breeding companies expect the market share to stay relatively small. This would change if consumers' demand changes.
- The cost price difference between slow and fast growing broilers largely determines the limited growth of markets for slow growers. Price elasticity for poultry meat is very high, and price is an important buying factor for consumers.
- The broiler breeding industry is characterised by a fierce competition. The three companies are frightened to lose trade secrets and intellectual property.

The genetic selection process

- Broiler breeding companies provided evidence that they have been including welfare traits directly or indirectly in their selection process for many years. Breeding companies have made substantial genetic improvements to reduce leg problems and ascites. Many of the recommendations made by EFSA are said by the companies to be already common practice.
- Breeding companies will derive their breeding goals from future customer requirements. They follow global market requirements, trends and legislation in the broiler production sector and this determines how much of the total selection pressure can be put on welfare traits.
- The introduction of genomics provides new opportunities, in addition to the more traditional selection methods, to further optimise the breeding process and include more complex traits in the selection process.
- Breeding companies will continue to invest in multi-environment selection and assist multipliers, hatcheries, and farmers with management information. Furthermore, feedback from customers is used by breeding companies to optimise their breeding goals and selection process.

The scenarios

- More transparency about their selection process is needed from broiler breeding companies. However, the companies do not expect a mandatory scheme to improve the match between genotype and environment to be effective. Breeding companies could instead further develop their strategies to improve broiler welfare and, at the same time, increase their transparency about their breeding processes.
- Broiler breeding companies maintain substantial pools of genetic lines. Information supplied by the breeding companies and independent information suggest that these lines are retained with a

minimum of inbreeding; less than 1% per generation. For breeding companies, their gene pool is the most important asset, which is key to their current and future crossbreed portfolio.

- There is a need for more independent data on the welfare of commercial broilers in the EU. The few countries that routinely collect data on welfare indicators in the slaughterhouse report fewer welfare problems over time. The data collected in slaughterhouses and at broiler production farms are currently not available for breeding companies and do not provide information about the performance of different crossbred products.
- Although broiler breeding companies receive feedback directly from customers about performance and problems, they would welcome routine monitoring of welfare outcome indicators in the production chain. Breeding companies would welcome this even if the results were published by breeding company, feed company and combined company, provided that there is a balanced and proper discussion of indicators and targets.
- Although there is a clear legal basis at EU level for the monitoring of welfare and farm visits, breeding companies are not in favour of on-farm visits and monitoring of welfare indicators in the breeding pyramid. Besides biosecurity and confidentiality issues, animals on pedigree breeding and multiplication farms with great grandparent and grandparent stock and their production environments are not comparable to broilers on commercial broiler breeder and broiler farms. Consequently the information from animals on pedigree breeding and multiplication farms is not very well correlated with the welfare of broiler breeders and broilers. Currently it is only in Sweden that a small number of farms with grandparent stock are inspected on a regular basis for welfare data. Although improvements in animal welfare can go hand in hand with production efficiency, there is a tension between objectives in the EU to improve animal welfare and other policy objectives of the EU. Substantial improvements of animal welfare in the short term and particularly a large-scale transition to slower-growing broilers will be associated with higher prices for the consumer and will have a substantial negative effect on the environmental impact of broiler production.
- The market share for slower-growing broilers in the EU is estimated at 5% with expectations of a slight increase. A more dramatic change driven by consumer demand has to be considered. At least two of the three globally operating breeding companies offer such a slower growing broiler cross. A shift of the total EU production to slower growing birds might improve broiler welfare significantly but at the expense of environmental impact and costs of production. There are currently no legal means to force an increase in the market for slower broilers. If and how consumers can be persuaded to alter their consumption pattern is outside the scope of this report.

The main conclusion of this study is that the welfare of broilers in commercial production would be best served by an efficient and effective monitoring system in commercial slaughterhouses or on broiler production farms. The collected data could potentially be used to provide feedback to individual farms, farming companies, veterinary groups, feed suppliers and breeding companies on the impact of their management and products on aspects of broiler welfare. Such an approach stimulates all parties in the broiler production chain to improve broiler welfare, because of changes in market demand, and identifies the weakest links. The first step would be to obtain a set of meaningful and applicable welfare outcome indicators that are widely supported by the links in the broiler production chains.