

**FRAMEWORK CONTRACT: EVALUATION IMPACT ASSESSMENT  
AND RELATED SERVICES; LOT 3: FOOD CHAIN**

# **STUDY OF THE IMPACT OF GENETIC SELECTION ON THE WELFARE OF CHICKENS BRED AND KEPT FOR MEAT PRODUCTION**

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## **FINAL REPORT**

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## EXECUTIVE SUMMARY

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### 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 EFSA<sup>1</sup> 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, EFSA<sup>2</sup> 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

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<sup>1</sup> 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

<sup>2</sup> 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.

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, 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, O<sub>2</sub> 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 crossbred 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.

## 1. INTRODUCTION

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The European Commission will submit to the European Parliament and to the Council a report concerning the influence of genetic parameters on identified deficiencies resulting in poor welfare of chickens according to Article 6(1) of Council Directive 2007/43/EC<sup>3</sup> on the protection of chickens kept for meat production<sup>4</sup>. The report to the European Parliament and to the Council will be based on a scientific opinion of the European Food Safety Authority (EFSA).

Already in 1995, the Standing Committee of the European Convention on the Protection of Animals kept for Farming Purposes stated that “breeding programmes which cause or are likely to cause suffering or harm to birds shall not be practised, and that in breeding programmes particular attention should be paid to criteria conducive to the improvement of birds’ welfare, including health”<sup>5</sup>. In 2000, the Scientific Committee on Animal Health and Welfare<sup>6</sup> concluded that many metabolic and behavioural traits of broilers have changed through genetic selection.

In July 2010, EFSA published a scientific opinion on the influence of genetic factors on the welfare and the resistance to stress of commercial broilers<sup>7</sup>. EFSA highlights that over the second half of the 20th century, the growth rate of commercially-produced broilers has increased greatly. Simultaneously, the feed conversion ratio has been improved substantially. According to EFSA this is largely the result of genetic selection and the improvement in broiler performance has been accompanied by an increase in welfare problems such as skeletal disorders, contact dermatitis, ascites and sudden death syndrome. They advise the breeding companies to apply balanced breeding programmes.

In 2010, EFSA published a scientific opinion on welfare aspects of the management and housing of the grand-parent and parent stocks raised and kept for breeding purposes<sup>8</sup>. EFSA recommends that birds requiring less feed restriction should be selected as future breeders even if this may involve reduced selection pressure on growth rates.

There is a limited number of breeding companies that are involved in genetic selection programmes and provide the commercial crossbred broilers used worldwide. EFSA emphasises that the companies have the opportunity to influence the welfare of chickens bred and kept for meat production positively or negatively. EFSA recommends that the breeding industry use more comprehensive selection strategies in order to improve the welfare of chickens. In particular, breeders should select for welfare traits and test birds in environments representative for their progeny kept for meat production. They should also monitor animal welfare in commercial broiler and breeder flocks through independent data collection of welfare outcome indicators and publication of the results by type of commercial crossbred broiler.

The purpose of this study is to gather appropriate information for the preparation of the Commission report to the European Parliament and to the Council. The study analyses the impact of genetic selection on the welfare of chickens bred and kept for meat production. It identifies to what extent breeding companies are currently able to improve welfare and production traits simultaneously. It also explores the

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<sup>3</sup> EC, 2007.

<sup>4</sup> Chickens bred and kept for meat production: this includes commercial broilers as well as the previous generations involved in the selection and multiplication process (pedigree selection, great grand parents, grand parents, parents and commercial broilers or hybrid broilers)

<sup>5</sup> Council of Europe,

[http://www.coe.int/t/e/legal\\_affairs/legal\\_cooperation/biological\\_safety\\_and\\_use\\_of\\_animals/farming/introduction.asp](http://www.coe.int/t/e/legal_affairs/legal_cooperation/biological_safety_and_use_of_animals/farming/introduction.asp)

<sup>6</sup> SCAHAW, 2000.

<sup>7</sup> EFSA, 2010a.

<sup>8</sup> EFSA, 2010b.

socio-economic and environmental impacts of a baseline scenario and three possible solutions, based on the EFSA's recommendations:

*Baseline scenario:* A forecast of the situation within 15 years without any EU policy change, but taking into account the implementation of EU Council Directive 2007/43/EC on minimal rules for the protection of chickens kept for meat production from 2010 onwards;

*Scenario 1:* A mandatory scheme at EU level to achieve a better match between genetic lines and the environment, aiming at having a better balance between welfare and production traits in selection programmes;

*Scenario 2:* A mandatory scheme at EU level to maintain genetic diversity between poultry lines currently available in the EU;

*Scenario 3:* A mandatory scheme at EU level to monitor the welfare of chickens by measuring welfare outcome indicators in selection and multiplication farms as well as in the slaughterhouse.

The three alternative scenarios could be applied to improve welfare of chickens bred and kept for meat production through genetic selection. The study covers all Member states and the impacts on trade between EU and third countries are also analysed with a special emphasis on trades with USA and Canada.

In this report the term “broilers” is used for “chickens bred and kept for meat production”. The terms “parent stock” and “broiler breeders” are used for chickens that produce hatching eggs for broilers. The term “multiplication” means “breeding sites involved in the multiplication process” and refers to any multiplication or crossing of purebred lines with minimal genetic selection to produce great-grandparents, grandparents or parents of broilers. The term “pedigree breeding sites” is synonymous with “breeding sites involved in genetic selection” and refers to any population under genetic selection that produces their own replacement breeding stock.

## 2. METHODOLOGY

First of all, information has been collected from a review of literature and publicly available sources of data. Secondly, relevant experts and stakeholders have been consulted to collect data at EU and Member State level. In this chapter the methods used to collect the information are discussed.

### 2.1 Literature review and collection of publicly available data

The literature review is a meta-analysis of peer reviewed scientific papers and reports from a good scientific source on the subject of this project. Information and data collection include the following main topics:

- A description of the selection and multiplication process for producing chickens bred and kept for meat production;
- A description of the breeding industry of chickens kept and bred for meat production and the socio-economic and market context;
- A description of the genetic selection process and of its impact on the welfare of chickens bred and kept for meat production;
- The legislative context in the Member States related to genetic selection of chickens and maintenance of genetic diversity.
- The relationship between developments in the broiler meat production chains and priority policy issues at EU level.

### 2.2 Consultations with stakeholders

In addition to the literature review primary information is collected through consultation with a variety of stakeholders, who are directly or indirectly involved with broiler breeding or production. The list of stakeholders is provided in Annex III.F. Stakeholders were consulted using either face-to-face interviews or on-line questionnaires. In the following paragraphs the methodology and approach will be further explained.

#### Consultation of pan-European organisations

In the development phase of the questionnaire for the face-to-face interviews and the on-line consultation, The European Forum of Farm Animal Breeders (EFFAB) and the Association of the European Poultry Breeders (EPB) have been interviewed. These interviews were semi-structured, and the main goal was to get insights in their involvement and position with respect to peer reviewed papers and other reports from scientific institutes on the subject of the research project. This information provided useful background information for the study additional to the literature review.

#### Face-to-face interviews with breeding companies and multiplication companies

The face-to-face interviews were carried out to collect detailed information, insights and evidence from breeding companies, multiplication companies and national authorities. These interviews covered the present situation in the broiler sector and the possible consequences of the baseline and the three alternative scenarios (Annex III.A, III.B, III.C and III.D).

Scripts have been developed for the purpose of interviewing. The scripts used for the three breeding companies were more detailed on the above mentioned topics than those for the two multiplication companies. Each breeding company received the questionnaire with factual questions (Annex III.C and III.D) and the interview script (Annex III.A), prior to the date of the interview for preparation. Multiplication companies received beforehand a different interview script (Annex III.B). Organisations were asked to make their information available already before the interviews and if needed to add more information following the interviews.

The breeding companies answered the questions in Annex III.A in detail, but generally not the questions in Annex III.C and III.D, as they were considered too commercially sensitive for the purpose of this study. The

reason is that they are not protected by patents. Intellectual property and trade secrets of these companies can only be protected via safeguarding knowledge<sup>9</sup>.

A substantial part of the information shared by the breeding companies is confidential. Detailed confidential information from individual breeding companies was disclosed to the team of experts to get a correct understanding of the practices of the breeding companies and to verify the claims of the breeding companies on maintaining genetic diversity, the genetic selection procedures or programmes utilised by the breeding companies and the inclusion of broiler welfare in the genetic programme. Where allowed, confidential information from individual breeding companies is presented in the final report of this study at an aggregated level across breeding companies.

### **Face-to-face interview with competent authorities in Sweden and Denmark**

With respect to scenario 3, there is experience in Sweden, Denmark and Canada. Therefore additional face-to-face interviews were carried out with competent authorities in Sweden and Denmark. The main topic of these interviews was to get insights about routine or other data collection about welfare indicators in commercial broiler production chains and slaughterhouses. For this purpose the script in Annex III.E was developed. The model and monitoring of animal welfare indicators in Sweden and Denmark has been treated as an example of best practice in the EU, to be evaluated in the context of this study.

### **Information on the monitoring system of broilers in slaughterhouses in Canada**

In addition, information about monitoring activities in Canada has been collected by sending a questionnaire, based on the script in Annex III.E, to the Meat Programs Division of the Canadian Food Inspection Agency (CFIA). CFIA inspects carcass by carcass all broiler flocks at the slaughterhouse.

### **Collecting information through on-line consultations with stakeholders**

Face-to-face interviews with specific stakeholders were followed by on-line consultations of a more diverse group of stakeholders (Annex III.F), using the Delphi method. The questionnaire covered the present situation in the broiler sector as well as the possible impact of the baseline and three alternative scenarios (Annex III.G). The on-line questionnaire was written after completing the face-to-face interviews with the breeding companies, multiplication companies and authorities in Sweden and Denmark. In total fourteen persons responded, of which three parties in the broiler breeding industry, three parties in the broiler production industry, four parties in the poultry processing industry and four other stakeholders (e.g. suppliers, NGOs and representative of the retail,) Stakeholders more involved with breeding or animal welfare were over-represented among the respondents. Representatives of, for example, consumer organisations were under-represented.

In the first round each respondent answered the questionnaire from his/her own perspective. After the first round, results were analysed and an average score per question or the frequency of answers was calculated. Based on this, each respondent received personal feedback on his own score in relation to the average answer or the frequency table. For each question and in light of the feedback received, respondents were asked to review their answers (either change them or keep the first version). No revisions were made after the first round. After this second round the final data analysis was carried out.

The on-line consultations resulted in additional inputs for further analysis, and were also used to validate and benchmark the outcomes of the preceding face-to-face interviews.

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<sup>9</sup> Breeding company interviews

### Collecting information from national authorities and experts

In order to collect information about national policies and regulations, three short questionnaires (Annex III.H) were subsequently sent by e-mail to national authorities and experts. A first questionnaire was sent by e-mail to National Coordinators for Animal Genetic Resources in Europe to investigate the current situation in Europe regarding maintenance of genetic diversity (national programmes, legislation, institutions). This was done in addition to a review of other sources of information and literature on poultry genetic diversity. Responses were received from 21 National Coordinators. The questionnaire included questions to identify the existence of:

- A national programme for the conservation of poultry genetic diversity;
- Commercial breeding programmes for poultry at national level;
- *In situ* conservation activities;
- An *ex situ* conservation programme

Another questionnaire was sent by e-mail to the Chief Veterinary Officers of all EU Member States to investigate the current situation in the different countries regarding the national legislation on broiler and parent stock welfare. Responses were received from 11 Member States. The questionnaire included questions on:

- Implementation of the Broiler Directive;
- Additional National legislation, codes or guidelines with respect to broiler welfare;
- National legislation with respect to parent stock welfare.

The third questionnaire was sent to National representatives of the Committee on Zootechnical legislation of the European Commission. Responses were received from 14 Member States. The questionnaire included questions about:

- National breeding legislation/law for poultry in your country
- National regulation/law that directly refers to 'genetic selection related to welfare of broilers'

### **2.3 Impact assessment of baseline scenario and three alternative scenarios**

The impact of three alternative scenarios (possible mandatory schemes) in relation to the baseline scenario on the sector and individual chain partners and stakeholders was analysed. The stakeholders' view of the baseline scenario was compared with the impact of the three scenarios as defined by the Commission. The consultation with stakeholders (face to face interviews and on-line consultations) included an assessment of the baseline scenario and of three alternative policy scenarios. The impact assessment of these scenarios included an analysis of:

- the effects of the scenarios on animal welfare;
- significant effects on other EU policies (i.e. social effects on employment, on CAP objectives, including food security, animal health, meat quality and food safety);
- environmental effects, in particular on genetic variation, on climate change, the use of energy, feed, water quality and resources, waste production or recycling;
- regional effects if breeding companies/sites constitute an important social and economic component of the region;
- qualitative and quantitative effects on the price of poultry meat, the risk of distortion of competition between operators within the EU and between the EU and third countries (in particular USA and Canada).

The analysis of impact is in line with the most recent version of the Commission's guidelines for impact assessment (EC, 2009). Information collected through stakeholders' consultation was analysed together with information from the scientific literature, recent policy documents, including wider socio-economic and environmental perspectives<sup>10 11 12 13</sup> taking into account further supporting evidences.

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<sup>10</sup> Agra Ceas, 2010.



### 3. LEGISLATIVE CONTEXT IN THE MEMBERS STATES

#### 3.1 Legislation in the EU Member States related to genetic selection of chicken

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); the laws, regulations and administrative provisions governing food in general, and food safety in particular, whether at Community or national level; it covers any stage of production, processing and distribution of food, and also of feed produced for, or fed to, food-producing animals. Public authorities and private operators should pay attention to safety management and the other legal issues enclosed in the definition of Food Law, namely: protection of consumers interests, fair practices and, where appropriate, the protection of animal health and welfare, plant health and the environment.

Council Directive 98/58/EC<sup>14</sup> 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 reasonably be 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<sup>15</sup>. The actual or potential impact of genetic selection on welfare of chickens is related to this Directive. However the Council Directive does only apply to holdings with broilers.

For broiler parent or grant parent, great grant parent and pedigree breeding stock of chickens Council Directive 98/58/EC applies and some countries have developed additional national legislation that applies to (grand)parent 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.

At EU level, there is a significant body of other legislation that directly or indirectly relates to conservation, breeding and use of Animal Genetic Resources. Some in the context of the Common Agricultural Policy, or in other areas, such as conservation of genetic resources, zootechnics (animal breeding), food products, animal diseases, animal welfare, export of animals and animal products, animal feed safety, veterinary controls and GMOs<sup>16</sup>.

The Community's zootechnical legislation aims at the promotion of free trade in breeding animals and their genetic material considering the sustainability of breeding programmes and preservation of genetic resources<sup>17</sup>. The legislation regulates breeding activities for: (a) bovine animals; (b) porcine animals; (c) ovine and caprine animals; and (d) equine animals. For each category, the legislation regulates aspects such as the recognition of breeding organisations, the keeping of herd books, pedigree certificates, performance testing and genetic evaluation and acceptance for breeding. Poultry are not covered by this legislation. Nevertheless, in some EU countries (e.g. Hungary, Poland) there are national animal breeding laws which also include poultry among other livestock species, setting the framework for breeding and conservation of chicken breeds. In general, there is no specific guidance or obligations for genetic

<sup>11</sup> EC, 2010.

<sup>12</sup> EC, 2012.

<sup>13</sup> Windhorst, 2006.

<sup>14</sup> EC, 1998.

<sup>15</sup> EC, 2007.

<sup>16</sup> Ingrassia *et al.*, 2005.

<sup>17</sup> [http://ec.europa.eu/food/animal/zootechnics/legislation\\_en.htm](http://ec.europa.eu/food/animal/zootechnics/legislation_en.htm)



selection related to broiler welfare in national regulations, however national implementation of broiler welfare legislation also refers to acceptable breeding approaches for chickens in general terms.

The Common Agricultural Policy (CAP) is the EU's largest common policy, both in terms of budget and in terms of policies and regulations. In the past decades the CAP has been reformed several times to increase the competitiveness of farmers, to increase sustainability and to improve the targeting of policy measures.

The CAP combines a direct subsidy payment for crops and land which may be cultivated with price support mechanisms, including guaranteed minimum prices, import tariffs and quotas on certain goods from outside the EU. However, from 2004 the CAP was reformed reducing import controls and transferring subsidy to land stewardship rather than specific crop production (phased from 2004 to 2012). The CAP moved away from a production-oriented policy to the so called Single Farm Payment (SFP). Each country can choose if the payment will be established at the farm level or at the regional level. Farmers receiving the SFP have the flexibility to produce any commodity on their land except fruit and vegetables. In addition, they are obliged to keep their land in good agricultural and environmental condition (cross-compliance). Farmers have to respect environmental, food safety, phytosanitary and animal welfare standards. This is a penalty measure, if farmers do not respect these standards, their payment will be reduced. The aim of the CAP is still to provide farmers with a reasonable standard of living, consumers with quality food at fair prices and to preserve rural heritage.

In October 2011 the Commission presented a set of legal proposals to further reform the Common Agricultural Policy (CAP) after 2013. Part of this is the "greening" of direct payment. To strengthen the environmental sustainability of agriculture and enhance the efforts of farmers, the Commission is proposing to spend a part of the direct payments specifically for the improved use of natural resources. Farmers would be obliged to fulfil certain criteria such as crop diversification, maintenance of permanent pasture, the preservation of environmental reservoirs and landscapes.

The CAP is focusing on payments for crops and land use. As many poultry farmers in the EU own no land, or just a limited area of land, the impact 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. The common market organisation (CMO) for poultry is based on protection at borders. Minimum access quotas have been instituted later as part of the WTO agreement. In general terms there are no market support measures in the poultry CMO, thus no guaranteed prices or direct aid. Less progress in feed conversion and less progress in slaughter yields both have an effect on utilisation of resources and consequently imply less reduction in environmental burden than would be possible with no restrictions on improvement in feed conversion and slaughter yields.

Rural development objectives and regulations in the European Union are particularly relevant to support conservation of farm animal genetic diversity. Council Regulation (EC) No 1698/2005 enables EU Member States to support rural development using funding from the European Agricultural Fund for Rural Development (EAFRD). Paragraph 5 of Article 39 specifies that support may be provided for the conservation of genetic resources in agriculture. Commission Regulation (EC) No 1974/2006 set out the detailed provisions for implementation of Council Regulation (EC) No 1698/2005. In relation to conservation of farm animal genetic resources, Article 27 states that support may relate to the rearing of farm animals of 'local breeds indigenous to the area and in danger of being lost to farming'. Paragraph 3 of Article 28 set out the measures that could be supported; in summary, these includes both *in situ* and *ex situ* actions for the conservation, characterisation, collection and utilisation of genetic resources in agriculture. Annex II of Commission Regulation (EC) No 1974/2006 indicated that a list of local breeds in danger of being lost to farming and the number of breeding females concerned must be certified by a duly recognised technical body or breeder's organisation/association. Annex IV set the numerical thresholds for breeds to be considered as in danger of being lost to farming and Annex V set the conversion rates for animals to livestock units. Not all EU countries give financial support to local breeds within the Rural Development framework, and a very limited number of poultry breeds is supported.

According to a UK survey<sup>18</sup>, five EU countries (Finland, Germany, Hungary, Slovenia, Spain) mentioned that they provide financial support to conserve poultry breeds, in total twenty-four poultry breeds.

Furthermore, The EU is also Party to the Convention on Biological Diversity<sup>19</sup> and, as a consequence, all EU countries are obliged to develop national biodiversity strategies that, in the context of agricultural biodiversity, also address conservation of livestock/poultry genetic resources. Countries have developed National Strategies and Action Plans, policies or regulations putting emphasis on the conservation and sustainable use of animal genetic resources, including poultry. National Action Plans or National Programmes have been developed in the context of the implementation of the Global Plan of Action for Animal Genetic Resources (FAO, 2007)<sup>20</sup>, and are also related to countries' commitment to the legally binding Convention on Biological Diversity.

Another relevant Council Regulation focussed on conservation and research in the area of genetic resources, is the Council Regulation (EC) No. 870/2004<sup>21</sup> on the conservation, characterisation, collection and utilisation of genetic resources in agriculture. Finally, EU regulations related to extensive and organic farming systems in particular (Regulation (EC) No. 1804/1999 of 21 August 2000) recommend maintaining indigenous breeds and strains that have adapted to local conditions. It also establishes rules of production for species such as namely bovine, ovine, caprine, equine and poultry.

### 3.2 National programmes and institutions to maintain genetic diversity of chickens in EU

#### Status of chicken genetic lines and genetic erosion

According to the State of the World's Animal Genetic Resources<sup>22</sup> genetic diversity within and between breeds and lines is threatened. A relatively high proportion (33%) of (local) chicken breeds and genetic lines listed in the European and global database<sup>23</sup> is endangered, when compared with other major livestock species. At the same time a large and commercially most relevant proportion of genetic diversity in poultry is owned and maintained by the poultry breeding industry, although the breeding companies do not reveal exact numbers.

There are also questions to what extent overall allelic diversity in chicken is being conserved for the future. Muir et al<sup>24</sup> indicated that as much as 50% of the genetic diversity in the hypothetical ancestral population is absent in commercial pure lines of broilers and layers. They concluded that this is primarily due to the limited number of chicken breeds that went into the formation of the modern commercial poultry lines. They also concluded that the modern farming system has contributed less than 5% to the level of inbreeding of 14-15%, despite intense levels of selection, closed populations and industry consolidation since 1950, indicating that the breeding companies maintain their genetic resources in a sustainable manner.

#### National programmes

In line with the recognition that there is a gradual erosion of biological diversity in farm animals including chickens, several efforts to sustainably use and conserve the genetic resources of livestock species have taken place at the national and global levels. The culmination of those initiatives and ambitions was the

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<sup>18</sup> Small and Hosking, 2009.

<sup>19</sup> CBD, 1992.

<sup>20</sup> FAO, 2007a.

<sup>21</sup> EC, 2004.

<sup>22</sup> FAO, 2007b.

<sup>23</sup> [www.fao.org\\_dad-is](http://www.fao.org_dad-is)

<sup>24</sup> Muir et al., 2008.

approval of the Global Plan of Action for Animal Genetic Resources in 2007<sup>25</sup>. EU countries committed themselves to the Global Plan of Action for Animal Genetic Resources, including national governments taking responsibility for the conservation of genetic diversity, both in vivo and in vitro.

In order to further analyse the state of chicken genetic diversity in Europe, a questionnaire was distributed among National Coordinators for Animal Genetic Resources in Europe. Information about programmes and activities at national level to maintain genetic diversity in chicken was collected through this survey.

The survey among National Coordinators showed that 19 out of the 21 respondents indicated the presence of on-going national programmes for conservation of livestock genetic diversity including chicken. On the other hand, there clearly is variation between countries how National Plans are being implemented. Various actors and institutes, such as NGO's, universities, research institutes and breeders/farmers associations play an important role.

### Chicken breeding programmes at national level

On the one hand, commercial poultry breeding is in the hands of a limited number of breeding companies. On the other hand, there is a large variety of, mostly rural, poultry kept by hobby or fancy breeders, and also breeding and marketing of local chicken. Seven EU countries (Belgium, Czech Republic, Germany, Hungary, Iceland, Poland, Slovenia) reported commercial breeding programmes for their indigenous chicken breeds. However, the survey among National Coordinators also showed that in most of the EU countries well-organised breeding programmes for local breeds at national level hardly exist. The majority of commercial broiler producers are using the crossbred products of commercial breeding companies and most of the local breeds became hobby breeds without a substantial commercial value. On the other hand, there seems to be an increasing number of initiatives to market differentiated quality products, including organic production, often using less specialised and local breeds of chicken.

### In vivo conservation

Breeding companies maintain commercially relevant lines for current and future breeding purposes. At the same time, there is a large variety of rural poultry, poultry kept by hobby breeders and research lines maintained by institutes/universities. According to the FAO State of the World's Animal Genetic Resources, only 101 out of 608 chicken breeds are purposely being conserved in vivo.

All 21 countries that responded to the survey among European National Coordinators indicated one or more institutions in their country ensuring in vivo conservation of local chicken breeds or lines. Often NGO's and farmers/breeders associations take responsibility for in vivo conservation. Some countries (Belgium, Italy, Spain) specifically reported the support of regional governments. Other organisations that ensure or support in vivo conservation of local breeds or experimental lines include government agencies, research institutes, universities, educational centres, breeding centres and some specialised farms.

Another survey on experimental lines maintained by universities or institutes<sup>26</sup> resulted in data on 119 chicken experimental lines, and 22 old breeds conserved at public institutions. It showed a large variety in the genetic background and characteristics of these lines, from inbred or congenic, to random bred or highly selected on a performance or experimental trait.

### In vitro conservation

Comparatively, in vitro conservation of poultry genetic diversity deserves less attention than the in vivo activities. Most of the genetic diversity in chickens is maintained in vivo, however there are also some countries or organisations that maintain in vitro gene bank collections. According to the State of the

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<sup>25</sup> FAO, 2007a.

<sup>26</sup> Tixier-Boichard, 2003.

World, for chickens only 6 out of 608 registered breeds or lines are being conserved in vitro. Only a limited number of countries have in vitro gene banks for poultry. Most in vitro conservation programmes are found in western and central Europe. The survey among National Coordinators indicated that 5 out of 21 respondents (Hungary, Netherlands, Slovenia, Spain and United Kingdom) have developed in vitro collections for chicken breeds, and another 3 (Croatia, Denmark, Germany) have plans to develop in vitro collections.

### 3.3. Legislation in EU member states related to the welfare of broiler chickens and (grand)parent stock

Minimum standards, including provisions on housing, food, water and care as stated in Council Directive 98/58 EC concerning the protection of animals kept for farming purposes<sup>27</sup> apply to all levels in the breeding pyramid (broilers, (grand)parent stock and pedigree flocks).

For broilers, i.e. chickens kept for meat production, Council Directive 2007/43/EC<sup>28</sup> lays down the minimal rules for the protection of the birds and applies to holdings having more than 500 chickens. All Member States should have complied with the Directive since 30 June 2010. The Council Directive does not apply to holdings with breeding stocks of chickens. Besides requirements on administration, light intensity and duration, air quality and training of the farmer, for example, the Council Directive restricts the maximum stocking density for broiler chickens. If all requirements are fulfilled and the mortality is kept below the maximum level stated in the Directive, farmers can keep their birds at a stocking density up to 42 kg/m<sup>2</sup> but individual countries differ in the upper stocking density limit allowed.

Results of the questionnaire to the Member States showed that all countries that responded had implemented the Broiler Directive, which is in line with the audits carried out by the Food and Veterinary Office in EU member states<sup>29</sup>. The majority of the countries that responded to the questionnaire indicated that it is allowed to keep the broilers at a stocking density of 42 kg/m<sup>2</sup> if all annexes of the Directive are fulfilled, but a few have lower stocking density limits. Examples are Sweden (36 kg/m<sup>2</sup>), Germany and Bulgaria (39 kg/m<sup>2</sup>) and Austria (30 kg/m<sup>2</sup>)<sup>30</sup>. In addition, a few countries have welfare recommendations or codes that apply to broiler farms (such as UK<sup>31</sup>) or additional National legislation, such as maximum levels of hock burns allowed (such as The Netherlands for birds kept at 42 kg/m<sup>2</sup> <sup>32</sup>).

With respect to (grand)parent stock Member States indicate that Council Directive 98/58 EC applies. A few countries have additional National legislation or welfare recommendations and codes that apply to (grand)parent stock. Examples are Sweden (regulations for parent stock and GP stock on care, stocking density, perch length, water and feeding space, mutilations<sup>33</sup>) and UK (codes and recommendations<sup>34</sup>, legislation on mutilations<sup>35</sup>).

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<sup>27</sup> EC, 1998.

<sup>28</sup> EC, 2007.

<sup>29</sup> [http://ec.europa.eu/food/fvo/ir\\_search\\_en.cfm](http://ec.europa.eu/food/fvo/ir_search_en.cfm)

<sup>30</sup> Questionnaire CVO's

<sup>31</sup> <http://www.defra.gov.uk/publications/files/pb7275meat-chickens-020717.pdf>

<http://www.defra.gov.uk/publications/files/pb13545-meat-chickens.pdf>,

[http://www.dardni.gov.uk/meat\\_chickens\\_code\\_of\\_practice.pdf](http://www.dardni.gov.uk/meat_chickens_code_of_practice.pdf),

<http://www.scotland.gov.uk/Resource/Doc/55971/0015788.pdf>,

<http://wales.gov.uk/topics/environmentcountryside/ahw/animalwelfare/livestockwelfare/poultry/broilerchickens/?lang=en>

<sup>32</sup> [http://wetten.overheid.nl/BWBR0027822/geldigheidsdatum\\_22-09-2012#3](http://wetten.overheid.nl/BWBR0027822/geldigheidsdatum_22-09-2012#3)

<sup>33</sup> SJVFS 2010:15, Statens jordbruksverks föreskrifter och allmänna råd om djurhållning inom lantbruket mm, Saknr L100; SFS1998:534, Saknr L1; SFS1988:539, Saknr L2

<sup>34</sup> <http://www.defra.gov.uk/publications/files/pb7275meat-chickens-020717.pdf>

<http://www.defra.gov.uk/publications/files/pb13545-meat-chickens.pdf>

[http://www.dardni.gov.uk/meat\\_chickens\\_code\\_of\\_practice.pdf](http://www.dardni.gov.uk/meat_chickens_code_of_practice.pdf)

## 4. GENERAL DESCRIPTION OF THE SELECTION AND MULTIPLICATION PROCESS FOR PRODUCING CHICKENS BRED AND KEPT FOR MEAT PRODUCTION

### 4.1 The 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 the ability to meet market demands. The crossbreeding process is then carefully implemented, so that all birds of any given type of marketed broiler are the same type of crossbred (Table 4.1).

Table 4.1. Diagram of crossbreeding structure of a four-way cross

| Level in breeding pyramid | Paternal lines           |                | Maternal lines       |                |
|---------------------------|--------------------------|----------------|----------------------|----------------|
| Pedigree                  | A♂ x A♀                  | B♂ x B♀        | C♂ x C♀              | D♂ x D♀        |
| GGP                       | 1 A♂ x 10 A♀             | 10 B♂ x 100 B♀ | 3 C♂ x 30 C♀         | 25 D♂ x 250 D♀ |
| Grandparents              | 250 A♂ x 2,500 B♀        |                | 1,500 C♂ x 12,500 D♀ |                |
| Parents                   | 62,500 AB♂ x 625,000 CD♀ |                |                      |                |
| Broilers                  | 87,5 million ABCD        |                |                      |                |

The numbers in Table 4.1 indicate the potential numbers that can be produced at the various levels in the breeding pyramid starting from one male from the paternal sire line. Based on statistics of poultry meat production we estimate that annually about 7500 million broilers are reared in the EU27. To produce these broilers about 60 million broiler breeders are required. The numbers of birds in the multiplication flocks of the GGP's and at the grand parent and parent level are adjusted according to the number of parent stock/broilers demanded by the market. Each company has one product that dominates the volume of parent stock equivalents sold. For the other products, the number of birds at grandparent, parent and broiler level is lower. 36

The structure to produce the large number of crossbred broilers is traditionally represented with a breeding pyramid, indicating that the number of birds in the genetic selection programme in the top of the breeding pyramid is very small compared to the number of crossbred broilers that are eventually produced after three or four steps of multiplication. There are other representations of the breeding pyramid that are slightly different from Table 4.1, for example to emphasize the resources in terms of time, expertise and data collection that are utilised in the top of the pyramid<sup>37</sup>.

The choice of the lines for the A, B, C and D positions in the crossbreeding structure is primarily determined by the market requirements. The lines A and B are referred to as paternal lines and the lines C and D as maternal lines.

<http://www.scotland.gov.uk/Resource/Doc/55971/0015788.pdf>

<http://wales.gov.uk/topics/environmentcountryside/ahw/animalwelfare/livestockwelfare/poultry/broilerchickens/?lang=en>

<sup>35</sup> <http://www.legislation.gov.uk/ukxi/2010/3034/contents/made>

<http://www.legislation.gov.uk/ssi/2010/387/contents/made>

<http://www.legislation.gov.uk/wsi/2010/2712/contents/made>

<http://www.legislation.gov.uk/nisr/2012/153/schedule/7/made>

<sup>36</sup> Breeding company interviews

<sup>37</sup> Laughlin, K., 2007.

## 4.2 Breeding sites involved in genetic selection

### Purebred lines

Each breeding company has its own set of pure lines, referred to as pedigree stock. Pedigree stock of all breeding companies is housed on multiple, geographically spread breeding sites involved in genetic selection. Breeding companies refer to these breeding sites as pedigree flocks. There is no exchange of purebred lines between breeding companies.

The purebred lines can be divided into paternal lines and maternal lines. Paternal lines produce the cockerels and maternal lines the hens for broiler production. There are only slight differences in emphasis in the breeding goal of these two groups of lines<sup>38</sup>. Each purebred line has a breeding goal. The breeding goal depends on the market requirements for the types of crossbred in which the line is included. These market requirements are ultimately dependent on customer, consumer and retailer demand. Determining the breeding goal is inherently a subjective process. Animal welfare, societal, economic and marketing aspects are generally taken into account<sup>39</sup>. The breeding goal determines for which traits the line is selected and which weight is given to each individual trait in the selection process. Birds of purebred lines in the pedigree have a unique identification number and a known sire and dam. In contrast, birds in multiplication and parent stock generally do not have known parents<sup>40</sup>.

### Bio-security and testing environments

Breeding material is kept at high biosecurity because of health regulations for international trade in poultry and because of demands of customers and the broiler meat production chain on a specific-pathogen-free status. The main biological characteristics recorded in the breeding programme are therefore measured in highly bio-secure facilities, where performance is optimised<sup>41</sup>.

There is also a scheme to record the major traits (see also Table 7.1) on relatives, genetically similar birds of the same pure line, in a production environment that is not bio-secure and resembles broader commercial conditions<sup>42</sup>. In practice, this comparison trial may range from testing birds given different diets, or different environmental conditions mimicking performance in different continents, or testing birds with a varying health status to test responses to various common poultry pathogens. This challenging testing with 'relatives' is carried out at various levels in the breeding pyramid and in flocks with optimal versus suboptimal management<sup>43</sup>.

## 4.3 Genetic selection

Genetic selection is identifying the most appropriate birds to become the parents of the next generation. The breeding goal determines what "most appropriate" means in practice. Various methods exist for genetic selection<sup>44</sup>. At pedigree level, birds are typically selected taking into account information on relatives, whereas at multiplication levels birds are typically rejected based on their own characteristics, as parents are not generally known.

The group of birds destined to replace the birds in the pedigree flocks are generally selected in such a way that the average genetic relationship 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

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<sup>38</sup> EFFAB, 2011.

<sup>39</sup> Breeding company interviews, multiplication company interviews

<sup>40</sup> Breeding company interviews, multiplication company interviews

<sup>41</sup> More details in Annex I.4.

<sup>42</sup> Kapell *et al.*, 2012a.

<sup>43</sup> Breeding company interviews

<sup>44</sup> More details in Annex I.4

inbreeding in the specific pure line<sup>45</sup>. After selecting the birds that will contribute to the next generation, the birds that follow on average genetic merit are allocated to multiplication.

#### 4.4 Breeding sites involved in the multiplication process

The multiplication process may include three types of steps (Table 4.1). The first type at the GGP level is pure-line multiplication. In this step the birds are bred pure, but the progeny never flow back into the pedigree flocks. The objective is to produce sufficient pure-line birds, without having to increase the pedigree breeding sites. The second type at the grandparent level is crossing animals of pure lines to produce the crossbred parent stock<sup>46</sup>. The third type at the parent stock level is crossing crossbred birds to produce commercial broilers. The size of the multiplication farms/flocks is calculated from the number of parent stock or broilers they have to generate, taking information on hatchability and liveability into account<sup>47</sup>. Among birds in the multiplication process only birds with visible abnormalities are rejected, but no further selection takes place.

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<sup>45</sup> Bijma *et al.*, 2001.

<sup>46</sup> Multiplication company interviews

<sup>47</sup> Multiplication company interviews



## 5. DESCRIPTION OF THE BREEDING SELECTION INDUSTRY FOR CHICKENS KEPT AND BRED FOR MEAT PRODUCTION: THE BROILER BREEDING AND PRODUCTION CHAIN

### 5.1 Number of breeding companies involved in genetic selection

Current broiler breeding companies were all established before the 1950s. In the past, they were often involved in both broiler and layer breeding, but starting from the 1980s onwards, specialisation became the standard<sup>48</sup>.

Nowadays three companies dominate the worldwide market for broiler breeding stock, in alphabetical order: Aviagen Broiler Breeders, Cobb-Vantress and Hubbard. Aviagen Broiler Breeders is a subsidiary of the Aviagen Group and is owned by the family-owned EW Group, based in Germany. Hubbard is owned by Groupe Grimaud, which is based in France and also a family-owned company. Cobb-Vantress is a subsidiary of Tyson Foods, Inc. In Europe, the company is represented by Cobb-Europe, based in Colchester, England.

All companies have subsidiaries all over the world and keep their breeding stock on different continents for safety and marketing reasons. In general, pure lines are completely company-owned; grandparent stock might be in joint ventures<sup>49</sup>.

### 5.2 The production process

The production in the poultry meat sector is organised within a production chain<sup>50</sup>. All three broiler breeding companies distribute grandparent stock (GP) or parent stock (PS) to almost all European countries. There is some variation between breeding companies in the extent to which they control the grandparent level in the breeding pyramid. Some prefer to supply broiler breeders, whereas another prefers to work with joint ventures or independent partners to supply broiler breeders. There are no independent, detailed data available on international trade flows of individual companies. However, Eurostat provides data with export values of GP and PS for poultry meat<sup>51</sup>. These data give insight in the economic value of international trade flows between and from EU countries and shows which EU countries are involved (see Chapter 6.1).

### 5.3 Number and distribution of breeding sites in the different Member States and at EU level with the number of chickens involved

#### Sites involved in the genetic selection process

All three breeding companies have pedigree breeding sites in the EU and the USA. The three companies disclosed the number and distribution of pedigree breeding sites to the interviewers, but they did not give permission to publish the details on number of sites per country and the number of flocks and flock size per site, because it was deemed too commercially sensitive information for the purpose of this study<sup>52</sup>. Any statistics on the number of pedigree breeding sites and birds in any EU country would relate to a single company, which would be relatively easy to identify. Therefore the information on the number of pedigree breeding sites and the number of birds is combined with the information on multiplication breeding sites (Table 5.1). Exact numbers of pedigree sites would allow competitors to calculate exactly the number of pedigree breeding sites and animals of the other company.

<sup>48</sup> Hunton, 1990.

<sup>49</sup> Multiplication company interviews

<sup>50</sup> See Figure in Annex I.5

<sup>51</sup> Eurostat, 2012.

<sup>52</sup> Breeding company interviews



### Sites involved in the multiplication process

The number of multiplication breeding sites with great-grandparent (GGP) or grandparent (GP) stock in the various parts of the world was disclosed by some companies, but they did not give permission to publish the details.

GGP breeding sites are generally part of or located in the proximity of pedigree breeding sites. Table 5.1 gives an indication of numbers of sites and birds in the EC-27. Table 5.1 does not provide exact numbers, but rather an indication of the importance of each EU country for pedigree breeding and multiplication of broilers. Exact numbers would be easily traceable to individual companies for several countries. From this table it can be concluded that most sites and birds are located in the UK and France, followed by Germany and the Netherlands.

*Table 5.1 Indication of numbers of pedigree, GGP and GP sites and total number of chicken on pedigree, GGP and GP sites, per country, in the EU-27<sup>53</sup>*

| Member state                   | Number of farms | Number of chickens x1,000 |
|--------------------------------|-----------------|---------------------------|
| Belgium, Czech Republic, Italy | <5              | < 50                      |
| Denmark, Finland, Poland       | 5-10            | 50-200                    |
| Hungary, Sweden                | 10-15           | 150-300                   |
| Ireland, Spain                 | 15-20           | 300-450                   |
| Germany, Netherlands           | 35-50           | 900-1,100                 |
| France, United Kingdom         | 65-90           | 1,200-1,400               |
| <b>Total EU-27</b>             | <b>321</b>      | <b>6,240</b>              |

### 5.4 Type of housing systems used for breeding sites involved in the genetic selection process and in the multiplication process

Pedigree, GGP and GP sites are all isolated and highly bio-secure sites. At pedigree breeding sites, typically the housing is associated with the three phases of broiler breeders: growing (0-6 weeks), rearing (7-19 weeks) and laying (20 weeks and older).

At GGP and GP sites, the types of housing are environmentally controlled with solid floors and loose, dry, free-flowing litter<sup>54</sup>. Housing of adult hens also includes areas of raised, slatted floors in addition to areas of solid floors with loose and dry litter. The management, type of housing, lighting programmes, ventilation and feeding regimes follow the guidelines developed and laid out in the management guides provided by the breeding companies<sup>55</sup> and the EU Broiler Directive. Feeding regimes vary from daily feeding to practicing forms of skip-a-day feeding during rearing. Skip-a-day feeding is not allowed in the UK and Sweden. Growing houses have heating, rearing and layer houses have heating depending on the climatic region.

The size of pedigree, GGP and GP flocks varies considerably, but the size generally increases with the layer of the breeding pyramid from pedigree flocks to PS flocks. At Aviagen, birds are not housed in cages. Nearly all birds are housed in groups, except from males from one crossbred in multiplication (less than 0.003%).

<sup>53</sup> Association of European Poultry Breeders on behalf of the breeding companies

<sup>54</sup> Multiplication company interviews

<sup>55</sup> All companies have their management guides available on-line, [www.aviagen.com](http://www.aviagen.com), [www.hubbardbreeders.com](http://www.hubbardbreeders.com) and [www.cobb-vantress.com](http://www.cobb-vantress.com)

Table 5.2 Ranges of stocking density across companies in type of housing per layer in the breeding pyramid<sup>56</sup>

| Type of housing | Stocking density in birds/m <sup>2</sup> |           |          |
|-----------------|--|-----------|----------|
|                 | Pedigree sites                           | GGP sites | GP sites |
| - Growing       | 10-19                                    |           |          |
| - Rearing       | 5-7                                      | 6-8       | 6-8      |
| - Laying        | 4-6                                      | 5-7       | 5-7      |

Stocking densities at the various levels in the breeding pyramid are quite similar across companies, although the stocking density during rearing appears to be more variable (Table 5.2). All stocking densities are below or at the legal requirements.

## 5.5 Production and trade of poultry meat

### Worldwide

Global poultry meat production is rapidly increasing. In 2000 the total poultry meat production, also including among others turkey, duck, geese and quail, was 69 million tons and the volume grew to over 97 million tons in 2010<sup>57</sup>. This corresponds to about 70,000 million broilers<sup>58</sup>.

In poultry meat production, the USA, China, Brazil and the EU-27 rank in the first four positions. Other large producers are Russia, Mexico, India, Argentina, Iran and Japan. The total share of the EU-27 in total poultry meat production was 15.1% in 2000 and 12.1% in 2010. Although there was an increase in production in the EU-27 between 2000 and 2010, the share of the total world production decreased because other countries increased production more rapidly.

Trade in poultry meat mainly relates to trade in broiler meat. Only a few countries have a major share of exports of poultry meat: the ten leading exporting countries share 88% of the total export volume. The largest exporters, the USA and Brazil, contribute to 56% of the global exports. In 2010 the EU was the third largest exporter of broiler meat<sup>59</sup>, with a share of 9% in total world exports.

The leading importers of poultry meat are China, Russia, Japan, Saudi Arabia and some EU countries<sup>60</sup> (e.g. the Netherlands, UK and Germany). The export of the USA is mainly leg meat. Thailand is exporting breast meat to the EU. The portfolio of Brazil is more diverse, with export of whole birds to the Middle East, deboned leg meat to Japan and breast meat to the EU.

### In the EU

In 2011 total poultry meat production in the EU-27 was around 12 million tons. The main poultry meat is broiler meat with a total production in 2011 of 9.6 million ton<sup>49</sup>. 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 (with 14% of the total EU-27 production), followed by Poland, Germany, France, Spain, Italy and the Netherlands (Figure 5.1). 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<sup>61</sup>.

<sup>56</sup> Breeding company interviews and multiplication company interviews

<sup>57</sup> Windhorst, 2011.

<sup>58</sup> More details in Annex I.5

<sup>59</sup> Rabobank, 2011.

<sup>60</sup> Windhorst, 2011.

<sup>61</sup> MEG, 2012.

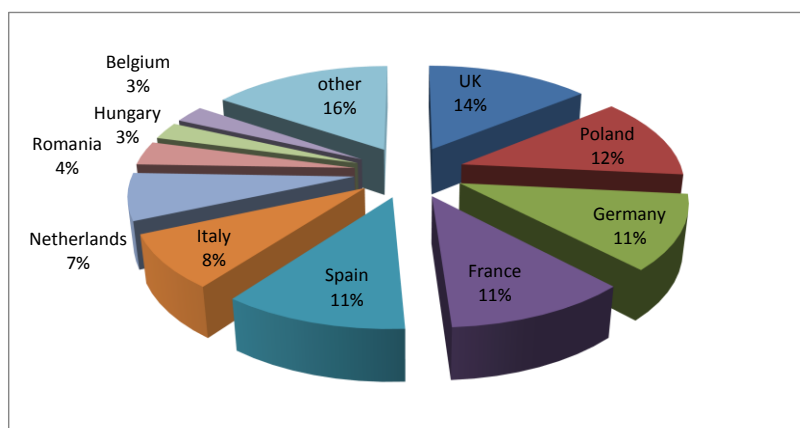


Figure 5.1. Share of 10 leading EU countries in broiler meat production in 2011

Trade in live slaughter birds between the EU and non-EU countries is negligible. Within the EU live broilers are traded between neighbouring countries, but this is in general because of availability of slaughter capacity or regional across border activities. Within the EU the Netherlands dominates broiler meat export with 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. Several countries, especially in north-west Europe export frozen leg meat to eastern-European countries. 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<sup>52</sup>. Besides the intra-EU trade large amounts of broiler meat were imported into the EU from Brazil and Thailand, mainly breast meat. The Netherlands, Germany and UK are the main importers of frozen or cooked breast meat from third countries.

### Organisation in the production chain

The European poultry industry is working within a very strict organisational model. Within the model, the different parts within the production chain are linked to each other. Within the links of production there is trade in hatching-eggs and day-old chicks for breeding stock and broilers, breeders at the age of starting to lay eggs, broilers and poultry meat. At the different stages, feed is provided by a feed mill<sup>62 63</sup>. The two main organisation models that exist for broiler meat production chains in Europe are (1) independent links in the broiler production chain and (2) integrated production<sup>64</sup>. 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.

### Market segmentation

In general, for most EU countries, broilers achieve the target market size in around 5 to 6 weeks with a live weight of 2 to 2.5 kg. However, there are differences between countries and between farms within a country on actual live weight produced. The specific broiler live weights farmers are producing depend on the market in a specific country, region or the market segment, i.e. retail, food service, which has to be supplied.

### Broiler production systems in the EU

The vast majority of broilers are kept in large groups in housing systems with a controlled environment or in more open, naturally ventilated systems. The general trend in Europe is to keep broilers in closed,

<sup>62</sup> AgraCeas, 2010.

<sup>63</sup> Van Horne, 2008.

<sup>64</sup> More details in Annex I.5

controlled housing systems. Broilers are usually kept on litter with automated supply of feed and water. The common commercial broiler products are crosses of genetic lines that are selected for rapid growth. In general broilers grow in 35 to 45 days to a live weight of 2 to 3 kg. Poultry meat of fast growing broilers is the basic product in the market is as sold as commodity product.

Slower growing genotypes of broilers exist and are generally used in free-range and organic production<sup>65</sup>. The meat of slower growing broilers is a premium product and farmers and processors receive a higher price in the market to compensate for the higher production costs. The number of farms with free range or organic production is small, except in France where more than 6,000 free range farms were identified in 2008 (of a total of 9,500 broiler farms)<sup>66</sup>. Although the organic production of broiler meat is growing in EU countries in north-west Europe, it is expected by the industry that this will stay a niche market. For both organic and outdoor broiler production, which both give broilers access to an outdoor area, it is expected that the market will only slightly increase.

A new development is the so-called 'intermediate' market segment or certified broiler production, with broilers reaching the target weight in at least 56 days. Although the market demand for this type of product is increasing, the certified broiler market will likely continue to be a niche market in our opinion, due to the increased cost of production and a larger environmental burden, because of lower growth rates and higher FCR. However, predictions could change if public pressure demands it.

There are no statistics available on the numbers of organic, free-range and certified broilers in the EU. Industry people estimate their market share of broiler production to be between 5 and 10%.

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<sup>65</sup> More details in Annex I.5

<sup>66</sup> ITAVI, 2008.

## 6. DESCRIPTION OF THE BREEDING SELECTION INDUSTRY OF CHICKENS KEPT AND BRED FOR MEAT PRODUCTION: SOCIO-ECONOMIC CONTEXT AND TRADE FLOWS OF BREEDING STOCK

### 6.1 Trade flows of breeding stock across companies and market shares for breeding companies in the EU, in the different Member States and in third countries

This section deals with the trade in broiler *breeding* stock, which is directly linked to the breeding organisations. Broiler breeding stock is grandparent stock or parent stock sold by breeding organisations to companies in the production chain. Only international trade in breeding stock is discussed. There are no detailed data available on international trade flows per company. Eurostat, however, provides data on the export of GP and PS for poultry meat across countries. The Eurostat data give insight in the international trade flows from all EU countries and shows which EU countries are involved.

Eurostat<sup>67</sup> gives annual data on value and numbers of export of grandparent and parent female chicks of 'poultry' of a weight of less than 185 gram (excluding layer stock), but it is not possible to distinguish GP and PS birds. Under product code 01051119 the export value is given for all 27 EU member states. Table 6.1 gives for the year 2010 the total export value for the entire EU-27 and the 12 individual EU countries with more than 500.000 euro export value. Table 6.2 gives the numbers of female chicks exported for these countries. GP and PS can differ more than a factor 10 in value, but actual market prices are not available. A relative high average value indicates that probably the share of GP chicks is high and a relative low average value that the share of PS is high. From Table 6.1 and 6.2 it can be concluded that for example the share of PS is greater in intra-EU trade than in extra-EU trade and that Ireland and Slovakia export predominantly PS and the UK GP.

The total export value of broiler breeding stock is 274 million euro (Table 6.1). The total value of export to EU countries (intra-EU) 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. Probably the share of grandparent female chicks, with a higher value, is higher in the extra-EU trade balance. The 12 countries in Table 6.1 have a share of 99% in the total EU export value. Of these countries the largest exporters of poultry meat breeding stock (in total export value of intra- EU plus extra-EU trade) are UK, Netherlands, Germany, France and Hungary.

Table 6.1. Export value (\*1000 euro) in 2010 of broiler breeding stock of EU-27 total and for the 12 main exporting countries<sup>68</sup>

|                | Export value of total EU export (in 1000 euro) | Export value of intra-EU export (in 1000 euro) | Share intra-EU export of total (%) | Export value of extra-EU export (in 1000 euro) | Share extra-EU export of total (%) |
|----------------|--|--|------------------------------------|--|------------------------------------|
| United Kingdom | 70353  | 41259  | 26%                                | 29094  | 25%                                |
| Netherlands    | 53892  | 27625  | 18%                                | 26267  | 23%                                |
| Germany        | 47184  | 29241  | 19%                                | 17943  | 15%                                |
| France         | 26996  | 7829   | 5%                                 | 19167  | 17%                                |
| Hungary        | 20774  | 6970   | 4%                                 | 13804  | 12%                                |
| Denmark        | 14480  | 12739  | 8%                                 | 1741   | 2%                                 |
| Ireland        | 12188  | 12188  | 8%                                 | 0  | 0%                                 |
| Spain          | 10766  | 6355   | 4%                                 | 4411   | 4%                                 |
| Slovakia       | 9497   | 9497   | 6%                                 | 0  | 0%                                 |
| Finland        | 3374   | 1338   | 1%                                 | 2036   | 2%                                 |
| Italy          | 1142   | 706  | 0%                                 | 436  | 0%                                 |
| Poland         | 653  | 73   | 0%                                 | 580  | 1%                                 |

<sup>67</sup> Eurostat, 2012.

<sup>68</sup> Eurostat, 2012.

|             |        |        |  |        |  |
|-------------|--------|--------|--|--------|--|
| Total EU-27 | 273281 | 157411 |  | 115870 |  |
|-------------|--------|--------|--|--------|--|

Table 6.2. Numbers of broiler breeding chicks exported (millions) of EU-27 total and for the 12 main exporting countries<sup>71</sup>

|                | Number (x 10 <sup>6</sup> ) in total EU export | Number (x 10 <sup>6</sup> ) in intra-EU export | Share intra-EU export of total (%) | Number (x 10 <sup>6</sup> ) in extra-EU export | Share extra-EU export of total (%) |
|----------------|--|--|------------------------------------|--|------------------------------------|
| United Kingdom | 13.2   | 8.9  | 8%                                 | 4.3  | 13%                                |
| Netherlands    | 20.0   | 11.8   | 11%                                | 8.2  | 25%                                |
| Germany        | 16.8   | 11.3   | 10%                                | 5.4  | 16%                                |
| France         | 10.2   | 5.0  | 5%                                 | 5.2  | 16%                                |
| Hungary        | 7.6  | 3.3  | 3%                                 | 4.3  | 13%                                |
| Denmark        | 16.9   | 16.4   | 15%                                | 0.5  | 2%                                 |
| Spain          | 4.1  | 2.1  | 2%                                 | 1.9  | 6%                                 |
| Slovakia       | 23.3   | 23.3   | 21%                                | 0  | 0%                                 |
| Finland        | 1.2  | 0.6  | 1%                                 | 0.7  | 2%                                 |
| Ireland        | 24.7   | 24.7   | 22%                                | 0  | 0%                                 |
| Poland         | 0.5  | 0.2  | 2%                                 | 0.3  | 1%                                 |
| Italy          | 1.9  | 0.9  | 8%                                 | 1.0  | 3%                                 |
| Total EU-27    | 143.1  | 110.4  |                                    | 32.7   |                                    |

The UK, the Netherlands, Germany and France export to most EU countries. Export from Hungary is concentrated on the UK and eastern EU countries. Export outside the EU is mainly to countries in eastern Europe (Ukraine, Belarus and Russia), North Africa (Morocco, Algeria and Egypt), Middle East (Iran and Saudi Arabia) and Asia (Bangladesh, Thailand and Indonesia). Export to countries like USA, Brazil and Canada is below 1 million euro<sup>69</sup>.

Breeding of pedigree, GGP and GP stock is highly centralised in the three breeding companies. The transport distance for these day-old chicks is therefore in general very low. Breeding companies generally disseminate birds from the genetic selection programme as day-old GP chicks. Broiler breeders are mostly locally hatched and transported. The transport distance is dependent on the organisation in distribution areas of the company and it is dependent on the market share in the region. In general one can say that pedigree and GGP chicks travel less than 100 km, GP chicks travel less than 500 km and broiler breeder chicks may travel up to 2000 km, but most broiler breeder chicks travel less than 500 km. The transport distance for broiler breeder chicks is dependent on the density of hatcheries and parent stock farms in a country.

## 6.2 The products (breeding chickens of different breeds and lines) put on the EU market, their commercial value, and the main trade flows within the EU and with third countries (in particular USA and Canada)

All companies have a portfolio of marketed breeder and broiler “products”, which they currently sell<sup>70</sup>. Each company has one product that dominates the company sales in terms of parent stock equivalents. Parent stock equivalents are either broiler breeders or the number of broiler breeders that can be sold from a grandparent female. The dominating products are: Ross 308 for Aviagen, Cobb 500 for Cobb and Hubbard Flex for Hubbard. These products have in common that they are suitable for a wide range of production environments, suitable for the world market and highly feed efficient. In addition, all companies have broiler products for specific demands, such as slower growing products for the European

<sup>69</sup> More details in Annex I.6

<sup>70</sup> More details in Annex I.6

market. There is virtually no demand for slower growing broiler products outside the EU, except for companies importing poultry meat into the EU.

With currently available EU-statistics the market share of the various products cannot be determined. Two of the three companies did not disclose their estimates of market shares, because it was deemed commercially too sensitive, so a quantitative description of market shares is not possible. Aviagen estimate the total EU27 PS market to be 60-65 million PS. The company disclosed that it has a majority share of this market. In general it can be said that each breeding company has some regions around the world in which they are stronger or weaker. For example, Cobb is strong in the USA and Brazil (Cobb 500) and Aviagen is very strong within the EU (Ross 308) and Hubbard has a strong position in the USA (Hubbard M99 male) and in its home market France (F15). For slower growing broiler production Hubbard has a majority share in Europe. In France, Sasso in collaboration with Cobb is a significant party as well for slower growing broilers.

The disclosed information gives clear evidence that all three large breeding companies are economically dependent, in their turnover and profits, on fast growers. For all three companies more than 95% of their turnover is realised by fast growers. Slower growing broilers are for these companies only a niche. The commercial value of having a successful fast growing broiler product is much higher at the moment, than having a successful slower growing broiler. Results from the on-line stakeholder and interested party consultation support the perception of breeding industry. All stakeholder groups see in Europe a dominance of parts of fast growing birds. Most of this meat is sold fresh.

Market prices for breeding stock or broilers are dependent on the level of integration. In an integrated situation real prices for parent stock or broiler chicks are not published. In countries with less integration between links in the production chain day old broiler chicks have a market price, but this price is not available per crossbred product in statistics. Only an average price is available for broiler chicks. In North-West Europe, the market price of a broiler chick is approximately € 0.30-0.35. As a rule of thumb, PS chicks cost ten times the cost of a broiler chick, so €3.00-3.50 and GP chicks ten times the cost of a PS chick, so €30-35<sup>71</sup>. None of the companies disclosed the details of their pricing structure, so no accurate information is available.

### 6.3 Number of employees concerned and their level of qualification involved in the breeding selection process

Aviagen: 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-Europe: Cobb-Vantress has about 1,700 employees employed globally.

Hubbard: The number of people working for Hubbard is not disclosed. The owner, Groupe Grimaud employs about 1,700 people<sup>72</sup>.

These three companies predominantly sell GP stock which are ultimately used to provide the broilers used worldwide. To survive in this market with severe competition, outstanding R&D and technical support to clients are necessary. This requires that a combination of excellent well-educated animal scientists and technical specialists are employed by the breeding companies. All staff are trained within the company to meet the high demands on service to customers, and knowledge of animal genetics, health, nutrition, management and physiology.

### 6.4 Economic output of the breeding selection companies

Aviagen: Aviagen Broiler Breeders is owned by EW Group, a family-run business. There are no public financial reports available.

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<sup>71</sup> Peter van Horne, personal communication

<sup>72</sup> Van Boekholt, 2012.



**Cobb-Europe:** Cobb-Europe is owned by Tyson Food Inc., a public-owned company with shares in the stock market. Financial reports are available for Tyson Food, showing the total sales amounting to 28,400 million dollar in 2010 of which 35% is related to poultry<sup>73</sup>.

**Hubbard:** Hubbard is part of Groupe Grimaud (GG) that has a turnover of 245 million euro of which 75% on the international market<sup>74</sup>. GG is a family-run business. In 2010, 40 million euro was raised to support their growth strategy, but the Grimaud family still holds the majority of the shares<sup>75</sup>. There are no public financial reports available. None of the companies disclosed any information on economic output beyond the information in the public domain. They quote fierce competition as the main reason. Two of the three companies indicated that at this moment, 99% of their turnover is realised by selling fast growing birds. Only 1% is realised by selling slower growing birds. According to the response to the on-line questionnaire, it is necessary for the competitiveness of the EU broiler sector to continue to have European (departments of) breeding companies.

### 6.5 The impact of feed conversion rates on the price of the different broiler crosses

Feed conversion rates have a major impact on the profitability of a broiler production company. Feed conversion is strongly, but not completely linked to growth rate (number of days to grow to slaughter weight). Other important traits are slaughter yield (being the % of carcass weight of the live weight before slaughter) and especially the amount of breast meat, the most valuable part of a broiler. The prices of broiler parent stock and broilers are extremely elastic for feed conversion rate. Feed conversion is continually improved, both by genetic selection and by improved dietary composition. Currently a broiler requires about 3 kg feed (about 13.2 MJ energy and 20% protein) for a live weight of 2 kg (feed conversion ratio 1.50). A small unfavourable difference cannot be compensated for by reducing the price of broiler breeders. There are examples where large-scale broiler operations changed supplier of breeding stock because of an observed 0.02 points difference in feed conversion ratio of the broilers (i.e. 40 g, or 1,3% extra feed per slaughter ready broiler). For the final stage in the production column, the broiler farms, the feed conversion ratio is a crucial economic parameter. Feed cost account for 60 to 70% of the total production costs. One point of feed conversion (10 g feed per kg weight gain) is equal to 0.5 eurocent of extra costs per bird. In a situation with high feed prices, which is the case in 2011 and 2012, the extra costs are even higher up to 0.75 eurocent per bird. With small margins of only a few eurocents per bird, these differences are of high economic importance. With the current incidence of poor harvests and the increased competition from for example biofuels, the situation may not improve in the foreseeable future. It is absolutely critical for a breeding company that the feed conversion ratio remains close to that of similar products of the competition. It could determine whether the company stays in business or not<sup>76</sup>. Feed conversion is important in all markets, whether whole birds or parts.

### 6.6 Level of concentration of the breeding selection industry

The ownership of all the major broiler lines and brands in the world by just three broiler breeding companies is the result of a process of line and brand acquisition and loss over the last 30 years. Laughlin<sup>77</sup> named 14 broiler breeding companies that were actively trading in 1980 among other companies. Since 2008 only 3 companies remained in the market. The companies claim that in this acquisition all original genetic lines have remained and that this consolidation had no impact on biodiversity. In the broiler production chain, the influence of the broiler breeding companies generally extends to the GGP or GP level in the breeding pyramid only. Broiler production companies and integrations are generally independent of broiler breeding companies, except for the owner of Cobb-

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<sup>73</sup> Tyson Food, 2010.

<sup>74</sup> [www.grimaud.com](http://www.grimaud.com)

<sup>75</sup> Hubbard, 2010.

<sup>76</sup> Breeding company interviews, multiplication company interviews

<sup>77</sup> Laughlin, 2007.



Vantress Inc., Tyson Foods, Inc. Tyson Food's chicken operations are fully vertically integrated from the parent flock to the distribution of fresh and processed poultry meat<sup>78</sup>.

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<sup>78</sup> Tyson Food, 2011.

## 7. GENERAL DESCRIPTION OF THE GENETIC SELECTION PROCESS AND OF ITS IMPACT ON THE WELFARE OF CHICKENS

### 7.1 Impact of genetic selection on the welfare of chickens reported in the scientific literature

EFSA recently reviewed the scientific literature and concluded that “It is generally accepted that most of the welfare problems are caused by genetic factors”, but management and environmental conditions may alleviate or aggravate the magnitude of the welfare problems. Birds develop welfare problems if they have a genetic predisposition and are kept in a risk environment. The extents to which welfare problems are caused by genetic factors or environmental and management factors may vary. Even in an environment that causes expression of the genetic predisposition, only part of the variation between animals can be attributed to variation in genotype and this is commonly referred to as the heritability of a trait. Estimates of the heritability of Tibial Dyschondroplasia (TD) are around 40%, of Foot Pad Dermatitis (FPD) between 20 and 30%, of hock burn between 10 and 20% and of Sudden Death Syndrome (SDS) around 30%<sup>79</sup>. The remaining major part of the variation is due to non-additive genetic effects, such as dominance and epistasis, and non-genetic effects. Genetic selection impacts only on the additive genetic merit.

The breeding companies are critical of the EFSA recommendations, because the report is based on peer-reviewed scientific literature only, and they say that it does not present a balanced description of the current situation.

Genetics not only affects the welfare of the broilers, but also the welfare of the parent stock (broiler breeders) and further up in the selection pyramid, that of grandparents and great grandparents. As broilers are selected for fast growth and lean meat production, these characteristics are also present in the parent stock. As for broilers, the welfare of parent stock is influenced by genetic as well as environmental and management factors. Major welfare problems in parent stock are: a strong motivation to eat after consuming the daily feed allowance, aggressive and rough mating behaviour, a barren environment and a high stocking density<sup>80</sup>.

The literature reviewed by EFSA provides evidence that the genetic predisposition for aspects of these welfare problems was higher in lines strongly selected for production traits than in other lines, at least at the time of the experiments. There is evidence that the genetic predisposition may be largely masked in high-quality environments and more fully expressed in broader commercial conditions, as Kapell et al.<sup>81</sup> showed for foot pad dermatitis, a form of contact dermatitis. Genetic selection for production traits, however, 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.

### 7.2 The genetic selection methods currently used and foreseen within the next fifteen years

Chicken of pedigree flocks and some male chicken in multiplication flocks are subject to broilerisation. It means that they are fed and reared for 6 weeks as if they were broilers. Selected individuals are then placed on a standard broiler breeder rearing feed programme from 7 to about 20 weeks of age so that the birds will achieve the physical and physiologic attributes to be a successful breeder. Broilerisation of male

<sup>79</sup> EFSA, 2010a.

<sup>80</sup> De Jong and Guemene, 2011.

<sup>81</sup> Kapell et al., 2012a.

chicks in multiplication is aimed at identifying cockerels without a genetic predisposition to welfare problems in commercial conditions<sup>82</sup>.

Independent culling, which is culling of individuals on the basis of their phenotype, visible disorders or abnormalities, is used at all levels of the breeding pyramid. The percentage of animals rejected is highest in the pedigree flocks. A selection index of estimated breeding values (genetic value) is the common way to the select among the birds in the pedigree flocks that passed the independent culling. Such a selection index is generally only used in pedigree flocks as birds at the GGP and grandparent level in the breeding pyramid do not have known parents.

Two of the three companies use genomic selection and genetic markers and the third company is evaluating its usefulness<sup>83</sup>. The main objectives of doing so are 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. The use of genomic breeding values will increase over time, but the current combination of independent culling and selection on BLUP estimated breeding values will prevail.

### 7.3 The timeframe to put new breeds and lines of chickens on the market

Testing a new crossbred broiler product from a given cross of lines takes two years. Developing a new crossbred broiler product from evaluating various possible crosses of lines takes another four years. If additional development of the pure lines is necessary, it takes another four years. So introducing a new crossbreeding structure for a novel broiler product may take between six and ten years. It takes at least four to six years for the genetic change in the pedigree lines to transfer to the commercial broilers. This is generally referred to as genetic lag.

### 7.4 Interaction between genetic selection schemes and housing systems used for chickens

Genotype by environment interaction means that the superior animals in a favourable environment are not superior in a mediocre environment. It could mean that the superior animals in a favourable selection environment may develop welfare problems in a commercial environment. The environment does not encompass just the housing systems, but the entire complex of care, health, feed, social interactions, litter quality, air quality and stockmanship.

The commercial information supplied by breeding companies to their customers suggests that interaction between genotype and environment is of practical significance. Breeding companies also indicated that the variation in broiler performance between genetically identical flocks on commercial broiler farms may be as much as 33%<sup>84</sup>, indicating the importance of management for broiler performance. When comparing rates of improvement in different geographical regions as a result of genetic selection in two continents representing tropical (Brazil) and temperate regions (UK) there was no evidence that genotype-environment interactions are important for reproduction traits<sup>85</sup>.

All three companies consider interactions between genetic selection schemes and the diversity of housing and management systems of practical relevance. They address the issue in three ways. The most important method is to select for robust lines and products that thrive in the entire range of acceptable customer production environments. The idea is to make their birds robust enough to cope with variability in housing conditions, nutrition and management. The next method is to adjust the customer production environment to the target environment through providing manuals, feed specifications, health

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<sup>82</sup> Breeding company interviews and multiplication company interviews

<sup>83</sup> Breeding company interviews

<sup>84</sup> EFFAB, unpublished material

<sup>85</sup> Hocking and McCorquodale, 2008.

management protocols and technical support to allow the customers “to achieve the full genetic potential of the chickens in their care because the customer’s success depends on genotype x management x environment interaction.”<sup>86</sup> The third method is to match the specific customer environment with an appropriate crossbred product, but is not considered feasible by all companies. Developing broilers for specific environments is very expensive and not practical from a sustainability or economic viewpoint.

The selection environment is critical for developing robust lines. In reality, it is common practice to use additional selection environments that are similar to commercial production environments, by testing birds under 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<sup>87</sup>.

The breeding companies do not believe that any of their main broiler products require above-average management for acceptable welfare of the birds, but improving management standards of all customers helps achieving optimal performance, health and animal welfare. They believe that anyone with reasonable experience can achieve the levels of management that are needed to deliver a good outcome in terms of performance, and animal welfare, including health, both with fast-growing and slower-growing birds. Substantially slower growing birds are in general more robust and will be able to deal with a larger variety of circumstances.

## 7.5 Level of integration of welfare aspects or traits within the selection process by breeding companies and the balance achieved with meat production aspects or traits

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<sup>88</sup>. Traits included in the genetic programmes of the three companies are shown in Table 7.1. The individual traits in the four categories vary somewhat between companies, but the majority of traits are the same across companies. All breeding companies are using BLUP breeding values in the pedigree flocks, at least for some of the traits listed. Changing to a BLUP procedure for all these traits would improve the efficacy of genetic selection. On multiplication breeding sites, selection is generally based on independent culling<sup>89</sup>.

*Table 7.1 Traits associated with welfare of broilers that are subject to genetic selection in at least one breeding company*

|  |  | Indicator              |
|--|--|------------------------|
| <b>Skeletal integrity</b>                            | - Leg strength                         | Subjective score       |
|  | - Walking ability                      | Subjective gait score  |
|  | - Tibial dysplasia (TD)                | X-ray                  |
|  | - Crooked toes                         | Absence                |
|  | - Varus / valgus deformities           | Absence                |
|  | - Femur head necrosis                  | X-ray                  |
|  | - Symmetric keel bone                  | Presence               |
|  | - Hump back                            | Absence                |
| <b>Contact dermatitis</b>                            | - Foot pad dermatitis (FPD)            | Subjective score       |
|  | - Hock burns                           | Subjective score       |
| <b>Heart &amp; lung function (ascites &amp; SDS)</b> | - O <sub>2</sub> pressure in the blood | Oximeter               |
| <b>Liveability</b>                                   | - Mortality                            | Alive at 2 and 6 weeks |

<sup>86</sup> Breeding company interviews

<sup>87</sup> Breeding company interviews

<sup>88</sup> Kapell et al., 2012b

<sup>89</sup> Multiplication company interviews

The breeding companies seek a balance in the breeding goal between reproduction traits, welfare traits, including health 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 the welfare traits in the breeding goal varied from 18% to 33% across breeding companies.

Line-specific information on the weighting of welfare traits in the breeding goal was not disclosed by any of the three 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, not because of antagonistic relationships between welfare traits and economically important traits, but because the increased selection pressure for welfare traits implies a reduced selection pressure on some other traits. Substantial changes in the breeding goal in favour of welfare traits would only be justified by a change in market requirement<sup>90</sup>.

The weighting of the welfare traits in the breeding goal in the past is visible in the genetic trend graphs. All companies showed genetic trend graphs of the main welfare traits in the breeding goal like O<sub>2</sub> pressure in the blood, leg strength, TD, foot pad dermatitis and hock burns, with meaningful genetic progress at least in the lines shown.

## 7.6 Maintenance by breeding companies of genetic diversity of chickens within the EU

Results of Muir et al.<sup>91</sup> indicated that as much as 50% of the genetic diversity in the hypothetical ancestral population is absent in commercial pure lines of broilers and layers. They concluded that this is primarily due to the limited number of chicken breeds that went into the formation of the modern commercial poultry lines. They also concluded that the modern farming system has contributed less than 5% to the level of inbreeding of 14-15%, despite intense levels of selection, closed populations and industry consolidation since 1950, indicating that the breeding companies maintain their genetic resources in a sustainable manner. One company provided a critique of this paper, backed by leading scientists, saying that the estimate of the loss of alleles of 50% is heavily based on the assumptions of the method and varies considerably both up and down with different assumptions.

The breeding companies consider their gene pool as their most important asset. Therefore they keep sufficiently large populations, and control the number of progeny per sire and dam selected per generation. The maximum rate of inbreeding within any of their main lines is kept below 1% per generation<sup>92</sup>, conforming with the recommendation of the FAO. Only one company disclosed the exact rates of inbreeding in their main lines. All companies explained their approach to controlling the rate of inbreeding and their target. With the use of theoretical models and a few assumptions, it can be concluded that the described protocols are quite sufficient to successfully keep the rate of inbreeding below 1% per generation in breeding companies main genetic lines, if the population size is sufficiently large, which we could not verify.

Each of the three breeding companies retains more than 30 different commercial, control and experimental lines, not including back-up populations of the same line<sup>93</sup>. None of the breeding companies disclosed the exact make-up of their pool of genetic lines, but we estimate that 8-12 lines per company are used for commercially available broiler products. At least two companies have estimated the genetic distance between their main lines with genetic markers<sup>94</sup>.

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<sup>90</sup> Breeding company interviews and multiplication company interviews

<sup>91</sup> Muir *et al*, 2008.

<sup>92</sup> Breeding company interviews

<sup>93</sup> Breeding company interviews

<sup>94</sup> Andreescu, 2007.

Breeding companies store genetic material in-vivo with populations generally being double-banked in pedigree programmes and GGP operations across the world. One company operates two breeding programmes in parallel, one in Europe and one in the US.

### **7.7 Current use of indicators by breeding companies to monitor the welfare of chickens during the selection, multiplication, production and slaughter of broilers**

In pedigree and multiplication flocks, all birds are visually evaluated for the disorders and abnormalities and any birds carrying any defect are rejected. The main indicators and methods of selection are shown in Table 7.1. In general, breeding companies have no access to any welfare indicators that commercial flocks may collect, but they do receive feedback and complaints from clients.

## 8. MONITORING OF BROILER WELFARE IN SWEDEN, DENMARK AND CANADA

Welfare outcome indicators of broilers in commercial conditions (slaughterhouses and commercial broiler production) are routinely collected in Sweden, Denmark and Canada. In this study, we interviewed competent authorities in Sweden and Denmark face-to-face and in Canada via e-mail. A full report of these case studies is included in Annex II.

The monitoring schemes in Sweden and Denmark involve inspections of broiler farms and sampling in the slaughterhouse of all batches of broilers slaughtered in the country for foot pad dermatitis. Only the results from the sampling in the slaughterhouse are stored in a central database and are available for further analysis.

Foot pad dermatitis scores 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.

The farm inspections in Sweden are initiated by the industry itself and each herd is visited every 12-18 months. In Denmark, each farm is visited once every 6 years. The information from the inspections is only used to improve welfare on the farm itself. Condemned carcasses in the slaughterhouse would be available on request, but are currently not analysed.

There is currently no discussion on the cost of the monitoring schemes. Model calculations showed that the revenue resulting from the improved welfare exceeds the cost of monitoring.

In Canada, carcasses in the slaughterhouse are routinely monitored and information about them stored in a central database. The Canadian Food Inspection Agency provides feedback to individual farmers and periodically produces a summary report. Reductions are reported in the incidence of leg disorders and ascites.

None of the three countries provide feedback to individual broiler breeding companies, nor any other supplier to broiler farms. It means that if the cause of a welfare issue lies at a different level from the broiler farm, such as breeding company, feed supplier, veterinary centre, hatchery, broiler breeder flock, housing or equipment or haulage, it is not possible to identify the origin. An exception is Denmark, where data on foot pad dermatitis are averaged for hatchery and feed manufacturer and accessible for the production chain.



## 9. BASELINE SCENARIO: NOT CHANGING ANY EU-POLICY

The *Baseline scenario* is a forecast of the situation within 15 years without any EU policy change. In this scenario we evaluated the impact of the current selection and multiplication process, on animal welfare indicators and autonomous developments in the broiler meat production chains. The possible evolution given the current situation and likely trends and actions of the main stakeholders, including the Member States, was analysed.

### 9.1 Likely trends in EU and global broiler production and trade

Global poultry meat production will further grow with 2.4 percent per year over the next 20 years<sup>95</sup>. In 2030 the total production will be 160 million tons, and poultry meat will have a share of 39% in total meat production. An estimated<sup>89</sup> 75 percent of the global growth for the next decade will be in emerging markets, with the BRIC (Brazil, Russia, India and China) leading the way. The markets in Europe and the United States are saturated. As the production in the EU-27 will grow only a little, the share of the EU in the global production will reduce from 12.1 to 10.3% in 2020.

Countries with a competitive cost of production and a focus on trade, such as Brazil and Argentina, will increase their exports. Countries, like China and Thailand, will be exporter of labour-intensive poultry products. Increase in scale of broiler and broiler parent stock farms and enterprises is expected in the EU as well as worldwide<sup>89</sup>.

Global demand for broiler meat has been increasing because of an increase in wealth for the middle class in South America and Asia. With increasing wealth the consumption of animal products increases. As poultry meat is affordable and acceptable in most religions, the increase in consumption of poultry meat exceeds the increase in consumption of other types of meat<sup>89</sup>. The consumption of poultry meat in the EU will increase driven by the relative price-competitiveness and advantages in convenience for poultry meat compared to other meat products<sup>96</sup>. Demand for poultry meat in the EU is projected to increase by almost 10% to 12.7 million ton in 2020. It is expected that the total volume of slower-growing broilers and other niche products will increase but remain relatively low. However, recent developments driven by NGOs and the food processing industry show that the market may change faster than currently expected due to legislative or retailer pressures. Consumer studies in developed countries have shown in the past that the economic cost continues to be the primary driving force influencing consumer purchasing decisions and this does not support a major growth in this slow-growing market segment due to the increased cost of the products<sup>97</sup>.

The breeding companies observe that focus on animal welfare is greatest in North-West Europe. In Asia the interest in animal welfare is lowest compared to most countries, but it is nevertheless a key factor for companies that export poultry meat to the EU-27. The processing industry and poultry producers in the on-line consultation expect an increasing consumer demand for welfare-friendly produced broiler products in the EU.

The competitive position of EU-broiler industry and breeding companies could be affected by developments in WTO rules of trade between nations at a global or near-global level in the future. This concerns the incorporation of non-trade concerns and the incorporation of animal welfare standards in international trade. Until now animal welfare issues have been disputed rarely in relation to WTO<sup>98</sup>. For the purpose of this study, it is assumed that the international legal framework in this area will not change

<sup>95</sup> Rabobank, 2011.

<sup>96</sup> AgraCeas, 2010.

<sup>97</sup> Center for Food Integrity, 2011.

<sup>98</sup> Cook and Bowles, 2010.

in the near future. In other words, poultry meat produced with lower standards for broiler welfare than the minimum in the EU cannot be barred from entering the EU poultry meat market.

## 9.2 Possibilities for private operators to undertake regional and national initiatives as suggested by EFSA

The hypothesis that was considered in particular is the possibility for breeding organisations to take initiatives themselves, without changing any EU policy, as suggested by EFSA recommendations. The summarised EFSA recommendations and the possibilities for the breeding companies to follow up on these recommendations are discussed below.

*Agree on qualitative and quantitative selection objectives for welfare traits.* It is clear from Chapter 7.5 that the main aspects of broiler welfare are currently included in the genetic programmes of the three breeding companies. They will continue to do so. The weighting given to welfare traits in the selection process is currently determined by the market conditions.

*Have a better balance in selection programmes between welfare and aspects of production efficiency.* The breeding companies seek a balance in the breeding goal between reproduction traits, welfare traits, including health traits and broiler production traits (Chapter 7.5). This is a continuous process, driven by customer demand. All companies aim to maintain the welfare aspects at the current level, while some aim for a small improvement in the welfare aspects with the use of advanced technology and genomic selection tools. A change towards a greater emphasis on welfare aspects in the selection programme can only be demand-driven.

*Ensure appropriate selection environments for the target range of production environments.* The breeding companies use multiple selection environments that reflect the variation in customer production environments as well as possible (Chapter 7.4). 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 (Annex I.7). It is not clear how representative the additional selection environments are for commercial production environments and hence, how effective this strategy is in each individual breeding company. With the current lack of data from commercial production, it is very difficult for a company to prove that their selection environments are representative.

*Achieve a better match between the various crossbred genetic products and the diversity of the intended production environments.* Currently, different crossbred broiler products are more targeted to different market segments than different production systems. Production systems for fast growing broilers are relatively similar throughout the EU, so the environmental aspects creating genetic variation in welfare aspects are more related to litter management, ventilation, diet specification and ingredients, health status, stocking density and room climate. If there were a lasting market demand for broiler products specific for a set of deviating production systems, some might consider developing a tailored crossbred product, whereas others deem it unfeasible and too expensive. See also Chapter 8.3.

*Ensure a minimum level of genetic diversity across lines, but also within lines.* Breeding companies maintain genetic diversity within and between their main populations in a careful manner, given their protocols to control the rate of inbreeding (Chapter 7.6). The consolidation of the broiler breeding industry between 1980 and 2008 has not resulted in a significant loss of broiler lines, according to the companies, but this could not be independently assessed.

*Monitor the effects of such initiatives by routinely measured welfare indicators on chickens in selection, multiplication and commercial farms as well as slaughterhouses.* All chickens reared to become a breeder at any level in the breeding pyramid are evaluated for at least visible disorders (independent culling). So pedigree and multiplication farms controlled by the breeding companies record welfare indicators but do not publish them. The breeding companies have no ready access to welfare indicators that may be available to commercial broiler producers for their own flocks. Fear of the competition will make it

unlikely that they will change to publishing welfare information by broiler genetic product in the foreseeable future.

The three breeding organisations shared evidence that they are including broiler welfare in their breeding programmes. The current rate of genetic change in the welfare traits is determined by the ability to consistently and effectively select for the desired trait in all birds and by market demand, not by lack of attention or indifference.

Our conclusion is that the biggest gains in animal welfare can be achieved if the market demand for high-welfare broiler meat products increases in the national and EU markets and if the links in the broiler production chain work together at a regional or national level to monitor and improve welfare of commercial broilers.

### 9.3 Impact on improving animal welfare

#### Perception of broiler welfare among the breeding companies

The general policy of the breeding company is to develop appropriate birds for the various production systems via balanced breeding of robust, productive animals in order to meet global food demand. In the face-to-face interviews, the breeding companies were asked for their opinions about broiler welfare. Their ambition to improve welfare is highly dependent on the concept of animal welfare and the perception of animal welfare problems.

One breeding company considered welfare of broilers to be their ability to grow under various acceptable circumstances without problems. This company considered the main broiler welfare issues to be foot pad dermatitis, liveability, stockmanship of farmers, maintenance of robustness, ability to thrive without antibiotics, decreasing the use of mutilations and feeding management of breeders.

Another company said that welfare is adequate if the welfare outcome expected by their customers is exceeded, in which case welfare is not universally constant, but rather reflects the social norms of the particular society within which the customer operates. They consider gut health, foot pad dermatitis and feed restriction of breeders in the rearing phase the most relevant welfare issues at the moment. The company aims to ensure that their breeders and broilers are robust and well-adapted to deliver good outcomes in welfare, health and production in the environments and housing conditions in which they are reared.

The third company considered welfare to be adequate if there was trouble-free production, absence of disorders and low mortality in the various customer production environments. Only minimal use of antibiotics in broiler production is appropriate for sustainable broiler production. They consider robustness, skeletal disorders, contact dermatitis, inactivity and aggressiveness as the most relevant welfare issues at the moment. They stress that broiler welfare should be considered in the context of feeding a human population of 9,000 million in 2030 and not in isolation.

For improvements in welfare, broiler genetics companies are dependent on support from partners in the broiler production chain. In general, the collaboration and participation in the production chain is perceived to be good. Good broiler welfare is a product of genetics by environment interaction, so anyone in the production chain has an impact on and therefore a responsibility for actual broiler welfare. Also retailers and consumers have a responsibility, and the breeding companies say that retailers and consumers must pay an adequate price for products.

#### Perception of broiler breeding and welfare in broiler meat production

The views on the need to improve animal welfare in the broiler sector through breeding vary considerably among the four groups in the on-line consultation, which are the breeding industry, the broiler production industry, the poultry meat processing industry and a group of related stakeholders (e.g. suppliers, NGOs and the representative of the retail. The two extremes are the group of related stakeholders on the one

hand and the group breeding industry on the other hand. The latter group consisted of representatives of the broiler breeding industry whose organisations were not included in the face-to-face interviews, but are not completely independent of the three interviewed companies.

The group breeding industry thinks that the broiler breeding companies take welfare seriously, whereas NGOs claim that there is substantial room for improvement. The poultry meat processing industry and broiler production industry are in the middle: it needs attention but substantial changes are not necessary at the moment. Poultry meat processing industry and the group of related stakeholders think that main current breeding goals are broiler growth and carcass traits, while the groups breeding industry and broiler production industry think that breeding goals are more balanced and include animal welfare.

The group poultry meat processing industry claims that in the future even more attention could be paid to feed conversion and growth performance. The group breeding industry says that currently there is sufficient emphasis on broiler welfare in the breeding goals and that, for the European market, the emphasis will increase in the coming years. They think that the focus of the main breeding companies will continue to be on growth performance, feed conversion, as well as animal welfare. The group breeding industry further indicated not surprisingly that they are very satisfied with the current efforts of the main breeding companies on broiler welfare and expect a continuing improvement in the future. The poultry processing industry wants more attention on all these aspects. The group of related stakeholders thinks that on skeletal integrity and contact dermatitis significantly more could be done and that on heart and lung fitness a little bit more could be done, than is currently practised.

The group of related stakeholders still have specific worries with respect to welfare for broilers in which they see hardly any progress. On the other hand, the poultry production and poultry processing industry do observe that breeding companies are taking this development seriously and are making progress. To cover this divergence in opinions, 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.

### Impact of broiler breeding on welfare of commercial broilers

The breeding companies showed long-term favourable trends in welfare indicators, like incidence of TD, leg disorders, foot pad dermatitis, hock burns, O<sub>2</sub> pressure in the blood and mortality. We are satisfied that the trends are genuine for the pedigree flocks shown, but we realise that it may be different for the pedigree flocks not shown. The trends shown apply to main genetic lines used to produce commercial crossbred broilers.

Genetic trends in incidence traits are dependent on the actual incidence, as it becomes harder to select against a problem when the incidence is low. Companies did not provide genetic trends for several welfare traits with low incidence, for the reason that genetic trends can only be estimated when BLUP breeding values are routinely estimated (without BLUP they are difficult to estimate). No exact quantitative information can be presented in this report. However, genetic progress in an individual welfare trait can be theoretically calculated, loosely based on information from the three breeding companies. If the selection pressure on an individual welfare trait is 5%, and 30% of differences between animals has a genetic origin, then the change per generation will be around 1.5% of a phenotypic standard deviation. This does not seem a large change in one generation, but it is important to note that this change is cumulative across generations.

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. The 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 exactly predict for how many birds in commercial production the actual welfare will be improved because of the on-going genetic selection. On the other hand a substantial potential impact can be estimated based on genetic progress by the breeding companies.

In some cases, the year-to-year variation in risk factors may mask the short-term genetic improvement. In other cases, such as the Danish case of foot pad dermatitis, a concerted approach may yield a larger short-term response in number of birds affected than would be expected from the genetic progress.

The increasing worldwide demand for animal products and the decreasing availability of resources such as land and water require livestock production to increase its productivity and to reduce its environmental impact. It causes the animal breeding industry to focus on productivity and efficiency, subject to constraints due to feed availability, environmental load, and animal welfare as well as possible restrictions due to genotype by environment interaction, antagonisms between traits, and selection limits<sup>99</sup>.

#### 9.4 Consistency with other EU policies

If the three breeding companies place more emphasis on genetic selection for welfare aspects at the expense of feed conversion and slaughter yields, the contribution of genetic selection in broilers to the **CAP objectives** to strengthen sustainability of agriculture in Europe will be different from the current situation.<sup>100</sup> Improvement of broiler welfare as part of the sustainability objectives will be higher, whereas improvement of environmental impact will be lower.

More emphasis on broiler welfare in selection programmes is said to lead to less progress in environment-related traits such as a lower rate of reducing the use of water, land and energy, emissions to water, soil and air and the dependence on fossil fuels, but the trend is likely to remain favourable. The impact of improving broiler welfare through changing from fast-growing broilers and production systems to production systems for slower-growing broilers is strongly unfavourable for environmental sustainability in the short term<sup>101</sup>, but after the one-off change, the rate of improvement is again likely to be favourable. Improving broiler welfare in itself is likely to be positive for **sustainability** of poultry production, as more birds survive, less birds are condemned at slaughter, less feed is wasted and less medication is needed.

With the likely trends described in this chapter, **food security** in the EU will not be affected. Chicken is and will remain a relatively affordable type of meat compared with beef or pork. The EU will become more dependent on imports.

The **regional impact** of broiler meat production in the EU will continue as rural areas in large parts of Europe benefit economically from broiler production. At the same time, the influence of individual regions on production and processing will reduce as the scale of organisations in the production chains increases to multi-national operators.

**Employment** in rural areas will keep benefitting from the continuation of broiler breeding and production, although the breeding companies themselves do not employ a large number of people.

The vast majority of commercial broilers are of one of three types of crossbreds. The genetic diversity in commercial broilers is therefore low. **Genetic diversity** within genetic lines and between the genetic lines of each breeding company is quite sufficient and well-maintained. 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.

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<sup>99</sup> Neeteson et al., 2013

<sup>100</sup> More details in Annex I.8

<sup>101</sup> Leinonen et al, 2012; ABNAMRO, 2012

The diversity of genetic material in the gene pool of the breeding companies, and 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.

Breeding companies expect steady improvements in **health of broilers**, and hence in their welfare, through management and genetic selection and their aim 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 genetic selection is likely to be beneficial for several aspects of broiler health, too. Improving broiler welfare through changing to free-range systems may cause certain diseases to re-emerge.

The likely trends described above are unlikely to have a large impact on **meat quality**. Market demands will determine to what extent breeding companies will change their breeding goals.

If the current situation continues for another 15 years, it is expected that **food safety** will further improve with the current emphasis on reduction of Salmonella and Campylobacter contamination. The increase in number of free-range systems poses an increased risk of introducing pathogens from the wild bird population into the broiler production chain.

### 9.5 Competitiveness of EU breeding companies and production chains

All three leading breeding companies are world players and are operating in all parts of the world. None of the parties has a monopoly in a country, or a continent, or has exclusive contracts except where they are already a part of the same company, like Cobb as a subsidiary of Tyson. The competition between the companies is severe in every country, on every continent and at every level by all three parties. This situation will remain the same in the foreseeable future, since no further acquisitions within the broiler breeding industry are expected.

Gaining or losing market share in stable markets like Europe is determined by details of competitiveness. Growth in company turnover comes 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<sup>102</sup>. If the market drives the changes in emphasis in the breeding goal, all breeding companies operate on a level-playing field where adjustments in R&D and investments will be done gradually in relation to economic output. In case of substantial movements in the market, the party with the best economic situation will survive. All companies unanimously plead for a market development by demand instead of government interference at the supply side.

### 9.6 Impacts on trade between the EU and third countries with a special emphasis on the USA and Canada

The EU expects poultry exports to decline gradually in the medium term due to strong competition on the world market by low cost producers and an unfavourable euro exchange rate. EU imports will further increase. The EU will gradually lose its net exporter status and be a net importer by 2015<sup>103</sup>.

The Southern American and Asian countries are increasing the production on a high quality level. Both continents have aims at the European market with its great purchasing power. Brazilian producers are already producing broilers according to the British Retail Standards to be able to export to Europe. At this moment Europe is a substantial market for frozen poultry meat from Brazil.

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<sup>102</sup> Breeding company interviews

<sup>103</sup> EC, 2010.

Canada is not a significant player on the world export market and its broiler production has no impact on the trade with the EU. The larger players in the Northern American market, like Tyson Foods, are already world players. Their influence on the European market has been quite limited so far since faster-growing markets have their attention. Investments in those continents are much more attractive than investments in a stable market in Europe. Since Southern America, Asia and Africa still have potential to grow further in the next 10 years, we do not expect a large impact on the trade between the USA and the EU in the baseline scenario.

If the breeding companies place more emphasis on broiler welfare in genetic selection than in the past, it is still unlikely that it will have any impact on the trade between the EU and North-America.

## 9.7 Conclusions

Without a change of EU policy on broiler welfare, a change in emphasis on welfare aspects in the breeding goal will only happen in response to market pressure. This would affect the three breeding companies in the same way. Without any change in market pressure, the actual improvement of broiler welfare in commercial flocks will be limited, but with an increased demand for poultry meat from more welfare-friendly broiler production, it is likely to improve. The breeding companies are quite capable of improving welfare aspects faster, but refrain from doing so because they fear lagging behind in the competition on economically important traits.

We observe a lack of independent information about broiler welfare in commercial production. Therefore the perception of the magnitude of broiler welfare problems varies considerably. The closer the people are to broiler breeding in practice, the less they see an issue with breeding and broiler welfare, or the further away from practice, the greater the supposed role for breeding to improve broiler welfare in commercial flocks.



## 10. IMPACT ASSESSMENT OF SCENARIO 1: BETTER MATCH BETWEEN BREEDS AND ENVIRONMENT

The general objective of the first Scenario is to achieve a better match between the genetic lines and the environment, aiming at reaching a better balance in selection programmes between welfare and meat production aspects. A mandatory scheme in Scenario 1 has to ensure testing of breeding stock in the production environments. Welfare traits should be included in the genotype x environment studies and the selection of birds by breeding companies. Welfare traits that are found to be heritable should be included in breeding programmes and selection indices. Such a scheme would first of all require transparency of breeding companies about the results of testing different birds in different environments. This could for example be implemented in a quality assurance system that will include verification of the methods used by breeding companies to achieve a good match between the breeds and the variation in production environments.

The rationale of this first scenario is that genetic selection may be balanced for production and welfare traits in the selection environment, but if broilers have to produce in commercial environments - that are different from the selection environment in terms of dynamics and level of management - their welfare may still be impaired in the production environment. EFSA<sup>104</sup> stated that genotype by environment interaction exists for nutrition, ambient temperature and management systems, and the breeding companies should select birds able to adapt to environments in which they will be reared. According to EFSA, birds' welfare will be improved if they are tested and selected to their rearing and production environments. Both breeding companies and farmers should ensure that the most appropriate strain of bird for the local environment is used.

Furthermore, breeding companies should be encouraged to follow up thoroughly the ability of the birds to adapt to different kinds of environments from welfare as well as productivity and marketing perspectives, and not simply on a 'no complaints basis'. In particular, further diversification of broiler production systems would require even closer collaboration between producers and their breeding companies.

### 10.1 Impact on competitiveness of the broiler production and breeding sector

#### Impact on commercial broiler production in the EU

The breeding industry in the on-line consultation expects that this scenario leads to a decrease in employment in the poultry sector. All parties in the broiler meat production chain (breeding industry, broiler production industry and poultry meat processing industry) think that the competitive position of EU multiplication farms, hatcheries, broiler producers and poultry meat processors will decrease in this Scenario. The NGOs expect that the competitive position will improve slightly. Further, the breeding industry, the broiler production industry and the poultry meat processing industry think that this scenario will lead to a decrease of export of breeding stock from the EU to third countries. The NGOs expect hardly any effect on export of breeding stock.

The interviewed breeding companies assumed that Scenario 1 will significantly shift the weighting in the breeding goal from reproduction and broiler production traits to welfare traits. So assuming that the legislation results in a significant divergence between chickens selected in the EU and outside the EU, it would reduce the competitiveness of the EU poultry meat production chains and, under the current WTO agreement, force broiler production in the EU into a contraction. The main reason is that the flexibility for breeding companies in their genetic programmes decreases. In case of this Scenario, specific animals have to be selected and bred for the European market. This segmentation in the breeding programme takes away the flexibility to export surpluses in multiplication to other continents.

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<sup>104</sup> EFSA, 2010a.

For the local fresh market meat from European chicken, in this scenario, could be marketed with an additional value, but this market still has to be developed. At this moment there is only a niche market for such meat. For processed products from chicken meat, already frozen poultry meat from Brazil is used. In this Scenario this will only increase. The market for processed products with welfare indications is even smaller than the market for fresh meat with welfare indications. Therefore in this Scenario, poultry meat for the EU market would be largely produced outside the EU, with less stringent welfare legislation.

### Impact on broiler breeding in the EU

In the face-to-face interviews, the breeding companies indicated that a mandatory scheme as intended in Scenario 1 could be a reason for them to move pedigree breeding out of the EU. The breeding companies believe that they, more than anyone else, have accumulated the skills, experience and resources to make the right choices to remain competitive in the EU and globally, delivering products that the markets require. They recognise their responsibility in breeding for welfare and aim to be transparent in explaining their breeding strategy.<sup>105</sup>

The breeding companies indicate that the genetic divergence between EU-bred broilers and non-EU-bred broilers under Scenario 1 would be a serious problem for the competitiveness of EU-based breeding companies.

Scenario 1 implies that EU or third-party officers visit the pedigree breeding sites and multiplication sites regularly to audit the genetic programme. Even though it is a legal requirement for any owner of farm animals to allow competent authorities to check compliance with the provisions in directive 98/58/EC, animal breeding companies across species generally operate on the principle that any additional visit increases the risk of introducing a pathogen or a zoonosis, so they keep the number of visit by non-company people to the absolute minimum. If a commercial producer or a multiplication site breaks down with salmonella, it can be cleared, washed, disinfected and re-stocked. If a pedigree breeding site breaks down with 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. EU or third-party officers would visit multiple companies with the risk that commercially sensitive information is inadvertently shared with a competitor.

A third issue is leaking of trade secrets. Breeding companies would have to give insight in the exact make-up of their commercial crossbreds to allow meaningful inspection. Again there is a risk of this information being shared with a competitor inadvertently.

When breeding companies outside the EU will not be exposed to such inspections and sharing of information, they will have a competitive advantage compared to the EU-based companies.

The stakeholders from the groups breeding industry and poultry processing industry in the on-line questionnaire think also that Scenario 1 will change the competitive situation between breeding companies totally in the EU and will slightly affect the competitive situation in the world. The broiler production industry does not expect any changes, while the NGOs do not express a specific opinion on the consequences for competitiveness of the EU broiler breeding industry.

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<sup>105</sup> Breeding company interviews

## 10.2 The impacts on trade between the EU and third countries with a special emphasis on the USA and Canada

Part of the production in Europe is destined for markets outside Europe. EU companies now produce for markets like the Middle East and Africa. In those markets there is no demand for more welfare-friendly produced birds. If this Scenario is implemented, EU companies will no longer be able to compete with the US and Brazil on these markets. Canada is too insignificant a party on the world market to have any influence. The trade with non-EU countries in general will reduce if the EU and non-EU birds become too different on economically important aspects.

## 10.3 Impact on welfare and genetics of broilers

The representatives of the breeding industry who completed the on-line questionnaire and the breeding companies interviewed think that a mandatory scheme for the design and implementation of a broiler genetic programme will not be effective to improve welfare of broilers in commercial production faster than in the Baseline Scenario. If the selection process moves out of the EU, birds are no longer selected under European conditions and grandparent stock will have to travel greater distances. If broiler production moves out of the EU, too, the welfare of the broilers in countries outside the EU that produce the meat for the EU market may not be at the EU standard.

A genetic programme involves a large number of small decisions on a daily basis and in multiple locations. Only part of those decisions are captured in figures that can be used for monitoring among other purposes. It is generally difficult to meaningfully assess these decisions with occasional inspections. The efficacy of a genetic programme is both in the design and the details of the implementation, in particular in the collaboration of the team implementing the genetic programme.

Auditing the objectives, the design and the implementation of a genetic programme is a daunting task, which only very experienced people are capable of doing if they visit pedigree breeding sites regularly. Such people are generally associated with one of the three companies. The breeding companies believe that there are hardly any EU or EFSA appointed officials or contractors with sufficient expertise and information to make an appropriate assessment of a genetic programme for broilers<sup>106</sup>.

Auditing the genetic programme and involvement in the objectives, design and implementation of a genetic programme eventually affects the genetic predisposition of almost all broilers in the EU, but does not affect the risk factors in the production environments. Due to genetic selection birds will become less susceptible to these risk factors, but will not become insensitive. So the impact on the number of commercial broilers with improved animal welfare due to genetic selection is difficult to quantify.

It is unlikely that the external constraints on the means of the genetic programmes actually result in better welfare for commercial broilers than in the Baseline Scenario. It is our view that if external constraints are necessary, they should be set on the objectives and monitored on the outcome in the full range of commercial conditions instead of on the input in selection programmes, which is the core of Scenario 1.

## 10.4 Impact on and consistency with other EU policies

If in response to a mandatory scheme as in scenario 1, the breeding companies move their pedigree flocks out of the EU, the average distance over which GP or PS chicks are transported will increase, which increases the environmental impact such as the use of fossil fuels and the emission of CO<sub>2</sub>.

If the breeding companies remain in the EU and the mandatory scheme results in a substantial shift of emphasis in the breeding goal towards welfare aspects, the improvement rate of **environmental aspects**, such as use of resources and emissions to the environment will be lower than in the Baseline Scenario.

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<sup>106</sup> Breeding company interviews

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.

If such a 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 directly affects the competitiveness of the EU broiler production and goes against the **CAP objectives** of improving the sustainability of the poultry sector.

If this means that EU production of broilers declines and the EU becomes more dependent on import of poultry meat, **employment** in poultry breeding, production and processing is likely to reduce and **food security** may become more vulnerable. The affordability of poultry meat becomes more dependent on factors outside the EU.

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.

**Broiler health** may improve faster than in the current situation if emphasis on broiler welfare in the breeding goal is increased. An unfavourable impact is unlikely.

This Scenario will not reduce or increase **genetic diversity** of broiler pedigree flocks, but it may cause a relocation of such flocks to countries outside the EU.

The impact of Scenario 1 on **meat quality** and **food safety** is likely to be small.

### 10.5 Competitiveness of EU breeding companies and other chain partners

The breeding companies in the EU expect such a large impact of Scenario 1 on their competitiveness, that they have no choice but to re-locate their pedigree flocks outside the EU and maintain only a sales office in the EU. The EU is just one of their markets, as they are operating globally. At this moment, they have pedigree flocks in the EU, because of the high hygienic standards and the availability of qualified personnel. Most highly-qualified employees already travel all over the world, so having another base for pedigree breeding is only a matter of changing working schedules and no empty threat. Re-location of pedigree flocks is likely to be more expensive for the two EU-based companies.

EU-based broiler production companies will eventually have difficulty to maintain their economic base, since they can no longer compete with broiler production outside the EU. This could lead to take-overs and bankruptcies for integrations with a large share outside Europe. The European market will be more attractive for Brazil and the USA in this Scenario for export. Their production conditions are much cheaper and therefore they have a competitive advantage in case the European market is not protected by regulations or import tariffs to prevent large amounts of imports from production systems.

## 11. IMPACT ASSESSMENT OF SCENARIO 2: MAINTAIN GENETIC DIVERSITY

The general objective of the second mandatory scheme at EU level is to maintain the genetic diversity of the genomes of the poultry lines currently available in the EU. Breeding companies have a responsibility in maintaining genetic diversity between and within breeding lines and this is reflected by Scenario 2. In such a Scenario the breeding industry will have to provide information regularly on how they maintain genetic diversity within and between breeds or genetic lines in the pedigree.

The rationale of the second Scenario is to be prepared for future changes of direction in the types of broilers that are required in commercial production systems throughout the EU. EFSA<sup>107</sup> stated 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.

### 11.1 Impact on the broiler production and breeding sector

#### Impact on commercial broiler production in the EU

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

The breeding companies in the face-to-face interviews do not refer to such a negative impact, except for a possible increase in the cost of replacement breeding stock, because of the potentially higher costs at the pedigree breeding sites.

The breeding companies are in the best position to oversee the consequences of this Scenario, so we consider the effect of this Scenario to be rather limited for the other chain parties.

#### Impact on broiler breeding in the EU

In the on-line consultation, the broiler production industry indicate that it expects a change in competitive position between breeding companies in this Scenario. The group breeding industry expects a slight change, because it would have the same impact on all companies. Both groups expect a change on the EU breeding activities, the turnover of these activities and the export and import of day old chicken, as well. The poultry meat processing industry and the related stakeholders see hardly any impact on these economic variables.

In the on-line questionnaire the opinions are diverse as to whether or not this mandatory scheme is necessary. The broiler production industry thinks a mandatory scheme on genetic diversity is not necessary, while the group of related stakeholders (NGOs, suppliers and the representative of retailers) think it is necessary. In the breeding industry group and poultry meat processing industry group maintenance of genetic diversity is considered to be important, but the question is whether legislation is necessary to achieve this.

As maintaining genetic diversity is costly, there is a possible risk of cutting back on maintaining genetic diversity when financial results are poor. Because genetic diversity is the main asset of a breeding company and maintaining genetic diversity is the basis for future product development, it is our view that breeding companies will continue to carefully maintain their resources. Hence Scenario 2 may be a solution to a supposed problem that may not exist in reality.

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<sup>107</sup> EFSA, 2010a.

## **11.2 Impacts on trade between the EU and third countries with a special emphasis on the USA and Canada**

If Scenario 2 is implemented, the breeding companies may well move their pedigree flocks to countries outside the EU. The trade with other countries will change to importing GP chicks on a large scale instead of exporting GP chicks. It is not clear whether the trade with North-America would be affected by this.

## **11.3 Impact on welfare and genetics of broilers**

According to the parties in the on-line questionnaire, this Scenario will have no direct impact on the welfare of broilers in the EU. On the specific and major animal welfare problems like skeletal disorders and contact dermatitis this scenario has hardly any impact. Only the poultry processing industry sees a possibility that current problems could be resolved, in the future, with maintenance of genetic diversity.

The breeding companies see no advantage of Scenario 2 for the welfare of commercial broilers now or in the future. It is unclear to them what the benefit could be for genetic diversity within or between lines, let alone an impact on broiler welfare. They feel that with the vast majority of genetic lines from historic genetic programmes still present, they are adequately prepared for any future market requirements for broilers with their current sets of genetic lines. In this study, we did not find any evidence that did not support this stance.

## **11.4 Impact on consistency with other EU policies**

The impact of moving pedigree flocks outside the EU on consistency with other EU policies is described in Chapter 9.4. If pedigree breeding remains in the EU, Scenario 2 is unlikely to have a significant impact on CAP objectives, sustainability, environment, employment, food safety and food security.

Breeding companies pointed out that a mandatory scheme for maintaining genetic diversity would not increase the diversity they have, as they already maintain diversity in a responsible way. They say that maintaining genetic diversity is their core business. The breeding companies indicated that they still have most of the lines from the companies that they acquired in the last decades and that they keep these lines as long as strategically, technically and economically feasible.

## **11.5 Competitiveness of EU breeding companies and other chain partners**

This Scenario only has an impact on breeding companies in the EU. It is difficult to envisage a mandatory scheme under Scenario 2 without the breeding companies having to disclose the exact make-up of the genetic pool in terms of characteristics and population size. Such a scheme would compromise the intellectual property and trade secrets of the company. The genetic pool is the most important asset of a breeding company. Maintaining it is expensive. It is the basis of any future product development. The precise make-up of the lines in the genetic pool is not disclosed by any of the breeding companies, not even for this study. Being secretive is their only way of protecting their intellectual property and trade secrets. They are also worried that Scenario 2 increases the cost of the breeding programme without any additional revenue. This means that there is a competitive disadvantage for EU-based companies and no benefits.

## 12. IMPACT ASSESSMENT OF SCENARIO 3: ROUTINELY MONITORING OF WELFARE DATA IN COMMERCIAL ENVIRONMENT

The general objective of the third Scenario is to monitor the welfare of chickens by measuring welfare outcome indicators in selection and multiplication farms as well as in slaughterhouses. Implementation of a mandatory scheme in Scenario 3 would yield routinely and independently collected data in the commercial environment at a national level, for the various commercial genotypes and the different levels of the breeding and production pyramid. In such a scheme, welfare indicators will be measured in the commercial environments. Since those welfare outcome indicators are a consequence of 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<sup>108</sup> 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 harmonised across countries, to assess phenotypic trends of various traits as well as the impact of genetic selection on these traits. Practical methods are needed for independent welfare surveillance and to objectively assess and record welfare indicators in large-scale operations. EFSA also suggests that information on welfare and production of genetic broiler products, should be provided to farmers for them to make a reasoned choice. There should be an independent organisation providing this information to commercial producers.

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 also indicates that Member States should monitor broiler mortality rates as a means of preventing too high a stocking density. Directive 98/58/EC already requires that mortality rates are recorded regularly.

EFSA emphasized that mortality itself does not imply an effect on animal welfare but that increased mortality rate is generally associated with poor welfare before death. It is important that there is reliable surveillance of animal based indicators that reflect the areas of welfare concern influenced by genetic selection. The EU funded research project Welfare Quality<sup>109</sup> proposed an assessment protocol for broilers on farm, during transport and at slaughter using, as much as possible, animal-based measures that have been scientifically evaluated with regards to validity, reliability and feasibility. EconWelfare<sup>110</sup> is another European research project aiming at providing suggestions for national and European policy makers to further improve farm animal welfare. EFSA suggested groups of animal-based indicators that could be collected on farm or at the slaughterhouse<sup>111</sup>.

### 12.1 Impact on the broiler production and breeding sector

#### Impact on commercial broiler production in the EU

The impact of this Scenario on the competitive position of the broiler sector is diverse. The broiler breeding industry and the breeding companies expect that this scenario will have no impact on their

<sup>108</sup> EFSA, 2010a.

<sup>109</sup> Welfare Quality® Assessment protocol for poultry  
<http://www.welfarequality.net/everyone/43299/7/0/22>

<sup>110</sup> EconWelfare Project <http://www.econwelfare.eu/>

<sup>111</sup> EFSA, 2012



competitive position if monitoring takes place in slaughterhouses or on broiler production farms. The breeding industry does not see a necessity to monitor at the pedigree, GGP or GP sites.

The results of the on-line consultation show that people in the broiler production industry think that monitoring has to be done at all levels of the production chain and the group related stakeholders think that monitoring is most important at slaughterhouses and broiler farms. On monitoring at selection farms and multiplication farms the opinions are diverse. Like the breeding industry, the poultry processing industry indicated that they do not see the necessity of monitoring at selection and breeding farms.

All consulted stakeholders expect a negative impact of this Scenario on the competitive position of EU broiler production, since this scenario implies extra activities and thus has a cost price and production costs increasing effect. This will have consequences for the EU export position, and this in turn will influence the competitive position of all chain partners.

### **Impact on breeding companies in the EU**

The impact of on-farm monitoring of welfare indicators in the breeding pyramid on the competitiveness of broiler breeding companies is similar to Scenario 1 as it also requires allowing third-party officers on the breeding sites. As explained in Chapter 11.3, this poses a potential risk for broiler health and food security and there is a risk that intellectual property and trade secrets could be leaked to competitors.

According to breeding companies, there would be an additional risk of monitoring welfare indicators in the breeding pyramid, especially if the collected information is used to set targets. The breeding and multiplication companies need a challenging environment to allow expression of any genetic predisposition for welfare problems. They suggest that if the legislation focuses on reducing the expression of such a genetic predisposition on pedigree breeding or multiplication sites, the broiler breeding company ends up with genetic broiler products that actually have more welfare problems in commercial broiler production. This would comprise a significant competitive disadvantage for EU-based breeding and multiplication companies.

On the other hand, monitoring welfare indicators in the slaughterhouse has no detrimental impact on the competitive position of the breeding companies, in their opinion. If the data collected in slaughterhouses or production farms is analysed by genetic broiler product and published, broiler farmers may opt for a broiler product with better welfare in similar conditions. This creates a market pressure for placing more emphasis in the breeding goal on welfare of commercial broilers. This approach provides 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. A mandatory scheme to collect and publish data in commercial slaughterhouses or production farms would facilitate a market-driven approach to improving broiler welfare.

The breeding companies further emphasized that welfare indicators need to have support throughout the broiler meat production chain. The welfare indicators need to be defined carefully and all parties in the broiler meat production chain should be involved in the process.

## **12.2 Impacts on trade between the EU and third countries with a special emphasis on the USA and Canada**

The impact of moving pedigree flocks out of the EU on the trade with third countries is discussed in Chapter 10.2. It is not likely that monitoring welfare indicators in the slaughterhouse or on commercial broiler farms would affect the trade between the EU and third countries, compared with the Baseline Scenario.

## **12.3 Impact on welfare and genetics of broilers**

This Scenario has potentially the highest impact on the number of commercial broilers with improved welfare and the level of welfare of commercial broilers. It particularly affects the reduction of skeletal disorders, contact dermatitis and heart and lung fitness of all scenario's according to all groups in the on-

line consultation. Only the poultry processing industry is sceptical about the results on contact dermatitis and heart and lung failure.

The interviewed breeding companies see two aspects in Scenario 3, on-farm monitoring of welfare indicators in the breeding pyramid and monitoring welfare indicators in the slaughterhouse or broiler farms.

Monitoring in the breeding pyramid is not thought to have an additional positive impact on the welfare of commercial broilers. Environmental conditions, health status, nutrition, management skills and stocking density are more favourable than the average in commercial production and certainly less variable. Furthermore, birds with visual problems on multiplication breeding sites never continue to become breeding stock. A mandatory scheme to monitor welfare aspects in pedigree breeding sites and multiplication sites is unlikely to affect welfare of commercial broilers favourably. If anything, it is more likely to affect it unfavourably as a genetic predisposition for a welfare problem in a risk environment will more often go unnoticed in a very favourable environment. For this issue, it is important that the production environments in the breeding pyramid reflect the acceptable range in the commercial practice.

Monitoring welfare indicators in the slaughter house or on production farms is generally welcomed as long overdue in the EU, but a discussion about which welfare indicators are appropriate is necessary. Welfare should be measured using an animal-based measure in the commercial environment. Hence, data collection in a commercial slaughterhouse is entirely appropriate. 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 expect a positive impact of welfare data collection in commercial slaughterhouses on welfare of commercial broilers compared to the Baseline Scenario.

The results of the monitoring of welfare indicators should be stored centrally with additional information on supplying parties and regularly analysed in our opinion to put pressure on the party that is most strongly associated with welfare problems. An EU-wide monitoring and evaluation scheme would be ideal in this respect.

#### 12.4 Impact on consistency with other EU policies

Monitoring welfare aspects in the breeding pyramid in itself is not expected to have a big impact on other EU policies, unless, as the breeding companies suggest, as a consequence the welfare of commercial broilers deteriorates.

Monitoring welfare aspects in commercial slaughterhouses or broiler farms may have a slightly unfavourable impact on **CAP objectives** if the cost of the monitoring scheme is too high. In case this scenario increases the cost of production, it may increase the retail price and could 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 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. Also, if no action is taken, consumers may start refusing to buy chicken products, with great costs to the industry.

An EU monitoring scheme in commercial slaughterhouses and broiler farms may create new jobs and have a slightly favourable impact on **employment**.

Scenario 3 is not expected to have a substantial impact on **infectious disease control, food safety, meat quality** and **genetic diversity**, but animal welfare, including **animal health** will be positively affected.

### **12.5 Impact on competitiveness of EU breeding companies**

On-farm monitoring of welfare indicators in the breeding pyramid is perceived by the breeding companies as an infringement of their biosecurity and intellectual property as they have to allow for independent inspectors entering their facilities and providing them with information on their breeding programme that has to be made public to some extent. Each entrance of a person is a risk on introduction of diseases and monitoring in the breeding pyramid. Measuring at breeding farms, could be a reason for breeding companies to move the pedigree outside the EU. If that is done, the same effects as in Scenario 1 and 2 can be expected.

Monitoring welfare indicators in the slaughterhouse has no detrimental impact on the competitive position of the breeding companies, in their opinion. The slaughterhouses expect however a (small) increase of production costs in this Scenario.

## 13. DISCUSSION AND GENERAL CONCLUSIONS

The purpose of the study was (1) to analyse the impact of genetic selection on the welfare of broilers, and (2) to explore the socio-economic and environmental impact of a Baseline scenario and three alternative scenarios aiming at the improvement of broiler welfare in commercial production. As also stated by EFSA, there is a clear relationship between genetic selection of breeding stock by breeding companies and the welfare of broilers at the level of commercial broiler producers. However, broiler welfare is only partly determined by genetics. Moreover the breeding companies have to follow global market requirements, trends and legislation in the broiler production sector and this determines which part of the total selection pressure can be put on welfare traits.

The broiler breeding and production sector can be considered as an industrial sector, currently having a relatively loose relationship with other EU policy objectives (e.g. CAP, environment). In this chapter general conclusions will be drawn about the socio-economic importance of the broiler breeding and production sector, the relationship between the selection process and welfare of broilers, the current level of inclusion of welfare aspects in broiler breeding programmes and the impact of a Baseline and three alternative Scenarios on the broiler breeding and production sector, on animal welfare and other policy objectives of the EU.

### 13.1 Baseline Scenario: current trends

#### Socio-economic importance of broiler breeding selection industry in Europe

The broiler breeding and production sector in the EU has a substantial socio-economic value and export value. The EU production volume is increasing. Currently the EU produces 12.1% of global poultry meat production. However, the relative importance of the EU in the global market is declining, because other regions are growing more rapidly. Two of the three broiler breeding companies have their headquarters in the EU, the other in the USA. All three companies operate on the world market and have breeding stock and subsidiaries both within and outside the EU.

The majority of broiler producers worldwide request fast growing broilers, because of their economic advantages. Also, fast growing broilers have a higher resource use efficiency compared with slower 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 market share will stay relatively small if no drastic demand changes take place. It is possible that campaigns by animal protection groups to slow growth may change this situation. The cost price difference between slow and fast growing broilers largely determines the limited growth of markets for slow growers. Price elasticity for meat is very high, and price is still an important buying factor for many consumers.

#### Competition in the broiler breeding sector

The broiler breeding industry is characterised by a fierce competition. The three companies are frightened to lose trade secrets and intellectual property. To illustrate this, companies were willing to share many confidential details, provided that the details were not published in such a way that they could be traced back to the company.

#### Views of animal welfare

Animal welfare is influenced by a mixture of different factors such as genetic background, housing system, climate, disease challenges, feed, stocking density and stockmanship. Breeding companies consider welfare to be good when there is trouble-free production, absence of disorders and low mortality in different customer production environments. Broilers must be able to perform under various acceptable circumstances with good welfare, including good health and the ability to produce without or with minimal use of antibiotics. This is largely in line with the opinion of several groups of stakeholders from the on-line consultation.

## Impact of the selection and multiplication process on animal welfare

Information from broiler breeding programmes showed clearly that companies have been including welfare traits directly or indirectly in their selection process for many years. However, the priority given to such traits may often be quite low. Nevertheless some breeding companies made substantial genetic improvements to reduce leg problems and ascites. Breeding companies favour a balanced and market-driven approach to improve welfare of commercial broilers, meaning that their breeding goals will be derived from (future) customer requirements. The companies say that many of the recommendations in the EFSA<sup>112</sup> report 1666 are already common practice among the breeding companies and this is generally supported by the evidence provided to the interviewers.

## Possible changes in breeding goals and breeding methods

The introduction of genomics provides new opportunities, in addition to the more traditional selection methods, to further optimize the breeding process and include more complex traits in the selection process. Genomics selection will never replace traditional methods, but it will allow increases in selection accuracy and open new opportunities for managing the balance between antagonistic traits. It will enable for a more accurate selection in the future against an unfavourable genetic predisposition outside the risk environment that causes the expression of it.

The market share for slower growing broilers in the EU is estimated at 5% with expectations of a slight increase. All three globally operating breeding companies offer such a slower growing broiler cross. Data on comparisons of welfare of slower growing versus standard broilers show that the slower growing birds have on average fewer welfare problems. On the other hand data are available that indicate that the negative environmental impact of such a production system is substantial: it requires about 20% more resources per kg of product. A shift of the total EU production to slower growing birds thus 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-growing broilers. We are not asked how consumers can be persuaded to alter their consumption pattern.

## **13.2 Scenario 1: Better match between breeds/lines and the environment**

It is in the interest of breeding companies to guarantee a good match between the chicken and the environment. Besides measurement of traits on pedigree breeding sites which are generally bio-secure, there are also schemes to record the same traits on relatives in a production environment that resembles broader commercial conditions.

Breeding companies say they 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 optimize their selection process. Companies think there is no need to make changes in the selection process to improve the match between genotype and environment. They agree that transparency about the match between genotypes and environment is important to the public. However, they do not wish this to be mandatory and they pointed out that breeding companies will probably move their pedigree breeding sites out of the EU if that becomes reality. There are various reasons for this position, in particular the principle that the market should determine the design of the genetic programme and not legislation, fear of losing confidential information and biosecurity arguments.

Breeding companies in Europe developed the CODE-EFABAR<sup>113</sup>. This 'Code of Good Practice for Farm Animal Breeding and Reproduction Organisations' addresses the issues of food safety and public health, product quality, genetic diversity, efficiency, environmental impact, animal health, animal welfare, and breeding and reproduction technologies. CODE-EFABAR is following the principles of sustainable breeding

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<sup>112</sup> EFSA, 2010a

<sup>113</sup> <http://www.effab.org/CODEEFABAR.aspx>

and gives a transparent presentation of the principles of conduct of farm animal breeders and backs these principles by practical rules of conduct. In order to address the concerns of society about broiler welfare and the match between genotypes and environment, the CODE could be further developed to increase transparency of the breeding process.

### **13.3 Scenario 2: Maintenance of genetic diversity**

Broiler breeding companies maintain substantial pools of genetic lines with well in excess of 30 lines each, not including back-up populations. Information supplied by the companies and independent information suggest that these lines are retained with a minimum of inbreeding (less than 1% per generation).

There are only three major breeding companies left, who take responsibility for maintaining genetic diversity of poultry lines for meat production, but cannot be responsible for the total chicken genetic diversity in Europe and abroad. They take responsibility for the lines they have and perhaps any other lines that are economically relevant from their own short and long term perspective. They believe that as a breeding company, their gene pool is the most important asset, which is key for their current and future crossbreed portfolio. Further public support may be needed to conserve chicken genetic diversity in Europe, including support to develop niche markets. This, however, concerns traditional or local breeds rather than the commercial ones owned by the breeding companies.

It is not expected that regulations to maintain genetic diversity will improve broiler welfare.

### **13.4 Scenario 3: Monitoring of broiler welfare in the production chain**

There is only a limited amount of independent data on the welfare of commercial broilers in the EU. A few countries routinely collect data about welfare indicators in the slaughterhouse and on poultry production farms. Information from three countries that are monitoring broiler welfare in slaughterhouses shows a tendency towards less welfare problems over time.

The data collected in slaughterhouses and at broiler production farms are currently not available to breeding companies and do not provide information about the performance of different crossbred birds. Although broiler breeding companies receive feedback directly from customers about performance and problems, they would welcome routine monitoring of welfare indicators in the production chain. Breeding companies would even welcome this if the results are published by breeding company, feed company and integration, provided that there is a balanced and proper discussion of indicators and targets. Companies however do not wish there to be on-farm visits at the top of the breeding pyramid for the monitoring of welfare indicators. Besides biosecurity and confidentiality issues, animals on breeding and multiplication farms and their production environments are not comparable with broilers on commercial broiler farms and consequently the information from breeding and multiplication farms is of limited value for the majority of poultry, the broilers.

This Scenario has potentially the highest impact on the number of commercial broilers with improved welfare and the level of welfare of commercial broilers.

### **Animal welfare and other EU policy objectives in the baseline and the alternative scenarios**

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 in animal welfare, with a transition to slower growing broilers, will be associated with higher prices for the consumer and will have some negative impact on the ecological footprint of broiler production. Changed feed conversion rates affect the price of products and the

environment. Slower growing chickens may have better welfare but the ecological footprint per kg broiler is substantially higher<sup>114</sup>.

Many other EU policy objectives are indirectly related to improving broiler welfare through genetic selection. E.g. if the EU were allowed by WTO to implement trade restrictions based on animal welfare indicators, this would certainly influence broiler selection and the production sector in Europe.

### 13.5 Summary – Impact of Baseline and Alternative scenarios

Table 13.1 summarises the potential impact of the Baseline (continuation of trend) and the three possible future Scenarios on a variety of EU policy objectives.

*Table 13.1. Summary of the potential impact of the Baseline and alternative Scenarios on EU policy objectives*

|  | Baseline | Scenario 1<br>(better match<br>between genotype<br>and environment) | Scenario 2<br>(maintenance of<br>genetic diversity) | Scenario 3<br>(monitoring of animal<br>welfare in the<br>production chain) |
|--|----------|---|---|--|
| Animal welfare, including animal health      | 0 / +    | 0 / -   | 0 / -   | +  |
| Competitiveness of breeding sector           | 0        | -   | -   | 0  |
| Competitiveness of broiler production sector | 0        | -   | 0   | 0  |
| Food security                                | 0        | 0   | 0   | 0  |
| Environment                                  | +        | 0   | 0   | 0  |
| Food safety                                  | 0        | 0   | 0   | 0  |

### 13.6 Main Conclusion

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 and on broiler production farms, which provides information by farm, integration, veterinary group, feed product and genetic product. Such an approach stimulates 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 indicators that are widely supported by the links in the broiler production chains.

<sup>114</sup> Leinonen, 2012.



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## GLOSSARY AND ABBREVIATIONS

**Animal-based measure** A response of an animal or an effect on an animal. It can be taken directly from the animal or indirectly and includes the use of animal records.

**Ascites** Ascites syndrome is a non-infectious, metabolic disease of broiler chickens characterized by pulmonary hypertension, right-sided heart failure and accumulation of excessive fluid (transudate) in the abdomen.

**Artificial insemination:** Collecting semen from a male and depositing it into the female genital tract.

**Beak trimming (de-beaking)** Removal of part of the upper (and sometimes also lower) mandible of the beak.

**Behavioural restriction** The broiler is unable to perform its whole range of behaviours, which may be due to either management or physical conditions.

**BLUP (Best Linear Unbiased Prediction)** A statistical method that gives the statistically best estimation of a breeding value of an individual for a specific trait.

**Breeding goal** The breeding goal determines for which traits the line is selected and which weighting is given to each individual trait in the selection process

**Breeding value** The additive genetic value for a particular trait of an individual defined by the combined additive genetic effects of all genes of the individual. On average, half of the breeding value of a parent is transmitted to its offspring, as the other half comes from the other parent. The breeding value is not generally known and needs to be estimated using performance data on the animal itself or related individuals (BLUP) and/or genetic marker effects.

**Breeding pyramid** The different levels in the production of commercial broiler lines, and typically comprise pedigree flocks producing A, B, C and D birds, great-grandparent (GPP) flocks producing A, B, C and D birds, grandparent (GP) flocks producing AB cockerels and CD hens and parent (PS) flocks producing ABCD broilers. A, B, C and D are genetic lines of broilers.

**Broiler** A type of chicken (*Gallus gallus domesticus*) kept and bred for meat production

**Broiler breeder** Bird of the parent (PS) generation in the system of producing broilers.

**Broiler product** Commercially available type of crossbred broiler, marketed as a branded product. Ross 308, Cobb 500 and Hubbard Classic are examples of broiler products.

**Broilerisation** Practice of feeding potential breeding animals in the first 6 weeks of their life as broilers and then restricted in such a way that up to about 15 weeks birds become physiologically older, but do not gain substantial weight. From about 15 weeks of age some weight gain is allowed to obtain sexual maturity from 20 weeks of age onwards. Typically applied in birds destined for pedigree and GGP flocks and sometimes in birds destined for GP flocks for the purpose of performance testing and breeding value estimation.

**Back-up population** An additional subpopulation of a purebred pedigree population in a different geographical location to minimise the risk of losing pedigree populations in case of a calamity.

**Contact dermatitis** Comprises diseases arising from skin contact with wet litter e.g. foot-pad dermatitis (pododermatitis), breast blisters (sometimes known as breast burns) and hock burns

**Crossbred** A cross of two or more lines or breeds.

**Crossbred selection** Performance data of crossbred related individuals is included in the breeding value estimation of birds in the pedigree flocks, in addition to performance data of purebred related individuals.

**Dam** Mother

**De-toeing** Removal of the dew (and sometimes also pivot) claw from the feet of breeder males to prevent damage to females during natural mating

**De-spurring** Removal of the spur bud on the back of the male chick's leg

**Digestive function** The functioning of the gastro-intestinal tract of the bird

**Dubbing** Removal of all, or part, of the male comb

**Dwarf gene** Sex-linked, recessive gene that causes reduced weight and height

**Environment** External factors that affect an animal.

**Estimated Breeding Value (EBV)** An estimate of an animals' additive genetic value for a particular trait

**Feed conversion rate (FCR)** The amount of feed consumed (in kg) divided by the weight gained (kg) in the same period for a bird or a group of birds. One point FCR is 10 g feed per kg weight gain, or 0.01 kg feed per kg weight gain.

**Genetic correlation** Selection for a trait may change another trait because some of the same genes affect both traits or genes affecting two traits are closely linked. It reflects the way genetic values for the two traits co-vary. The extent to which this happens and the direction in which it happens is expressed in the genetic correlation, which varies from -1 to +1. A genetic correlation close to zero indicates that the two traits are relatively independent.

**Genetic relationship** The extent to which two individuals are family of each other.

**Genetic distance** A measure of the genetic divergence between pedigree flocks. It can be measured by a variety of parameters. Smaller genetic distances indicate a close genetic relationship and at least partly a common origin whereas large genetic distances indicate a more distant genetic relationship and a much longer period of independent breeding.

**Genetic diversity** Within a population it refers to a low level of the average genetic relationship in the population, which implies that the variety of alleles in the population is still unaffected. Genetic diversity diminishes with high rates of inbreeding, particularly with rates above 1% per generation. Across populations it refers to the number of populations and the average genetic distance among the populations.

**Genetic line** Purebred pedigree population breeding its own replacements to be parents of the next generations. A, B, C and D in the crossbreeding structure refer to genetic lines.

**Genetic marker** Gene or sequence of DNA with a known location on a chromosome that can be used to identify individuals with certain characteristics.

**Genetic progress or genetic change** An increase in the average genetic merit of a population from one generation to the next for a particular trait as a result of selective breeding

**Genomic selection** Selection of typically young animals to be used as parents of the next generation based on genomic breeding values.

**Genomic Breeding Value** An estimated breeding value for a trait calculated from the effects of a very large number of genetic markers (typically SNP's) that were estimated earlier in a reference population.

**Genotype** The actual genetic make-up of an individual as determined by its genes. It may refer to a particular trait or the genome as a whole

**Genotype × Environment Interaction (GxE)** Refers to genotypes ranking differently in different environments or the difference between two genotypes being dependent on the environment.

**Grandparent stock (GP)** Flocks that are two generations above the production (broiler) level and produce crossbred parent stock (PS). They are only subject to independent culling on disorders and abnormalities.

**Great-grandparent stock (GGP)** Refers to purebred flocks breeding purebred GP birds. GGP birds are progeny of birds in the pedigree flocks, but are only subject to independent culling on disorders and abnormalities and never produce replacements for the pedigree flocks.

**Half-sibs** Individuals who have either the same sire or the same dam (i.e. half-brothers and half-sisters)

**Heritability** Is the ratio of the genetic over phenotypic variance and reflects the proportion of variation in a measured or observed trait that is transmitted to the offspring by genes that act in an additive manner.

**Inbreeding** Refers to the fact that in any closed breeding population the average genetic relationship between individuals increases over a number of generations. Inbreeding is inevitable, but the **rate of inbreeding** can be controlled. The rate of inbreeding is considered unsustainable above 1% per generation.

**Independent culling** Any bird with a measurement above a certain threshold and without specific disorders and abnormalities is considered selectable and any bird not meeting these criteria is rejected regardless of the selection index and other favourable characteristics it may have

**Integrated production** Several or all links within the production chain are under control of one company.

**Leg weakness (leg problems)** A condition where the legs (including joints, bones, muscles, tendons etc) are affected and may have a predisposition to lameness

**Marker assisted selection (MAS)** Selection using a small number of genetic markers with a major effect for a particular trait.

**Maternal line** The lines that produce the hens for broiler production. In the crossbreeding structure they are referred to as line C and line D.

**Multiplication sites** Breeding sites involved in the multiplication process; multiplication or crossing of purebred lines with just independent culling for disorders and abnormalities to produce grandparent or parents of broilers

**Parent stock (PS)** Generally referred to as broiler breeders. Parents of commercial crossbred broilers. Offspring of Grandparent stock (GP).

**Paternal line** The lines that produce the cockerels for broiler production. In the crossbreeding structure they are referred to as line A and line B.

**Pedigree breeding sites** Breeding sites involved in genetic selection

**Pedigree stock** Birds used for breeding great grand-parent (GGP) stock and the generations prior to these. Pure line or purebred line

**Phenotype** The observed or measured expression of a trait for an individual. Genetic and environmental effects contribute to the phenotype, but not always in an additive manner

**QTL (Quantitative Trait Locus)** A DNA sequence (locus of an unidentified gene) with a major effect on a quantitative trait

**Rearing farm** A farm that grows broiler breeders from day-old until the transfer to the laying farm between 18-22 weeks of age.

**Robustness** Little dependence on favourable conditions or management.

**SDS (sudden death syndrome)** Birds (broiler chickens) that die suddenly with no other obvious pathology



**Selection** The process of deciding which animals will be parents of the next generation based on some pre-determined criterion

**Selection accuracy** A measure of the extent to which additional information on the animal itself or relatives might change the selection index. It varies between 0% (no information) and 99.9% (no change with additional information).

**Selection index** A single figure per animal calculated as the sum of weighted EBV's on which the birds are ranked for the purpose of genetic selection. The weighting of the EBV's reflects the breeding goal.

**Sire** Father

**SNP** Single-nucleotide polymorphism, pronounced as *snip*. A SNP is a DNA sequence variation occurring when a single nucleotide — A, T, C or G — in the genome varies between individuals of a species. SNP markers highlight individual variation at the genome level. A SNP may or may not be associated with variation in traits.

**TD (tibial dyschondroplasia)** A disorder that affects the growth of bone and cartilage, caused by dietary and/or genetic factors. The tibial cartilage does not mature enough to ossify (turn into bone). This leaves the growth plate prone to fracture, infection, and deformed bone development. It is one of the causes of lameness in broilers.

**Thermal discomfort** The thermal environment is not maintained at a temperature which is comfortable for the birds in a long term, resulting in either heat stress or cold stress in the birds.

**Trait** Any measurable or observable characteristic of an animal

**Variation** The amount of difference observed or measured for a trait in a group of animals; may refer to phenotypic or genetic differences.

**Varus/valgus deformity** A leg deformity in broiler chickens. A lateral or medial angulation of the shaft of the distal tibiotarsal bone resulting in deviation of the lower part of the leg and frequently with bending of the proximal shaft of the tarsometatarsus. It is one of the causes of lameness in broilers. Also referred to as **bowed-in** or **bowed-out**.

**Welfare** The welfare of an individual is its state as regards its attempts to cope with its environment.

**Welfare indicator** an observation, a record or a measurement used to obtain information on an animal's welfare. An indicator is not necessarily measured and it may show a trend.

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- **Dr Ingrid de Jong**, WUR, Netherlands. Interviews with broiler breeding companies.
- **Dr Ferry Leenstra**, WUR, Netherlands. Preparation of the interviews. Analysis of results. Discussion of the manuscripts.
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- **Dr Gemma Tacken**, WUR, Netherlands. Interviews with broiler breeding companies. On-line consultation with stakeholders.
- **Dr Antonio Velarde**, IRTA, Spain. Interview with multiplication company in Spain.

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## ANNEX I. BACKGROUNDS, EXAMPLES AND SUPPORTING EVIDENCE

### I.4 Background information for Chapter 4

#### I.4.1 Biosecurity of breeding sites involved in genetic selection or multiplication

Breeding material is kept at high biosecurity because of health regulations for international trade in poultry and because of demands of customers and the broiler meat production chain on a specific-pathogen-free status. The biosecurity of the broiler breeding companies is illustrated with the details of the approach of one company (see text box). The other breeding companies have similar, but not identical biosecurity programmes.

The primary breeding companies have been involved in compartmentalisation programmes in the various countries where the pedigree breeding sites are located. For example, Aviagen sites in the UK are a DEFRA-recognised compartment. Compartmentalisation is a procedure which may be implemented by a governmental body to define and manage animal subpopulations of distinct health status within its territory, in accordance with the recommendations in the OIE Terrestrial Animal Health Code, for the purpose of disease control and/or international trade. Traditionally compartments were defined regionally to prevent spread of contagious diseases. Transport was allowed within the compartment, but not between compartments. After the AI-outbreak of 2003 the OIE introduced also compartments based on organisations. In this case transport of animals and/or products like hatching eggs is allowed within the compartment organisation, independent of location or national borders. It serves as an example how critical the health status of breeding sites is to the three breeding companies.

Aviagen biosecurity involves a package of measures throughout the company and the pedigree sites.

- Government certified laboratories. In the UK and USA they have large government-certified laboratories, in which tests on a range of diseases are carried out systematically.
- The intensive health monitoring of the flocks, sites and people working at Aviagen go well beyond legal minima.
- All pedigree, GGP and GP sites receive biosecure batches of feed, which means that the batches of feed are decontaminated (e.g. preheating) and obtained from specific high level feed mills with dedicated contracts ensuring the high level of the feed. Thousands of tons of raw materials are sampled each week, and the feed is tested bacteriologically (in the labs). The feedstock management is adapted to the possible losses of nutrients that can occur in the decontamination process and reassessed on a continuous basis.
- They apply high hygiene levels throughout, e.g.
  - o Strict controls on all poultry, eggs and equipment entering-leaving farm
  - o Very stringent visitor policy
  - o People showering in-out, down time and no 'non-Aviagen' bird contact
  - o Isolated farms and logistics (in-out), including flow and separation design (in site set up and in management) for types and movements of goods, birds and people
  - o All-in-all-out animals and in between extensive cleaning

Due to all these procedures of the high biosecurity programme, Aviagen birds are free from Salmonellae, Mycoplasma, Leucosis, AI and ND. (Source: Aviagen, 2012)

#### I.4.2 Genetic selection methods

1) Various genetic selection methods are available to be used within the pedigree flocks. The simplest method is mass selection or **independent culling**. Any bird with a measurement above a certain threshold is selected for that trait and any bird not meeting the threshold is rejected regardless of other

characteristics. Rejecting birds with undesirable disorders or abnormalities is also referred to as independent culling.

2) A second method is a selection index of **estimated breeding values (EBVs)**. Breeding values are estimated for various traits measured on the individual and/or relatives using statistical methods that take into account the genetic relationships with other birds measured with so-called BLUP-methods (Best Linear Unbiased Prediction). The other birds can be either pure line birds or crossbreds that are related to individual pure line birds. Every animal receives an EBV for each trait that is included in the breeding value estimation. The EBV of any trait provides a better indication of the bird's genetic merit for the trait than just the phenotypic measurement. It is possible to include data collected on purebred and crossbred individuals, provided that parents are known without error. A trait recorded on purebred birds and the same trait recorded on crossbred birds would then be treated as two traits<sup>116</sup>.

With many EBVs per animal it is difficult to identify the most appropriate individuals to become parents of the next generation. A **selection index** therefore weights the various EBVs across traits according to the breeding goal and combines them in a single figure per animal on which the birds can be ranked for the purpose of genetic selection.

3) The selection may be extended with genomic breeding values<sup>117</sup>. These are breeding values that are predicted from a large number of genetic markers simultaneously. Genetic markers are minor variations in DNA sequence. It creates the opportunity to obtain an accurate breeding value for an animal even before the trait can be recorded on the animal. This is often referred to as **genomic selection**.

4) Genetic selection may also include the use of a selected set of genetic markers, that were found to explain a significant part of the variation in the trait of interest, either through a marker breeding value or via independent culling of undesirable marker haplotype(s). Such genetic markers are called quantitative trait loci, or QTLs. This method is often referred to as **marker-assisted selection** or MAS.

In practice, independent culling is used at all levels of the breeding pyramid, but the percentage of animals rejected is lower outside the pedigree flocks. A selection index of estimated breeding values is the common way to select among the birds in the pedigree flocks that passed the independent culling. Information from birds at the GGP and grandparent level in the breeding pyramid is not used in selecting the pure line birds as they do not have known parents. The use of genomic selection and marker-assisted selection is currently being evaluated and gradually implemented<sup>118</sup>.

#### **I.4.3 Genetic gain versus rate of inbreeding**

The inbreeding coefficient of a bird is the probability that two copies of a single allele of an ancestor are passed on to the bird, one through the sire and one through the dam. It is a measure of genetic relationship between the parents. At population level, geneticists work with the rate of inbreeding per generation. It indicates at which rate the average inbreeding coefficient in a population increases. Any closed breeding population has a positive rate of inbreeding. The FAO recommend that the rate of inbreeding per generation be lower than 1%.

The group of birds destined to replace the birds in the pedigree flocks are generally selected in such a way that the average genetic relationship 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<sup>119</sup>. The maximum rate of inbreeding within any line is in all cases below

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<sup>116</sup> Jiang and Groen, 1999.

<sup>117</sup> Goddard and Hayes, 2007.

<sup>118</sup> Breeding company interviews

<sup>119</sup> Bijma *et al.*, 2001.

1% per generation<sup>120</sup>, conform the recommendation of the FAO. Like the breeding goal, the balance between genetic merit and inbreeding is a matter of choice. After selecting the birds that will contribute to the next generation, the birds that follow on average genetic merit are allocated to multiplication.

## I.5 Background information for Chapter 5

### I.5.1 Broiler breeding companies

The information below on the structure and organisation of these companies was obtained from public sources and was updated with data collected through the interviews at the headquarters of the three companies. Special focus was on socio-economic aspects as size of the company, turnover and profit.

#### I.5.1.1 Aviagen Broiler Breeders

**Portfolio:** Aviagen is using different brand names, namely Ross, Indian River and Arbor Acres, for fast-growing broiler products. In 2008, Aviagen added the slower growing Ross Rowan to their product range<sup>121</sup>.

**Headquarters:** The company is based in Edinburgh, UK and Huntsville, USA

**Owner:** Since 2005, Aviagen is owned by the Erich Wesjohann group (EW Group). EW Group employed, before the takeover in 2005, around 2,000 people worldwide. EW Group has its headquarters in Germany. EW Group also includes Lohmann Tierzucht, Hy-Line International and H&N International (layer breeding), a majority share in AquaGen (aquaculture breeding), Aviagen Turkeys (turkey breeding, as part of Aviagen Group), traditional turkey and broiler breeding companies (Hockenhull turkeys, Hollyberry hatcheries, S&G Poultry), egg laying distribution companies, two nutrition companies, Vaxxinova and Valo Biomedica (animal and human vaccines), egg and mushroom product companies<sup>122</sup>. Aviagen Group employs 5000 people.

**Distribution:** Aviagen distributes parent stock throughout the EU with eight wholly-owned distributors, based in the United Kingdom, Belgium, France, Spain, Italy, Hungary, Russia and Sweden plus two long-standing contracts with Moy-Park in Northern Ireland and Suomenbroiler in Finland Grandparent stock is distributed in the EU from the GGP and pedigree flocks which are housed in the United Kingdom.

#### I.5.1.2 Cobb-Europe, subsidiary of Cobb-Vantress

**Portfolio:** Cobb-Vantress portfolio includes Cobb 500, Cobb 700 and Cobb Avian. After the partnership with Sasso, the Cobb-Sasso 150 and Cobb-Sasso 175 were introduced. The Cobb-Sasso 150 is accredited by RSPCA for Freedom Food products. Cobb acquired Avian farms (2000), Hybro (2008) and Kabir International (2009)<sup>123</sup>, and maintains genetic pure lines from each of these former breeding companies at company-owned pedigree farms.

**Headquarters:** Cobb-Vantress has its headquarters in Arkansas, USA and Cobb-Europe based in the UK.

**Owner:** Cobb-Vantress is a subsidiary of Tyson Foods, Inc., based in Arkansas, USA. Tyson Foods is one of the world's largest processors of chicken, beef and pork. In total, Tyson has an estimated 115,000 global employees, and processes more than 42 million broilers weekly<sup>124</sup>.

**Distribution:** Cobb maintains wholly-owned pedigree, GGP and GP flocks in the USA, Brazil and Europe. The Cobb-Europe division (headquarters located in the UK) is responsible for sales and technical support across Europe (including Russia), Middle-East and Africa. In Europe, company managed facilities include the primary pedigree flock kept in the Netherlands, GGP flocks in the UK and Ireland, and GP flocks in the

<sup>120</sup> Breeding company interviews

<sup>121</sup> <http://en.aviagen.com/aviagen-launches-the-ross-rowan>

<sup>122</sup> EW Group, 2012

<sup>123</sup> [www.cobb-vantress.com](http://www.cobb-vantress.com)

<sup>124</sup> Tyson Food, 2010

UK and the Netherlands. Additionally, Cobb has European GP distributors located in Ireland, Germany, Sweden and Spain that supply broiler breeders to these markets and customers within the EU-27 and beyond.

In addition to the European division, Cobb has three additional divisions covering the other parts of the world and maintains a network of GP distributors and GP joint venture operations to supply breeding stock directly into these distinct geographical areas.

### I.5.1.3 Hubbard

Portfolio: Hubbard markets the Classic, Flex, Yield and Color ranges of broiler products. Hubbard has a long tradition in providing slow-growing breeds for markets requiring differentiation and quality (e.g. Label Rouge, Certifié and intermediate markets)<sup>125</sup>.

Headquarters: Hubbard headquarters are in Quintin in France.

Owner: Hubbard was purchased in 2005 by Groupe Grimaud (GG). Now Groupe Grimaud is the second largest multi-species breeding company in the world. GG is active in selection of ducks, geese, broilers, laying hens, rabbits and swine. GG also has bio-pharmacy department (e.g. vaccine production)<sup>126</sup>.

Distribution: Hubbard has pedigree breeding sites in Châteaubourg and Courtenay in France and in Walpole, NH in the USA. It has production centres in the United Kingdom, France, Poland, Brazil and the USA.

### I.5.2 The production process

The poultry meat production sector is organised in a production chain (Figure I.5.1). At the top is the breeding company that selects a number of pure lines, produces crossbred grandparent stock and parent stock as day-old chicks. The day-old chicks are grown in rearing farms to become broiler breeders. At the age of 20 weeks the young broiler breeders are moved to broiler breeder farms to produce hatching eggs for broilers. After incubating and hatching in a hatchery, the day-old broiler chicks go to broiler farms. Broilers reach slaughter weight in 38- 82 days, depending on the broiler product and the market, and are delivered to the slaughterhouse. In the final stage, poultry meat is distributed to retail (supermarkets), food service (restaurants, catering, institutions) and food industry (further processing into convenience consumer products)<sup>127</sup>.

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<sup>125</sup> [www.hubbardbreeders.com](http://www.hubbardbreeders.com)

<sup>126</sup> [www.grimaud.com](http://www.grimaud.com)

<sup>127</sup> Van Horne, 2008.



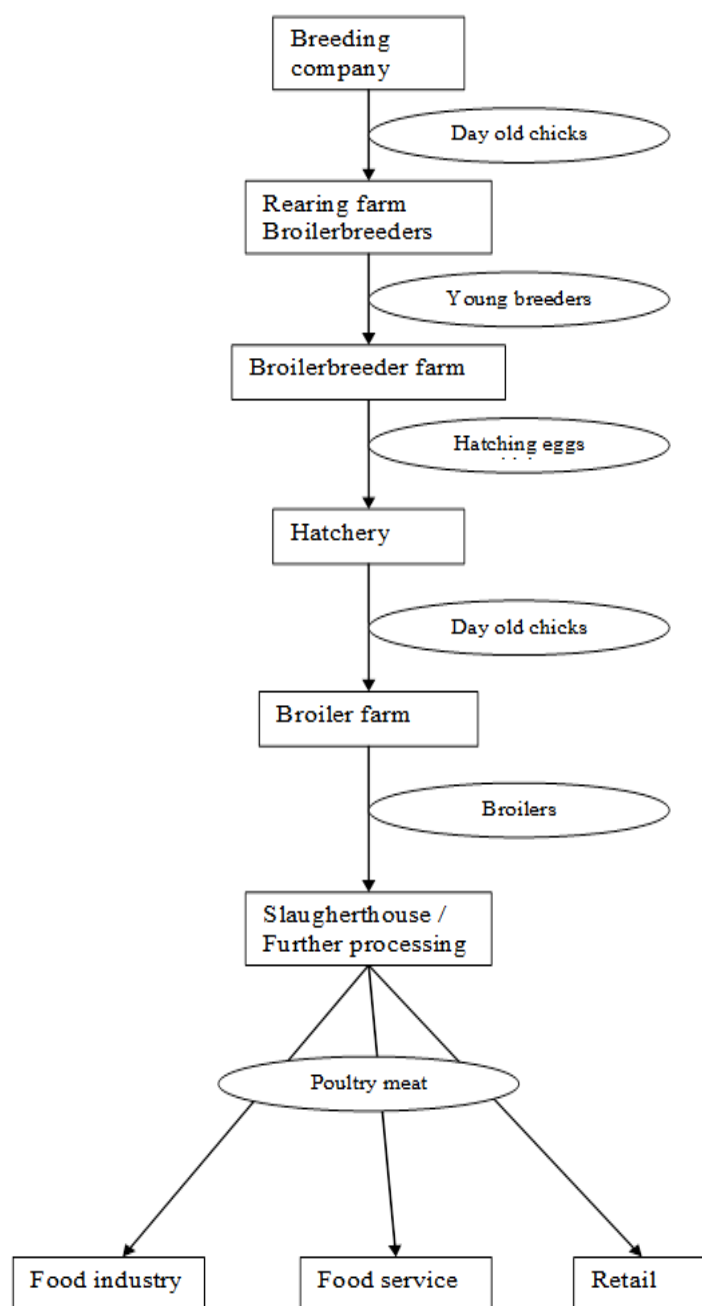


Figure I.5.1. Overview of the production chain of poultry meat

### I.5.5 Production and trade of poultry meat worldwide

Global poultry meat production is rapidly increasing. In 2000 the total poultry meat production was 69 million tons and the volume grew to over 97 million tons in 2010<sup>128</sup>. These numbers are based on FAO data and relate to total poultry meat (i.e. turkey, duck, geese, quail, etc. included)<sup>129</sup>. The quantity of poultry meat is measured in carcass weight after slaughter. Based on an average weight of 2,000 g live

<sup>128</sup> Windhorst, 2011.

<sup>129</sup> FAO database, 2012.

weight and a carcass yield of 67% (carcass weight/live weight) 97 million tons of poultry meat corresponds with about 70,000 million broilers.

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 (Figure I.5.2). Table I.5.1 gives the details for the ten leading countries in global poultry meat production. The ranking is based on the situation in 2010. The total share of the EU-27 in total poultry meat production was 15.1% in 2000 and 12.1% in 2010. Although there was some increase in production in the EU-27 between 2000 and 2010 the share of the total world production decreased as a result of higher increases in other countries. Figure I.5.2 gives an overview for the situation in 2010.

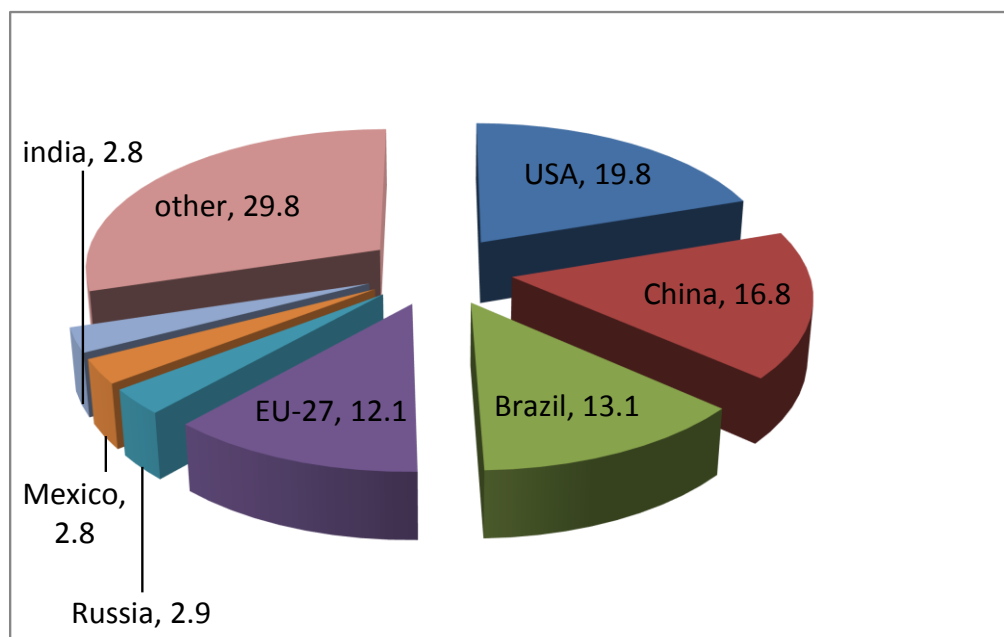


Figure I.5.2. The share of major producers of poultry meat in 2010.

Table I.5.1. Poultry meat production in the leading countries in 2000 and 2010 (data in 1,000 ton)

| Countries   | Production |       | Share |      |
|-------------|------------|-------|-------|------|
|             | 2000       | 2010  | 2000  | 2010 |
| USA         | 16362      | 19273 | 23.6  | 19.8 |
| China       | 12873      | 16347 | 18.5  | 16.8 |
| Brazil      | 6114       | 12751 | 8.8   | 13.1 |
| EU-27       | 10484      | 11786 | 15.1  | 12.1 |
| Russia      | 768        | 2850  | 1.1   | 2.9  |
| Mexico      | 1825       | 2742  | 2.6   | 2.8  |
| India       | 1142       | 2728  | 1.6   | 2.8  |
| Argentina   | 919        | 1629  | 1.3   | 1.7  |
| Iran        | 827        | 1551  | 1.2   | 1.6  |
| Japan       | 1199       | 1353  | 1.7   | 1.4  |
| total world | 69444      | 97546 |       |      |

Trade in poultry meat mainly relates to trade in broiler meat. Only a few countries take a major share in exports of poultry meat: the ten leading exporting countries share 88% of the total export volume. The largest exporters, the USA and Brazil, contribute to 56% of the global exports. In 2010 the EU was the

third largest exporter of broiler meat<sup>130</sup>, with a share of 9% in total world exports. Countries importing poultry meat can be found all over the world. The leading importers of poultry meat are China, Russia, Japan, Saudi Arabia and some EU countries<sup>131</sup> (e.g. the Netherlands, UK and Germany). Figure I.5.3 gives an overview of the main trade flows in poultry meat in 2010. The export of the USA is mainly leg meat. Thailand is exporting breast meat to the EU. The portfolio of Brazil is more diverse, with export of whole birds to the Middle East, deboned leg meat to Japan and breast meat to the EU.

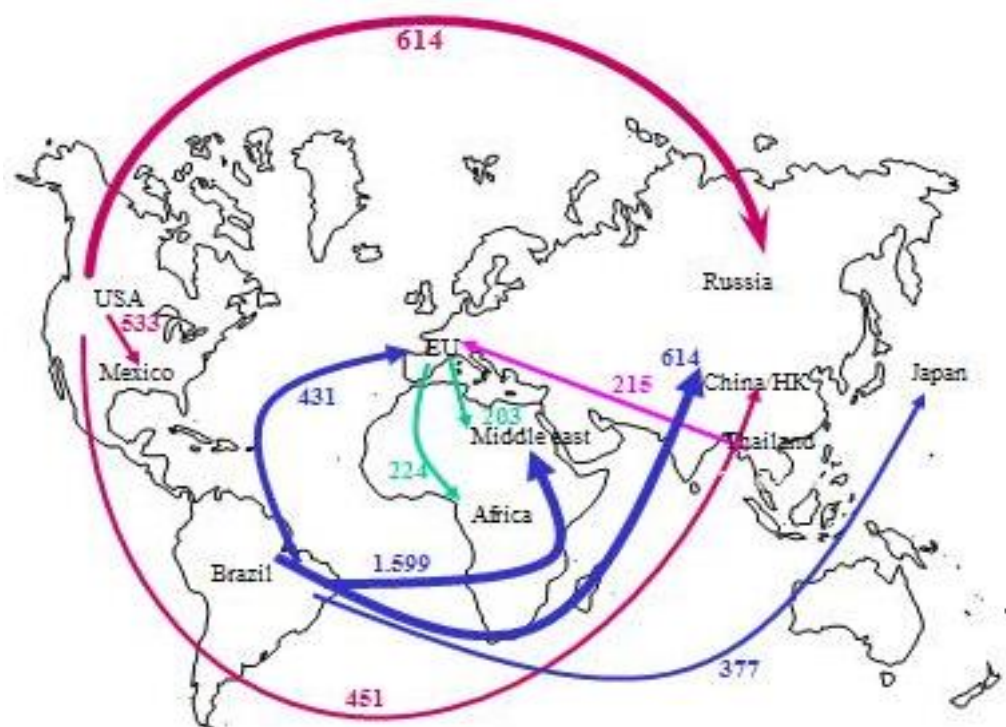


Figure I.5.3. Main international trade flows (in 1000 tons) in poultry meat in 2010<sup>132</sup>

### I.5.6 Production and trade of broiler meat in the EU

In 2011 total poultry meat production in the EU-27 was around 12 million tons. The main poultry meat is broiler meat with a total production in 2011 of 9.6 million ton<sup>39</sup>. 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 (with 14% of the total EU-27 production), 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<sup>133</sup> (Table I.5.2).

Table I.5.2. The 10 leading EU member countries in broiler meat production in 2007 – 2011 (in 1000 tons carcass weight)<sup>42</sup>.

|        | 2007  | 2008  | 2009  | 2010  | 2011  |
|--------|-------|-------|-------|-------|-------|
| UK     | 1,261 | 1,267 | 1,268 | 1,380 | 1,357 |
| Poland | 896   | 730   | 1,060 | 1,123 | 1,200 |

<sup>130</sup> Rabobank, 2011.

<sup>131</sup> Windhorst, 2011.

<sup>132</sup> Gira and PVE, 2011.

<sup>133</sup> MEG, 2012.

|             |       |       |       |       |       |
|-------------|-------|-------|-------|-------|-------|
| Germany     | 826   | 883   | 950   | 1,022 | 1,090 |
| France      | 993   | 1,009 | 1,027 | 1,042 | 1,076 |
| Spain       | 1,034 | 1,059 | 1,063 | 1,085 | 1,073 |
| Italy       | 670   | 713   | 742   | 780   | 788   |
| Netherlands | 612   | 626   | 655   | 664   | 687   |
| Romania     | 312   | 316   | 371   | 349   | 350   |
| Hungary     | 217   | 230   | 245   | 240   | 254   |
| Belgium     | 254   | 250   | 255   | 249   | 255   |
| EU-27       | 8,529 | 8,541 | 9,111 | 9,432 | 9,623 |

Trade in live slaughter birds between the EU and non-EU countries is negligible. Within the EU live broilers are traded between neighboring countries, but this is in general because of availability of slaughter capacity and/or regional (but across borders) activities of integrations.

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. Several countries, especially in north-west Europe export frozen leg meat to eastern-European countries. 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<sup>40</sup>. Besides the intra-EU trade large amounts of broiler meat were imported into the EU from Brazil and Thailand, mainly breast meat. The Netherlands, Germany and UK are the main importers of frozen and/or cooked breast meat from third countries.

#### I.5.6.1 Organization in the production chain

The European poultry industry largely uses one of two organization models:

1. Independent links in the broiler production chain. In this model the different links in the production column are independent companies. The hatchery, the feed mill and the processing plant are each independent firms that trade through an open market. Breeder and broiler farmers buy birds and feed at their 'own risk' and sell the hatching eggs and broilers to the next link in the production chain. The farmer is the owner of the birds. The broiler farmer has often a long term agreement with the slaughterhouse for the supply of chickens. Compared to integrated systems, in non-integrated systems farmers are more directly confronted with fluctuations in the market for feed and broilers.
2. Integrated production. Through vertical integration several or all links within the production chain are under control of one company. The hatchery, feed mill and processing plant are owned and controlled by the integrating firm. Also broiler or breeder farms can be owned by the integrator. However, many integrators work with contracts to link the broiler or breeder farm to the integrator. The integrator provides the day-old chicks and the feed and owns the birds at any time. The farmers are paid a set rate for their input through labor, providing the poultry housing and for the variable costs.

Both organization models are used within Europe. In Italy, France, UK and Spain the integration model is mainly used. Farmers grow broilers based on contracts with large integrators. Main integrators in those countries are Doux and LDC in France, Gruppo Veronesi and Amadori in Italy, Hook/2 Sisters, Vion and Cargill in the UK and Sada in Spain. In the Netherlands and Belgium the production is organized with independent links. In Germany both models exist. The main player in Germany, the PHW-Gruppe, is working as integration<sup>134</sup>.

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<sup>134</sup> Van Horne and Achterbosch, 2008.

### I.5.6.2 Market segmentation

In general, for most EU countries, broilers achieve the target market size in around 5 to 6 weeks with a live weight of 2 to 2.5 kg. However, there are differences between countries and between farms within a country on actual live weight produced. The specific broiler live weights farmers are producing depend on the market in a specific country, region or the market segment (retail, food service) which has to be supplied. In a country with a high demand for whole birds the farmers will produce broilers at a low body weight and in countries with a high demand for deboned breast meat the farmers will deliver broilers at a higher weight. Heavier birds are more economical to produce cuts. In general there are three production systems for a farmer to choose from (Table I.5.3)

*Table I.5.3. Production systems of broilers*

| Bird weight | age of birds | live weight at slaughter | Market              |
|-------------|--------------|--------------------------|---------------------|
| Light       | 30 - 35 days | 1.5 to 2.0 kg            | whole bird          |
| Medium      | 35 - 40 days | 2.0 to 2.5 kg            | poultry cuts        |
| Heavy       | 40 - 45 days | 2.5 to 3.0 kg            | cuts / deboned meat |

In the retail market, there has been a general trend away from whole birds towards more cuts and boneless meat<sup>135</sup>. Consumers are looking for more convenience meals and as a result poultry is also increasingly used in prepared meals. For this market heavy birds and meat deboning systems dominate the supply chain system. The general trend in Europe is to grow birds to higher weights, but detailed statistics on slaughter weights and destination of birds (whole or cut up) are not available.

In Western Europe there is a preference for white meat (breast file) over dark meat (meat from legs). This created a very competitive export stream of less-preferred dark meat products to countries with a preference for these products. This has been the main base for growth of EU and US exports to countries in Eastern Europe (especially Russia). At the same time the difference in preference created export opportunities for countries with a preference for dark meat. Countries like Thailand and Brazil, export white meat products to Europe. Currently, 25% of the total EU white meat demand is sourced from outside of the EU, mainly from Brazil and Thailand. Imported poultry meat from third countries is mainly frozen breast meat, which is used in the food processing industry in countries like UK, Germany and the Netherlands. In some European countries there is still a demand for whole birds sold in the supermarket. These whole birds are often sold frozen. Besides the demand in Europe there is export of frozen whole birds. Especially France is exporting whole birds to some countries in the Middle East.

### I.5.6.3 Alternative broiler production

Slower growing genotypes are generally used in free-range and organic production. The poultry meat of slow growing broilers is a premium product and farmers and processors receive a higher price in the market to compensate for the higher production costs. The conditions and names of the alternative broiler production in the EU are regulated by Regulation 543/2008. In this regulation the marketing terms are described. Table I.5.4 gives a summary of conditions.

*Table I.5.4. Name and conditions for production of alternative broilers, according to EC/543/2008.*

| Production system         | Minimum age (days) | Maximum density indoor (birds/m <sup>2</sup> ) | Access to outdoor run          |
|---------------------------|--------------------|--|--------------------------------|
| Extensive indoor          | 56                 | 15   | No                             |
| Free range                | 56                 | 13   | Yes, 1 m <sup>2</sup> per bird |
| Traditional free range    | 81                 | 12   | Yes, 2 m <sup>2</sup> per bird |
| Free range, total freedom | 81                 | 12   | Yes, 2 m <sup>2</sup> per bird |

<sup>135</sup> AgraCeas, 2010.

The production of organic broilers is regulated in Regulation 834/2007. The main production standards are feeding organic feed, a minimum age of 70 to 81 days, maximum density of 10 birds/m<sup>2</sup> and access to an outdoor run.

There are no detailed statistics available on the production and marketing of alternative broilers. The number of farms with free range or organic production is small, except in France where more than 6,000 free range farms were identified in 2008 (of a total of 9,500 broilers farms)<sup>136</sup>. In organic and free range systems the broilers have access to an outdoor range. According to EU data France is the largest European organic chicken producer with more than 7 million organic chickens produced in 2010. In the UK, the second producer, production of organic chickens reached a plateau in 2006, followed by a reduction at the end of 2008 and in 2009<sup>137</sup>.

Apart from organic broilers, there are also free-range production systems in which broilers have access to an outdoor area. An example of this type of this broiler production is Label Rouge in France. The standards for Label Rouge are a slow growing breed, a maximum density in the poultry house (11 birds/m<sup>2</sup>) and access to an outdoor area during daytime from 6 weeks of age onwards. In general the conditions of Label Rouge are similar to the 'traditional free range' systems, as given in Table I.5.4. It is estimated that in 2010, a total of 88 million Label Rouge broilers were produced in France<sup>138</sup>. France, the country with the highest share of alternative broilers, thus produces about 95 million broilers, that had access to an outdoor area. That is about 12% of the total numbers of broilers produced in France in 2010.

Although the organic production of broiler meat is growing in EU countries in north-west Europe, it is expected that this will stay a niche market. For both organic and outdoor broiler production (Label Rouge), which both give broilers access to an outdoor area, it is expected that the market will only slightly increase.

The so-called 'intermediate' market segment or certified broiler production is in between regular broiler production (with an average slaughter age of 38 to 46 days) and organic production (with a minimum slaughter age of 70 to 81 days). Certified broilers are slow-growing broilers and kept till at least 56 days of age. Certified broilers are produced in France ('certifié'), UK ('freedom food') and the Netherlands (one star within the 'Beter Leven kenmerk'). The market share is estimated to be around 10 % in France and 5% in the UK<sup>139</sup> (Oosterkamp, 2011). In the Netherlands the market share of certified broilers is rapidly growing and estimated to be 2 to 5% in 2011. Also some German companies are planning to start the production of some kind of certified broilers. It can be expected that this type of production will slightly grow in the coming years. Especially in northwest Europe certified broilers will get a position in the market. For most of these '56-days' broilers a slow growing genotype is required, depending on the system a brand name (i.e. Cobb/Sasso cross or Hubbard JA 757) or a maximum average growth rate of 45 g/day is compulsory. While there is some market demand of this type of product, due to the increased cost of production, the higher environmental cost (due to lower growth rates and higher FCR) and the increased cost to the consumer, the certified broiler market will likely continue to be considered a niche market.

All the above-mentioned production systems are based on commercial broiler chickens, provided by the large breeding companies. There is very limited production of poultry meat from traditional breeds, some certified by the Slow Food Movement, some recognized as regional product. Examples are Poule de Bresse (France <http://www.pouletbresse.com/site/>), Chaams Hoen (Netherlands <http://www.chaamshoen.nl/index.php?id=91>), Sulmtaler (Austria, <http://www.sulmtaler.at/>), Cosidetta

<sup>136</sup> ITAVI, 2008.

<sup>137</sup> Magdelaine, P. 2011.

<sup>138</sup> Riffard and Gallot, 2011.

<sup>139</sup> Oosterkamp *et al.*, 2011.

Nostrama (Italy, <http://www.cappedimorozzo.it/cappone>). In general production is on a very small scale. There is no relation with the large breeding companies. In most cases production of such original breeds is controlled by a 'society', that owns and selects the breeding stock. They select also farms that are allowed to grow the birds to be slaughtered. Very likely they select their stock on a traditional basis, i.e. try to keep it as it was, with probably some selection on liveability and egg production. Cockerels might be exchanged between producers to prevent inbreeding. The societies are very reluctant to provide information on the exact selection program and try to protect their product from copy-cats. To our knowledge there is no complete overview of this type of poultry meat production, its market share and genetic variability (diversity of stock or rate of inbreeding) involved.

There are no statistics available on the numbers of alternative broilers in the EU. Industry people estimate the market share of alternative broilers to 5 to maximum 10%. This estimate is based on a number of 3.5 million 'alternative' broiler breeders in the EU, which is around 8% of the total number of broiler breeders. The number includes the market for organic and free range broilers as regulated by EU regulations and directives. It also includes the numbers for back yard poultry production in some southern European countries and private label production (as Label Rouge in France, Freedom Food in the UK and intermediate extensive indoor in the Netherlands).

## I.6 Background information for Chapter 6

### I.6.1 Trade flows of broiler breeding stock

For breeding companies the trade in breeding stock is core business. Only three companies supply the demand of broiler breeder chicks in the world. Genetic selection, purebred multiplication and production of crossbred grandparents are highly centralized. All three companies have breeding units involved in genetic selection in Europe and in North America. All three breeding companies distribute grandparent stock (GP) and/or parent stock (PS) to almost all European countries. Within company breeding stock might travel in the form of a hatching egg for genetic security purposes and to allow the company greater flexibility with the utilization of the chicks produced. When leaving the direct control of the breeding company in general only one sex of a line or cross will be transported and consequently only newly-hatched, sexed chicks are traded and shipped to distributors and customers<sup>140</sup>.

There are no detailed data available on international trade flows per company. However, Eurostat provides data on the export of GPS and PS for poultry meat across countries. The Eurostat data give insight in the international trade flows from all EU countries and shows which EU countries are involved. The EU also does register international transport of poultry in TRACES. TRACES (Trade Control and Expert System) is a European network for veterinary health which notifies, certifies and monitors import, export and trade in animals and animal products. However, this system only gives data on poultry at a highly aggregated level without any details to distinguish breeding stock or to separate poultry kept for meat or egg production. For this reason in the paragraph only Eurostat data are used in this study.

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<sup>140</sup> Breeding company interviews, multiplication company interviews



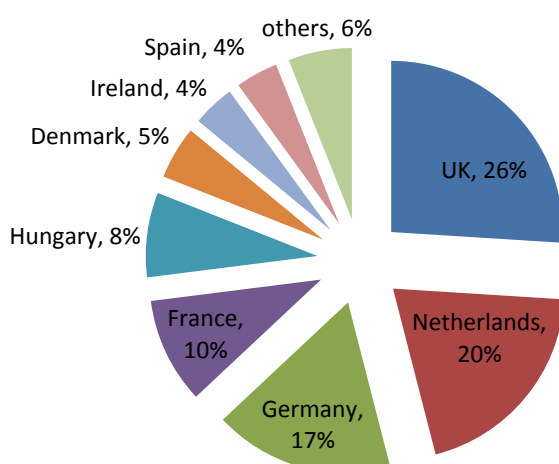


Figure I.6.1. Share of export value of breeding stock in 2010 of the main EU exporting countries.

To get insight in the export destination of the main exporters a selection of data was made per country. Table I.6.1 gives an overview of the 2010 export value of the main destinations of the UK, Netherlands, France, Germany and Hungary. A selection was made on an export value of at least 1 million euro to 1 or more destinations.

Table I.6.1. Overview of the 2010 export value (\* 1000 euro) of the main export destinations within the EU (intra EU) and outside the EU (extra EU) of poultry meat breeding stock exported from the UK, Netherlands, France, Germany and Hungary<sup>141</sup>

| Destination      | Exporting country |             |        |         |         |
|------------------|-------------------|-------------|--------|---------|---------|
|                  | UK                | Netherlands | France | Germany | Hungary |
| <b>intra EU:</b> |                   |             |        |         |         |
| France           | 2276              | 642         | 0      | 0       | 0       |
| Belgium          | 10                | 3799        | 692    | 91      | 0       |
| Netherlands      | 12425             | 0           | 0      | 185     | 18      |
| Germany          | 8216              | 7112        | 0      | 40      | 0       |
| Italy            | 331               | 758         | 4024   | 971     | 0       |
| United Kingdom   | 0                 | 4080        | 6662   | 1799    | 431     |
| Ireland          | 4521              | 676         | 0      | 119     | 0       |
| Denmark          | 2443              | 0           | 677    | 0       | 0       |
| Portugal         | 0                 | 0           | 0      | 1211    | 0       |
| Spain            | 1622              | 341         | 13     | 1336    | 0       |
| Sweden           | 2401              | 65          | 0      | 0       | 0       |
| Finland          | 1166              | 0           | 0      | 0       | 0       |
| Austria          | 0                 | 886         | 441    | 56      | 20      |
| Poland           | 181               | 8824        | 5024   | 1240    | 720     |
| Czech Rep.       | 0                 | 0           | 3966   | 26      | 1207    |
| Slovakia         | 0                 | 0           | 0      | 43      | 375     |
| Hungary          | 5000              | 353         | 2912   | 556     | 0       |
| Romania          | 0                 | 85          | 1768   | 29      | 1043    |
| Bulgaria         | 41                | 0           | 1449   | 0       | 1825    |
| <b>EXTRA-EU:</b> |                   |             |        |         |         |
| Turkey           | 3000              | 3368        | 2336   | 163     | 0       |
| Ukraine          | 109               | 0           | 9396   | 0       | 2107    |

<sup>141</sup> Eurostat, 2011.

|              |      |      |      |      |      |
|--------------|------|------|------|------|------|
| Belarus      | 944  | 0    | 709  | 0    | 591  |
| Russia       | 1113 | 8674 | 116  | 6831 | 9037 |
| Serbia       | 0    | 0    | 1108 | 0    | 728  |
| Morocco      | 347  | 0    | 0    | 1129 | 0    |
| Algeria      | 448  | 0    | 0    | 4048 | 0    |
| Tunisia      | 0    | 0    | 0    | 1283 | 0    |
| Egypt        | 638  | 851  | 0    | 252  | 0    |
| Syria        | 2831 | 66   | 0    | 43   | 0    |
| Iran         | 3528 | 96   | 627  | 9    | 0    |
| Israel       | 1674 | 0    | 0    | 28   | 0    |
| Saudi Arabia | 1756 | 1924 | 0    | 622  | 0    |
| Bangladesh   | 240  | 1780 | 0    | 6    | 0    |
| Thailand     | 443  | 321  | 0    | 139  | 0    |
| Indonesia    | 720  | 0    | 533  | 0    | 0    |

From intra EU trade it can be concluded (based on the upper part of Table I.6.1) that UK, the Netherlands, Germany and France export to most EU countries. Export from Hungary is concentrated on the UK and eastern EU countries. On extra EU trade (based on the lower part of Table I.6.1) it can be concluded that the main destination for breeding stock are countries in eastern Europe (Ukraine, Belarus and Russia), North Africa (Morocco, Algeria and Egypt), Middle East (Iran and Saudi Arabia) and Asia (Bangladesh, Thailand and Indonesia). Between the countries there are some differences in importance of the destinations. The data show that export of Hungary is more concentrated on Eastern Europe countries. UK, the Netherlands, Germany and France have a more diverse combination of export destinations. In Table I.6.1 only the destinations of the main exporters are given with a total export value of more than 1 million euro. This means that the export to countries like USA, Brazil and Canada is below 1 million euro. In general it can be concluded that international trade in grandparent stock and parent stock is concentrated in North-West Europe. Especially the UK, the Netherlands, France, Germany and also Hungary play an important role in the export of breeding stock (grandparent or parent female chicks) The total export value (INTRA + EXTRA EU) of grandparent stock and parent stock is 274 million euro. The total value of export to countries outside the EU is 116 million euro, which is 46% of the total value.

### I.6.2 Broiler breeding products

A list of the breeder and broiler products, currently marketed by the three breeding companies cited before, is presented in Table I.6.2, along with the commercial characterisation of the product.

*Table I.6.2. The products currently marketed by Cobb-Europe, Aviagen Broiler Breeders and Hubbard<sup>142</sup>*

|                | Product      | Type of product | Commercial positioning   |
|----------------|--------------|-----------------|--|
| <b>Aviagen</b> | Arbor Acres  | parent/broiler  | Very easily managed with capacity of producing high numbers of day-old chicks. The broiler has fast growth, low FCR and a robustness, which leads to excellent liveability |
|                | Indian River | parent/broiler  | Reproductive, robust and easy to manage. High growth rate and meat yield   |
|                | Ross PM3     | Parent/broiler  | Standard male mated to dwarf female for efficient egg production; high uniformity among broilers   |
|                | Ross 308     | parent/broiler  | Selected for economic performance, robustness and welfare traits.  |
|                | Ross 708     | parent/broiler  | Selected for economic performance, robustness and welfare traits. High meat yield  |
|                | Ross Rowan   | Parent/broiler  | Selected for slow growth rates, with excellent liveability, health   |

<sup>142</sup> Source: company leaflets and management guides from Aviagen, Cobb-Europe and Hubbard

|                    |                                  |                |   |
|--------------------|----------------------------------|----------------|---|
|                    |                                  |                | and robustness, FCR and yield and oriented to speciality markets (e.g. outdoors)  |
| <b>Cobb-Europe</b> | CobbAvian48                      | parent/broiler | High chick numbers of good quality and robust growth rate in wide range of nutrition programmes   |
|                    | Cobb/Sasso175 and Cobb/Sasso 150 | parent/broiler | Slower growing with robust health and suitable for outdoor and organic farms  |
|                    | Cobb 500                         | parent/broiler | Lowest cost per kg live weight, achieved through high feed efficiency and growth rate and ability to thrive on low-density, low-cost nutrition. |
|                    | Cobb 700                         | parent/broiler | High breast meat yield is combined with high feed efficiency and growth performance   |
| <b>Hubbard</b>     | Hubbard Classic                  | parent/broiler | Optimal balance between reproductive and broiler performance. Bred for ease of management and performance in range of climates.                 |
|                    | Hubbard Flex                     | parent/broiler | Competitive breeder performance combined with cost-efficient broiler performance and a good carcass conformation                                |
|                    | Hubbard F15                      | parent/broiler | High chick numbers at low cost (dwarf female?)  |
|                    | Hubbard H1                       | parent/broiler | Large number of hatching eggs and chicks and high growth rates. Suitable for heavy and medium weight markets.                                   |
|                    | Hubbard JV                       | parent/broiler | High & robust breeder performance and low cost of production  |
|                    | JA57                             | Parent         | Hen to produce wide range of coloured and slower growing broiler products   |
|                    | Redbro M                         | Parent         | Hen to produce coloured and slower growing broiler  |
|                    | Redbro S                         | Parent         | Hen to produce coloured and slower growing broiler  |

Presenting the main buying factors in average percentages for fast growing and slower growing broiler breeding products is not very meaningful, since many of the percentages given vary considerably. Therefore we give the range of answers. All three companies indicate that a relatively poor performance on feed conversion compared to competitors is a reason for many customers to choose another bird and therefore the most important buying factor (up to 70%). The growth rate (10 to 15%) is the next important. Low mortality in all levels of the chain (up to 20%) is the third important buying factor. Welfare indicators like absence of skeletal disorders (up to 5%), contact dermatitis (up to 5%), ascites (up to 5%) and sudden death syndrome (up to 5%) are relatively unimportant buying factors. On the importance of percentage breast meat, slaughter weight, mortality, layer percentage in parent stock and hatchability as buying factors, the companies vary considerably in their views, with a wide range of percentages quoted across companies.

Major differences between countries in the EU can be related to the level of integration of the broiler chain. In fully-integrated companies (Italy, Spain, Denmark, Sweden, Germany and the United Kingdom), the most successful breed will be the one that delivers the best net profit across the whole supply chain (feed mill, breeders, hatchery, broilers and processing plant). In non-integrated industries (the Netherlands), every part of the chain must make a profit so the successful breed must deliver a profit for each sector, even if the total combined profit across the whole chain is less than that that the integrated model can deliver.

The European and North American market for fast growers is mainly a breast meat market, since that is most wanted by consumers. In other parts of the world, there is less emphasis on breast meat. All of the companies expect some growth in the market for slow growers, but none of them expects a substantial growth. All companies see this market as a niche, for which they developed a crossbred, slower growing broiler product in their portfolio. The market share is expected to grow up to 5% of the European market. All companies expect that outside Europe the market segment for slower growing birds will remain negligible in the short and medium term.

## I.7 Background information for Chapter 7

### I.7.1 Impact of genetic selection in literature

The EFSA report, information from EFFAB and other overviews of genetic variation indicate that for most traits important in broiler production, about 30% of the total variation is due to genetic factors and 70% to environmental or management-related factors. Growth rate, feed conversion and slaughter yields are more dependent on genetic factors than for example mortality. Also specific disorders have a higher proportion of genetic variation than a 'summary trait' like 'leg defects' or 'ease of movement'.

For several welfare problems, there is substantial evidence that the genetic background of the birds is at least partially responsible for the problem. According to EFSA the major welfare problems in broilers are leg problems, foot pad dermatitis, ascites and sudden death syndrome. From these welfare problems, ascites, sudden death syndrome and leg problems are particularly related to the genetic background of the birds. However, genetic background of the birds also plays a role in thermal discomfort, foot pad dermatitis, behavioural restriction, and digestive function, although these problems also have a clear environmental and management component.

One criticism to the EFSA review is, that it is based on scientific literature and does not take into account the 'grey literature'. A disadvantage of peer-reviewed literature on a topic that is of direct importance in the current field is time lag. In general there are at least two years between conducting a broiler experiment and its publication in a scientific journal. Meanwhile selection programs in industry continue to make progress and are adapted if necessary. Publications that compare current commercial genotypes are therefore scarce.

Partly in response to the EFSA procedure of only considering peer-reviewed publications, Aviagen is now publishing their research in peer-reviewed journals<sup>143</sup> and industry magazines. Cobb-Vantress has also published research and welfare-related information in industry magazines and peer-reviewed journals<sup>144</sup>.

Major welfare problems in parent stock are a strong motivation to eat after consuming the daily feed allowance, aggressive and rough mating behaviour, a barren environment and a high stocking density<sup>145</sup>. Some of these problems result clearly from management or environmental conditions, such as barren environments and stocking densities, but there may be genetic variation between lines in the sensitivity to these inferior conditions. Others have a strong genetic background, such as high motivation to eat resulting from feed restriction and aggression, but undesirable consequences of the genetic predisposition may be prevented by environmental factors. Causes of rough mating behaviour are not clear yet, and could be both genetic as well as environmental. But also contact dermatitis, leg weakness, metabolic disorders and peritonitis exhibit genetic variation in broiler breeders in a risk environment, although information on prevalence is scarce.

The reviewed genetic correlations between welfare traits and production traits in the EFSA report were all in the range of -0.30 to +0.30, indicating that both groups of traits can be improved simultaneously. The genetic correlation indicates the extent to which a secondary trait changes as a consequence of genetic selection on the primary trait. If the genetic correlation is 1, then the secondary trait changes in the same direction as the primary trait. If it is -1, it changes in the opposite direction. If it is zero, the secondary trait does not change as a consequence of selection on the primary trait. Genetic correlations between -0.30 and 0.30 indicate that the secondary trait changes a little as a consequence of selection on the primary trait, but this can be avoided by including the secondary trait in the breeding goal.

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<sup>143</sup> Kapell et al, 2012a

<sup>144</sup> Paxton *et al.*, 2010.

<sup>145</sup> De Jong and Guemene, 2011.

Adding secondary traits to the breeding goal means that the selection pressure for the primary traits will be reduced, even if the genetic correlation is zero. The magnitude of the reduction depends on the desired change in the secondary traits and the genetic correlation between the primary and secondary traits. The reduction is small on an annual basis, but it is cumulative over years.

### 1.7.2 Interactions between genetic selection and housing systems used for chickens

The undesirable side effects on broiler welfare may be caused by the choice of selection environment between 1960 and 1980. The dominant paradigm in animal breeding was based on work of Hammond<sup>146</sup>, who concluded that the selection environment should allow full expression of the genetic potential. Later, Falconer<sup>147,148</sup> showed that superior animals in a favourable environment were not always superior in a mediocre environment, which is observed as interaction between genotype and environment.

The commercial information supplied by breeding companies to their customers suggests that interaction between genotype and environment is of practical significance, as some but not all product leaflets contain statements on “ease of management”, “robustness”, “suitable for a range of nutritional levels”, etc. Specific welfare traits as ‘no dermatitis’, ‘no ascites’, ‘excellent walking ability’ are not mentioned in the product leaflets.

The selection environment is critical for developing robust lines. Cooper<sup>149</sup> reviewed the discussion on the choice of selection environment in 2004. He compared four common strategies (select in the most favourable environment, select in the most unfavourable environment, select in the target environment and select in multiple environments) and concluded that a trait is best improved if selection takes place in the conditions in which the trait will be measured in commercial production. The EFSA recommendation “that birds should be tested and selected for their subsequent rearing and production environments” is in line with this conclusion.

It is common practice among the breeding organisations to test birds under 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<sup>150</sup>. For example Aviagen have been selecting on information collected in multiple environments since 2000<sup>151</sup>. In all cases at least broiler performance is evaluated, i.e. growth rate, feed conversion, liveability and slaughter yields. All companies use it, but the exact details (what type of environment, exact measurement, importance of the data in the overall selection program, etc.) are commercially sensitive.

In Aviagen, the main distinction between the selection environments is the level of control of all factors affecting production. High control implies low disease and gut challenge, constant and high quality of feed, dry litter and a healthy atmosphere. Low control means a higher disease and gut challenge, more variability in feed quality litter of more variable quality and higher humidity and variable levels of dust and obnoxious gases and is aimed to represent the lower end of the range of commercial broiler flocks.

The breeding companies do not believe that any of their main broiler products requires above-average management for acceptable welfare of the birds, but improving management standards of all customers helps achieving optimal performance, health and animal welfare. For example, Cobb has seen that the same broiler product, the C500, performs in open-sided houses in Central & South America with rustic housing and equipment, but exceptionally detailed caretakers, and in highly sophisticated farms in North America and Europe with enclosed housing and the latest technology to optimize productivity, without

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<sup>146</sup> Hammond, J., 1947.

<sup>147</sup> Falconer and Latyszewski, 1952.

<sup>148</sup> Falconer, 1990.

<sup>149</sup> Cooper, M., 2004.

<sup>150</sup> Breeding company interviews

<sup>151</sup> Laughlin, K., 2007.

large differences in the bird's performance. Aviagen observed in trials that the Ross 308 versus a slower-growing broiler product and the Ross 308 versus a non-selected control line, responded in a similar way to a large difference in production environment<sup>152</sup>.

### 1.7.5 Integration of welfare aspects in the breeding programmes

The breeding companies seek a balance in the breeding goal between reproduction traits, health and 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.

For example at Aviagen, the birds have always been selected under group circumstances, which has ensured the integration of social group behaviour into the populations in a natural way over a long period of time. They started selection for leg health in the 1970s, since then no animal with observed valgus/varus, hockburn or crooked toes was able to continue in the breeding programme. Since then simultaneous improvement of antagonistic traits has been applied – this is possible because of the large datasets and population sizes and the accuracy of the datasets. The accuracy of the data is ensured by a) using experienced selection teams with people that are benchmarked continuously, and b) continuously working towards further improvement of the trait measurements and accuracy of the data processing. They report genetic trends to customers and stakeholders once a year.

Also at Aviagen, the selection pressure on the group of broiler production traits (three traits, i.e. growth rate, feed conversion and yield), breeder reproduction traits (five traits, i.e. egg production, male fertility, female fertility, hatchability, breeder liveability) and health and welfare traits (seven traits i.e. hock burn, crooked toes, tibial dyschondroplasia, foot pad dermatitis, liveability, heart and lung function and leg strength) is similar for each group, implying that the total improvement per generation is similar across groups of traits.

Line-specific information on the weighting of welfare traits in the breeding goal was not disclosed by any of the three 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. This is not due to an antagonistic relationship between the welfare traits and the economically important traits but as overall selection pressure can only be allocated once, including welfare traits directly implies less selection space for production traits. The overall selection pressure is fixed, as the number of candidates, and the number of birds to select is given. The more traits are included in the selection, the lower the selection pressure on individual traits will be. Changes in the breeding goal in favour of welfare traits can only be justified by a change in market requirement<sup>153</sup>.

The weighting of the welfare traits in the breeding goal in the past is visible in the genetic trend graphs. All companies showed genetic trend graphs of the main welfare traits in the breeding goal like O<sub>2</sub> pressure in the blood, leg strength, TD, foot pad dermatitis and hock burns, with meaningful genetic progress at least in the lines shown.

Robustness or little dependence on favourable conditions or management is incorporated in the breeding goal by evaluating relatives of the birds under selection in a less favourable environment in terms of feed, health, conditions or management. Growth rate, mortality/liveability, condemnations at the slaughter plant and feed conversion should be affected as little as possible by the sub-optimal management to indicate 'robustness'. Skeletal strength involves many aspects, such as tibial dyschondroplasia (TD), leg deformities, poor gait and poor stature. Some companies showed meaningful genetic trend graphs for aspects of skeletal strength, such as TD and leg strength. Independent data of the Canadian Food Inspection Agency showed a favourable trend of valgus/varus leg deformities.

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<sup>152</sup> Fleming *et al.*, 2007.

<sup>153</sup> Breeding company interviews and multiplication company interviews

Contact dermatitis includes foot pad lesions, hock burns and breast burns. One company has shown meaningful and favourable genetic trends in foot pad lesions and hock burns. Several companies showed independent data from Denmark, indicating a reduction in foot pad lesions from 80% of the flocks scoring too high on foot pad lesions to 10-20% of the flocks, depending on the season. This can only be due to improved management in commercial broiler flocks in Denmark. One company showed in-house trial data that repeatedly showed marked differences between products of different companies in foot pad lesions and hock burns in three subsequent years. A very similar result was observed in an independent Dutch trial<sup>154</sup>. It is evidence that genetic selection can make a significant contribution to reducing the prevalence of foot pad lesions. It does not indicate how it should be done as the genetic broiler product with the highest prevalence of foot pad dermatitis may be equally sensitive to contact dermatitis, but produce litter with a higher moisture content in the same conditions. This indicates that current broiler production is able to reduce foot pad dermatitis in a combined approach of broiler management and choice of genotype.

Heart and lung fitness has been an issue since the 1990s, when ascites and sudden-death syndrome (SDS) were observed to have become problematic. Including heart and lung fitness in the selection process has largely reduced ascites and SDS to very low levels. The companies showed favourable genetic trends for O<sub>2</sub> pressure in the blood in the lines shown. The Canadian Food Inspection Agency reported 6 affected birds per 10,000 in 2010, whereas 38 birds per 10,000 were affected in 1996. No such figures exist for the EU.

Feed restriction in grandparents and parents of commercial broilers is common practice, but the magnitude of impaired welfare caused by restricted feeding is currently not under selection. At least one breeding company is doing research to fully understand the impact of weight control on their physiology and feeding requirement when the birds grow from the juvenile to the reproductive stage. Aggressiveness of cocks is an issue with certain genetic lines, but none of the breeding companies disclosed how they deal with this. One company selects under group conditions to integrate social behaviour in a natural way and avoid aggressiveness of males. Feather pecking occasionally happens in hens of both fast and slower growing strains, but it is not generally considered to be an issue.

## **I.8 Background information for Chapter 8, current trends, baseline scenario**

### **I.8.1 Likely trends in EU and global broiler production and trade**

The global poultry industry has grown rapidly in recent decades. Worldwide industry changed to large scale, often vertically integrated production. A combination of strongly specialized farming, good housing conditions and better animal nutrition has resulted in a very efficient industry compared to other meat industries. Developments in genetics have helped the industry to improve the production performance and create a very homogeneous broiler which fits the market needs. It is expected that the poultry meat production will further grow with 2.4 percent per year over the next 20 years<sup>155</sup>. With increasing wealth the consumption of animal products tends to increase. As poultry meat is affordable compared to other meat types and is accepted by almost all religions, the increase in poultry meat consumption worldwide is faster than the increase in other meat types. In 2030 the total production will be 160 million tons, and poultry meat will have a share of 39% in total meat production. However, markets in Europe and the United States are saturated. It is estimated<sup>90</sup> that 75 percent of the global growth for the next decade will be in emerging markets, with the BRIC (Brazil, Russia, India and China) leading the way. Countries with a competitive cost of production and a focus on trade, such as Brazil and Argentina, will increase their exports. Countries, like China and Thailand, will be exporter of labor-intensive poultry products.

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<sup>154</sup> De Jong *et al.*, 2012.

<sup>155</sup> Rabobank, 2011.



In Table I.8.1 the production forecast is given for the main poultry producing countries for 2020<sup>156</sup>. Especially in China, and also India and Russia a further growth in production is expected. As the production in the EU-27 will only slightly grow the market share of the EU will be reduced to 10.3% in 2020.

Table I.8.1. Poultry meat production in the leading countries in 2000, 2010 and the forecast for 2020 (data in 1,000 ton)<sup>90</sup>

| Countries   | Production |       |        | Share |      |      |
|-------------|------------|-------|--------|-------|------|------|
|             | 2000       | 2010  | 2020   | 2000  | 2010 | 2020 |
| USA         | 16362      | 19273 | 22870  | 23.6  | 19.8 | 18.7 |
| China       | 12873      | 16347 | 20849  | 18.5  | 16.8 | 17.0 |
| Brazil      | 6114       | 12751 | 14955  | 8.8   | 13.1 | 12.2 |
| EU-27       | 10484      | 11786 | 12632  | 15.1  | 12.1 | 10.3 |
| Russia      | 768        | 2850  | 3811   | 1.1   | 2.9  | 3.1  |
| Mexico      | 1825       | 2742  | 3595   | 2.6   | 2.8  | 2.9  |
| India       | 1142       | 2728  | 4258   | 1.6   | 2.8  | 3.5  |
| Argentina   | 919        | 1629  | 2391   | 1.3   | 1.7  | 2.0  |
| Iran        | 827        | 1551  | 2463   | 1.2   | 1.6  | 2.0  |
| Japan       | 1199       | 1353  | 1413   | 1.7   | 1.4  | 1.2  |
| total world | 69444      | 97546 | 122411 |       |      |      |

Figure 1.8.1 below provides an overview of the forecasted contribution per country in 2020.

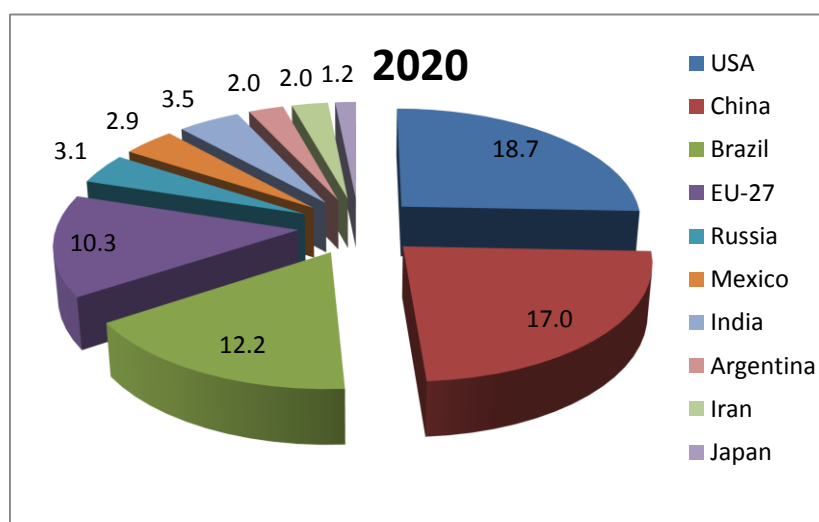


Figure I.8.1. Forecasted contribution per country of poultry meat produced to the global poultry meat production in 2020

Figure I.8.2 shows the development between 2000 and 2010 and the forecast towards 2020 graphically. This graph clearly illustrates the limited growth in the EU-27 compared to the USA and Brazil and especially China.

<sup>156</sup> OECD/FAO, 2011.

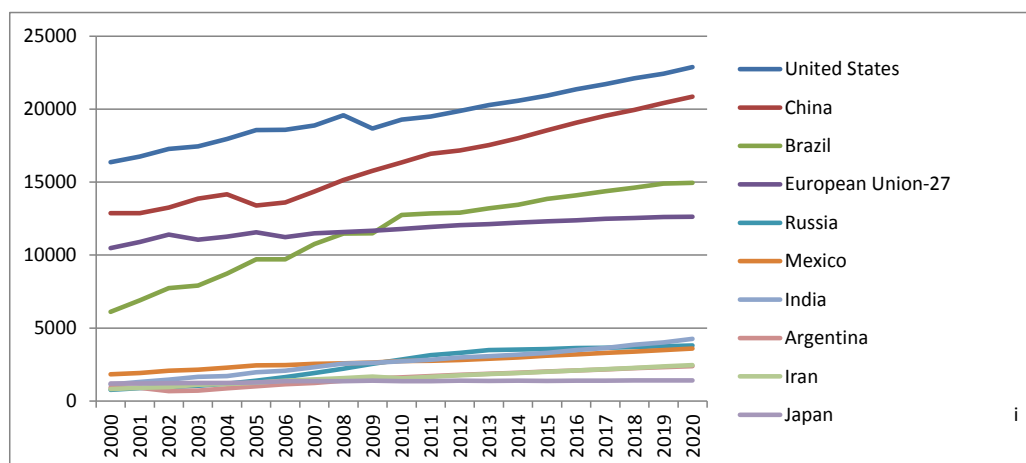


Figure 1.8.2. Development in poultry meat production between 2000 and 2010 and the forecast towards 2020 in the main poultry meat producing countries<sup>91</sup>.

Poultry meat production in the EU will increase slightly towards 2020. The consumption will increase driven by the relative price-competitiveness and advantages in convenience for poultry compared to other meat products<sup>157</sup>. Demand for poultry meat in the EU is projected to recover and will increase by almost 10% to 12.7 million ton in 2020. Poultry meat production is depicted to grow by almost 7% on aggregate from 2009 to 2020. The EU expects poultry exports to decline gradually over the medium term due to strong competition on the world market by low cost producers and an unfavorable euro exchange rate. EU imports will further increase. The EU will gradually lose its net exporter status and be a net importer by 2015<sup>158</sup>. Figure 1.8.3 below gives the development in the EU of production, consumption, export and import of poultry meat.

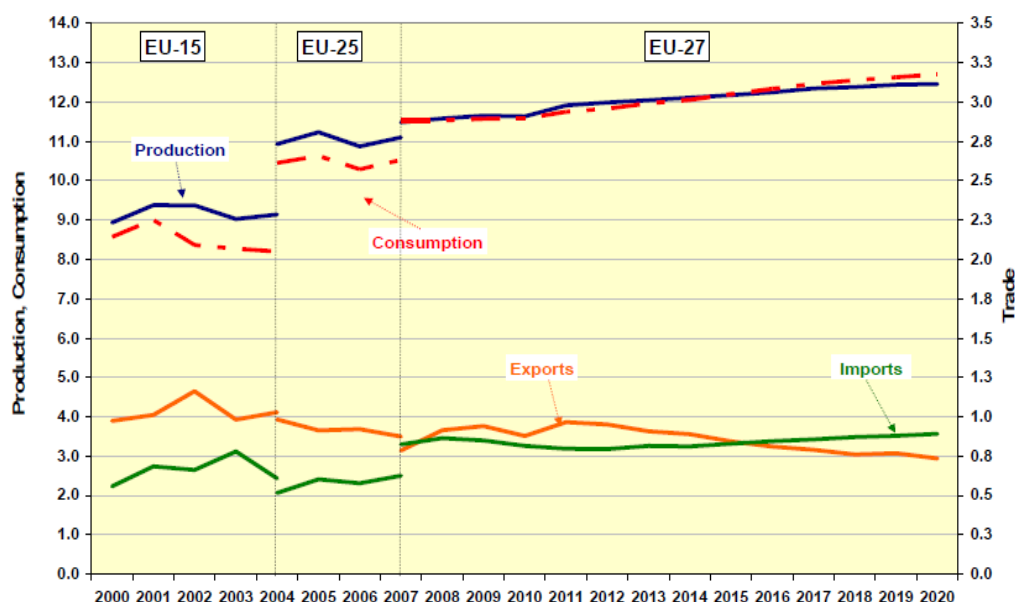


Figure 1.8.3. EU Poultry meat market developments (million ton), 2000-2020<sup>92</sup>

<sup>157</sup> AgraCeas, 2010.

<sup>158</sup> EC, 2010.

#### I.8.4 Quantitative impact on improving animal welfare

Aviagen demonstrated that it has a history of reducing skeletal disorders and intend to continue doing so. For example the prevalence of leg deformities has decreased by 0.7% per year since 1986 in their main product, the Ross 308, due to genetic selection. The prevalence of foot pad dermatitis in the lines contributing to the Ross 308 has reduced by 2% per year since 2008. Ascites is now virtually absent in the Ross 308. Mortality has reduced by 0.14% per year on average in this product in the UK and 0.27% per year in the Netherlands. The other companies also demonstrated favourable phenotypic or genetic trends in welfare aspects like leg strength and mortality for the genetic lines shown.

*Robustness.* Little dependence on favourable conditions or management is incorporated in the breeding goal by evaluating relatives of the birds under selection in a less favourable environment in terms of feed, health, conditions or management. Growth rate, mortality/liveability, condemnations at the slaughter plant and feed conversion should be affected as little as possible by the sub-optimal management to indicate 'robustness'.

*Mortality.* Reported reductions in mortality within lines and products vary from 0.2-1.0% per year. Ascites and SDS are now generally considered to be historical problems and current levels in the pedigree flocks are minimal. They do not hear from customers that it is a problem and as overall mortality continues to decrease, they presume it to be low in commercial production, too. All companies continue to select for high blood oxygen levels, to stop it becoming a problem again.

*Skeletal integrity.* This welfare aspect involves many aspects, such as tibial dyschondroplasia (TD), leg deformities, poor gait and poor stature. Some companies showed meaningful genetic trend graphs for aspects of skeletal strength, such as TD and leg strength. Independent data of the Canadian Food Inspection Agency showed a favourable trend of valgus/varus leg deformities from 7.5 condemned birds per 10,000 in 1995 to 0.2 birds in 2007. This is evidence that the breeding companies together are improving this welfare aspect with a genetic background.

*Contact dermatitis.* This welfare aspect includes foot pad lesions, hock burns and breast burns. One company has shown meaningful and favourable genetic trends in foot pad lesions and hock burns. In Denmark the foot pad dermatitis score is calculated by giving 2 points for a seriously affected birds and 1 point for mildly affected bird in a sample of 100 broilers at the point of slaughter. Danish data showed a rapid decline of flocks with a foot pad dermatitis score above 80 points of about 20% per year between 2002 and 2005. This rapid change is very likely the result of management (litter management, water management, light schedules), changes in diet composition (diets that prevent wet droppings) and more and more the effects of adaptations in the breeding program. It has been stable at on average 21% during winter time and 9% during summer time, since<sup>159</sup>. In Sweden foot pad dermatitis is scored and monitored likewise. Severe foot pad dermatitis decreased from 11% to less than 6% in about 10 years and is relatively stable since then<sup>160</sup>. This indicates that current broiler production is able to reduce foot pad dermatitis in a combined approach of broiler management and choice of genotype. Foot pad dermatitis is highly correlated with in particular the moisture content of the litter. Gut health has a major impact on the incidence of foot pad lesions, and feed ingredients have a major impact on gut health. There are (except for the Swedish and Danish data) no statistics on field performance for broilers.

*Heart and lung function.* This welfare aspect has been an issue since the 1990s, when ascites and sudden-death syndrome (SDS) were observed to have become problematic. Including heart and lung fitness in the selection process has largely reduced ascites and SDS to very low levels. The companies showed favourable genetic trends for O<sub>2</sub> pressure in the blood in the lines shown. The Canadian Food Inspection

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<sup>159</sup> De Jong *et al.*, 2011.

<sup>160</sup> Veldkamp *et al.*, 2007.

Agency reported 6 affected birds per 10,000 in 2010, whereas 38 birds per 10,000 were affected in 1996. No such figures exist for the EU. This reduction is largely due to genetic selection.

*Feed restriction in broiler breeders.* Feed restriction in grandparents and parents of commercial broilers is common practice, but the magnitude of impaired welfare caused by restricted feeding is currently not under selection. At least one breeding company is doing research to fully understand the impact of weight control on their physiology and feeding requirement when the birds grow from the juvenile to the reproductive stage.

*Aggressiveness of cockerels.* This is an issue with certain genetic lines, but none of the breeding companies disclosed how they deal with this. One company selects under group conditions to integrate social behaviour in a natural way and avoid aggressiveness of males.

*Feather pecking.* It occurs sometimes in hens of slower growing lines and very occasionally in fast growing lines, but in practice it is not considered an issue in any of the lines.

### **I.8.5 Consistency with other EU policies**

#### **CAP objectives**

In the past decades the Common Agricultural Policy (CAP) of the EU has been reformed several times to increase the competitiveness of farmers, to increase sustainability and to improve the targeting of policy measures. In October 2011 the Commission presented a set of legal proposals to further reform the Common Agricultural Policy (CAP) after 2013. Part of this is the "greening" of direct payment. To strengthen the environmental sustainability of agriculture and enhance the efforts of farmers, the Commission is proposing to spend a part of the direct payments specifically for the improved use of natural resources. Farmers would be obliged to fulfil certain criteria such as crop diversification, maintenance of permanent pasture, the preservation of environmental reservoirs and landscapes.

The CAP is focusing on payments for crops and land use. As many poultry farmers in the EU have no or just a limited area of land the impact of CAP is limited. However, CAP objectives to strengthen competitiveness and sustainability of agriculture in Europe also relate to sustainability issues of the poultry sector. For example, less progress in feed conversion and less progress in slaughter yields both have an effect on utilization of resources and consequently imply less reduction in environmental burden than would be possible with no restrictions on improvement in feed conversion and slaughter yields.

Balanced gains in efficiency within the constraints of biological performance and broiler welfare offer the European broiler production chains a secure future and the EU consumer a continued supply of affordable, nutritious chicken meat products.

#### **Environment and sustainability**

Livestock production has a major impact on the environment. The livestock sector increasingly competes for scarce resources, such as land, water and energy, and has an impact on air, water and soil quality because of emissions<sup>161</sup>. An assessment of the environmental impact requires a quantification of the emissions and resource use during the entire life cycle of that product. Life cycle assessment (LCA) is a generally accepted method to evaluate the environmental impact of a product and two types of impact are considered: a) use of resources such as land of fossil fuels, and b) emission of pollutants such as ammonia emission or methane. Emission of pollutants contributes to climate change, acidification and eutrophication of ecosystems.

Modern broilers are selected for a high daily growth rate. The result is a fast growing broilers producing poultry meat with a low feed conversion (kg feed used per kg of bird weight). Alternative broilers have a

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<sup>161</sup> De Vries and De Boer, 2010.

lower daily growth rate and as a result a higher feed conversion. The most common alternative broilers systems are barn (kept inside) and free range broilers. In general these alternative broilers are kept for 56 days in comparison with the regular broilers which are kept for 38 to 42 days. In EEC regulation 1538/91 broilers kept with a minimum of 56 days are called 'extensive indoor' ('barn reared') and 56 days broilers with access to an outdoor run may be marketed as with the term 'free range'

In literature, two recent studies are available comparing different production systems for broilers. In both studies results are given comparing fast and slow growing broilers and the environmental impact based on land use, energy use and global warming potential (GWP). GWP is expressed in CO<sub>2</sub>-equivalents to measure the impact of all greenhouse gases (such as N<sub>2</sub>O, CH<sub>4</sub> and CO<sub>2</sub>) and is often called CO<sub>2</sub> footprint. One study also quantified the eutrophication potential (EP) and acidification potential (AP).

Table I.8.2 gives the poultry production input data used in LCA model calculations<sup>162</sup>. These data are based on the situation in the UK. The data show that the free range broilers have a 19-day longer growing period with a higher feed intake per bird. Table I.8.3 gives the environmental burdens of regular and free range broiler production. The results show that for all aspects the free range systems have a higher environmental burden compared to the regular system. The primary energy use is only slightly higher and all other burdens are 16 to 29% higher for free range production.

*Table I.8.2. Poultry production input data values used in LCA model*

|                       | Regular (Ross 308) | Slow growth broiler, free range (Ross Rowan) |
|-----------------------|--------------------|--|
| Final age (days)      | 39                 | 58   |
| Final weight (kg)     | 1.95               | 2.06   |
| Feed intake (kg/bird) | 3.36               | 4.50   |

*Table I.8.3. Comparison environmental burdens of production of two poultry meat systems (per 1000 kg carcass weight)*

|                                    | Regular | Slow growth, free range | Difference (%) slow growth vs regular |
|------------------------------------|---------|-------------------------|---------------------------------------|
| Primary energy used, GJ            | 25.37   | 25.65                   | +1                                    |
| GWP, 1000 kgCO <sub>2</sub> equiv. | 4.41    | 5.13                    | +16                                   |
| EP, kg PO <sub>4</sub> equiv.      | 20.31   | 24.26                   | +19                                   |
| AP, kg SO <sub>2</sub> equiv.      | 46.75   | 59.73                   | +28                                   |
| Land use, ha                       | 0.56    | 0.72                    | +29                                   |

In another study, based on data from the Netherlands, a comparison of environmental burdens was made for the barn system compared to the regular broiler systems<sup>163</sup>. Table I.8.4 shows the results. The barn system has a 20% higher GWP (in the study called CO<sub>2</sub> footprint), a 13% higher energy use and a 12% higher use of land.

*Table I.8.4. Results comparison regular and barn reared (inside) broilers in NL<sup>164</sup>. Per kg broiler meat.*

|                             | Regular | Barn  | Difference (%) free vs regular |
|-----------------------------|---------|-------|--------------------------------|
| GWP, CO <sub>2</sub> equiv. | 3.31    | 3.96  | +20                            |
| Energy use, MJ              | 31.09   | 35.24 | +13                            |
| Land use, m <sup>2</sup>    | 4.67    | 5.22  | +12                            |

Both studies show that the environmental impacts of the slower growing broilers are higher compared to the regular systems. Using slow growing broilers the length of the production cycle is longer compared to

<sup>162</sup> Leinonen *et al.*, 2012.

<sup>163</sup> ABN AMRO and Blonk Milieuvadvis, 2011.

<sup>164</sup> ABN-AMRO and Blonk Milieuvadvis, 2011.

regular systems, and as a result, the feed consumption and manure production per bird are higher. These differences have a major impact on the environmental burdens between the systems.

Breeding companies also emphasized that their current breeding programmes will have a positive environmental impact. Improvements of 2 points FCR (20 g feed per kg weight gain) will save Europe 36,000 hectares of land used for poultry feed production per year<sup>165</sup>. For comparison, slow growing and fast growing broiler products may differ 40 points in FCR (Table 9.2) and would require 720.000 hectares of land extra if all EU poultry meat would be produced by slow growing birds. Improvements in feed conversion thus spare land that can then be used for other purposes, incl. the support of global food security or biodiversity. Lower use of water and energy, and production of less waste per kg of broiler meat are similar positive outcomes of improved efficiency of broiler production

### **Food security**

Breeding companies underlined their contribution to global food security. Chicken meat is affordable compared to beef or pork and requires the least amount of resources per unit of product.

### **Regional effects**

Breeding companies and their breeding and multiplication sites constitute an important social and economic component of the region. Furthermore, the rural area in large parts of Europe benefits economically from the poultry production sector. Often poultry production takes places in more remote and relatively poorer regions, usually also less exciting for tourism. Breeding and multiplication sites and broiler producers add to the viability of the areas where they are active, as well as companies further in the broiler production chain. Moreover, animal breeding is a highly knowledge-intensive area, spending around 10% of their annual turnover in R&D and collaborating with local research facilities, which is also profitable for Europe, as well.

### **Employment**

Employment in remote and rural areas and in research will keep benefitting from the continuation of broiler breeding and production, although the breeding companies themselves do not employ a large number of people.

### **Genetic diversity**

Breeding companies pointed out that they will continue to invest in maintenance of a sound genetic base enabling the breeders and the poultry production sector to meet changing demands from society and any future climatic, disease or other challenges. Development of a larger diversity of crossbred products for the European and global broiler producers will - above all - depend on the interest of the consumers. Without any EU policy change, the genetic diversity among the broiler breeding companies is not at risk of diminishing. The genetic diversity between broiler populations, however, is only a fraction of the genetic diversity across all poultry lines and breeds in the EU.

### **Climate change**

The variety of genetic material in the gene pool of the breeding companies, and selection of animals in multiple environments will ensure gradual adaptation of the animal populations to climate change (adaptation). Regarding mitigation strategies, see section 'environment and sustainability' in this Chapter. Poultry feed requires high quality protein, currently mainly provided by soy imported from North and South America. Soy production is discussed in relation to its effect on land use change. We do not elaborate this aspect of poultry production in this report.

### **Animal health**

Breeding companies indicate that they continuously search for possibilities and traits to improve health and robustness of broilers genetically. In addition to detailed registration of a variety of traits in the

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<sup>165</sup> Breeding company interviews

pedigree and multiplication breeding units, breeding companies use feedback mechanisms to use performance indicators of broiler production farms and upcoming and changing disease patterns to redirect or optimize breeding goals.

Breeding companies expect steady improvements in health of broilers and their aim 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 (already antibiotics free), but increasingly also at commercial level.

An autonomous development is that a portion of the industry changes to free-range systems, with the implication that some of the “historic” health issues, that have been resolved by housing broilers, will re-emerge and need to be addressed again. This will have impact on both health and welfare of the broilers. Outbreaks of diseases in Europe might affect international trade, especially in parent and grand parent stock.

### **Meat quality**

Changes in meat quality are expected to be limited. Steady improvements will be made by breeding companies, however market demands will determine to what extend breeding companies will make substantial changes in their breeding goals. There has been research into improving the nutritional value of chicken meat (such as fatty acid composition) through nutrition and broiler management.

### **Food safety**

Further improvements are expected, e.g. with research projects on *Campylobacter* already in progress. Levels of *Salmonella* in the breeder and broiler flocks in the EU have been going down for some time and *Salmonella*-related food poisoning due to poultry is also decreasing. Achieving similar progress with *Campylobacter* will take much longer, because it is less clear how contamination can be controlled in commercial herds. The increase in number of free range systems also poses an increased risk of introducing avian influenza from the wild bird population into the broiler production chain. This is more of a human health risk than a food safety risk.

## **I.8.5 Competitiveness of EU breeding organisations**

The Common Agricultural Policy (CAP) of the EU has the objective to increase the competitiveness of farmers and to increase sustainability. For poultry meat these objectives might have a conflict in it, because the demand for sustainable products (in terms of more welfare for the animals) is still a niche market. Demand development is needed before interventions on welfare in production can be done.

All three leading breeding companies are world players. All parties are operating in all parts of the world. None of the parties is a monopolist in a country or a continent or has exclusive contracts with integrations, of which they are not already part (like Cobb as a subsidiary of Tyson). The competition between the companies is experienced as severe in every country, on every continent and at every level of integration by all three parties. This situation will maintain in the future, since no further take overs are expect in the coming years. All parties expect that the current situation is a solid base for the market in the future.

Getting or losing market share in stable markets like Europe is determined by details now. Growth in company turnover is mainly realised in growing markets, like Asia, Africa and South-America. Interference in the market by governments can change the level playing field. The breeding companies indicated that they do not expect a change in competitive position of the three breeding companies if there is no EU policy change with respect to animal welfare or fast growing versus slow growing production<sup>166</sup>. If the market drives the changes in emphasis in the breeding goal, all breeding companies operate on a level-

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<sup>166</sup> Breeding company interviews



playing field where adjustments in R&D and investments will be done gradually in relation to economic output. In case of substantial movements in the market, the party with the best economic situation will survive and the number of companies will further decrease.

Therefore all companies unanimously plead for a market development by demand instead of government interference at the supply side.

The market for poultry broilers and poultry meat will however change in the upcoming years in this scenario. The European market for poultry meat will stay stable or just slightly increase. The challenge for the sector is to find a solution for the high antibiotics use on farms working with fast growing broilers. This and also the incidence of ESBL's could have a negative impact on the price of poultry meat and result in a lower demand. Next to that the demand for fish and new protein products increases in North-West Europe.

Especially the Southern American countries and Asian countries are increasing the production on a high quality level. Both continents have their view on the European market with great purchasing power. Brazilian producers are already producing products according to the British Retail Standards to be able to export to Europe. At this moment Europe is a substantial export market for frozen poultry meat from Brazil.

Canada is no substantial player on the world export market and therefore no influence of what development whatsoever in that country will have impact in Europe. The large players in the Northern American market, like Tyson, are already world players. Until now their influence on the European market is not substantial since other fast growing markets have their attention. Investments in those continents are much more attractive than investments in a stable market in Europe. Since Southern America, Asia and Africa still have potential for the upcoming 10 years, we expect no direct impact of the USA in Europe in the baseline scenario.

## **I.9 Background information for Chapter 9, impacts of Scenario 1, a mandatory scheme for better match between breeds and environment**

### **I.9.3 Impact on genetics and welfare of broilers**

The representatives of the breeding industry and the broiler production industry that completed the on-line questionnaire think that a mandatory scheme for the design and implementation of a broiler genetic programme is not necessary. One of the processing companies and the whole group of related stakeholders (e.g. suppliers, NGOs and the representative of the retail) think that such a scheme is necessary to improve broiler welfare.

The breeding industry in the on-line questionnaire further doubt whether such a scheme will actually improve the welfare of the broilers in commercial production, as they rather expect a decrease of welfare. The poultry meat processing industry and NGOs expect a slight improvement and the broiler production industry expect a relatively large welfare improvement. They expect that in this scenario it is possible to achieve a large improvement in welfare by reducing skeletal disorders, contact dermatitis and heart and lung failure. The NGOs, breeding industry and broiler production industry expect hardly any effect in this scenario on these specific welfare indicators.

This scenario will have hardly any effect on the demand for slower growing broiler products, the self-sufficiency for poultry meat in the EU and the feed restriction in parent stock, according to nearly all groups. Only the broiler production industry expects a higher demand for slower growing products and choice of parent stock in this scenario.

The breeding companies in the face-to-face interviews, however, expect a negative impact on welfare of breeders and commercial broilers for the EU market, if scenario 1 were implemented. If the selection process moves out of the EU, birds are no longer selected in European conditions and grandparent stock will have to travel greater distances. If broiler production moves out of the EU, too, the welfare of the broilers in countries outside the EU that produce the meat for the EU market may be lower.

Selection programs require knowledge on broiler and broiler breeder management and broiler and broiler breeder traits and how to judge them. Besides modern selection programs require thorough knowledge of matrix mathematics and data base management. The breeding programs itself are based on a large number of different steps varying in time and location.

The breeding companies think that there are no EU or EFSA appointed officials or contractors with sufficient expertise and information to make an appropriate assessment of a genetic programme for broilers, so it is unlikely that the external constraints on the breeding programmes actually result in better welfare for commercial broilers than in the baseline scenario.

#### **I.9.4 Impact on consistency with other EU policies**

##### ***Common Agricultural Policy objectives in particular food security***

The European poultry sector is likely to end up with less competitive strains of broilers and a higher cost of production and their market position would become less strong, if in fact EU regulations take over part of the breeding program. A relatively stronger emphasis on welfare aspects will be at the expense of emphasis on broiler production traits, causing Europe and the other parts of the world to slowly diverge into higher and lower cost broiler production. To illustrate the effect of a lower improvement in average feed conversion on total cost for the broiler producer, one breeding company estimated that 0.01 difference in feed conversion will result in 0.59% extra feed cost per broiler or around €400,000 per year for a small producer processing a modest 1 million broilers per week, as feed is 70% of the production cost.

With a significant difference in cost of production, retailers will source the poultry meat outside the EU, broiler producers will go out of business and Europe will need to depend more on imports and the food security could be at risk if imports from outside the EU are not possible.

##### ***Regional effects***

A reduction of poultry meat production in the EU is likely to have a detrimental impact on the viability of the rural areas where poultry production or breeding currently takes place, i.e. the originally poorer and more remote areas in Europe with virtually no tourism. If the European breeding industry withdraws from the EU as a result of scenario 1, it will also affect European agricultural knowledge centres and research institutes. External research projects will probably move to North America, Latin America, Asia and Australia.

##### ***Animal health***

All parties in the on-line questionnaire expect that this scenario will have hardly any effect on the health situation of broilers in the EU. The breeding industry will continue to improve the health of broilers through selection, better vaccines and better nutrition worldwide and doubt whether scenario 1 has any additional benefit for broiler health and welfare in the EU.

##### ***Meat quality***

It is not expected that meat quality will be affected either way by a mandatory scheme on the design and implementation of broiler breeding programmes. Meat quality is more dependent on slaughter age than on genetic background. Birds slaughtered at higher ages have less tender meat with a more pronounced chicken flavour. Consumers vary in their preference for both tenderness and taste.

##### ***Food safety***

The breeding companies are worried that in case of scenario 1, broiler producers may compromise the safety of EU poultry meat if the prices of poultry meat are below the cost of production for a considerable

period of time, as EU producers have to produce with progressively less competitive stock, compared to non-EU producers.

### **Employment**

Employment would decrease in relation to the loss of production, development of knowledge, breeding material, broiler innovations and other sectors depending on poultry meat production, compared to the baseline scenario.

### **Genetic diversity**

If the breeding companies withdraw from the EU, they will take their pedigree populations with them. Strictly speaking, this would reduce the genetic diversity in the EU for lines bred for poultry meat production, but the impact on genetic diversity of poultry in general in the EU would be limited. If the breeding companies stay in the EU it is unlikely that their gene pool will be much affected by Scenario 1, neither favourably nor unfavourably.

According to the group breeding industry in the on-line questionnaire this scenario will have a slightly positive effect on maintaining pure lines. The meat processors and NGOs do not expect this effect.

### **Environment, sustainability and climate change**

Depending on the details of scenario 1, it will become more difficult to improve the environmental impact through breeding simultaneously with the welfare aspects, than in the baseline scenario. As the total selection intensity is a given constraint, added emphasis on broiler welfare aspects will reduce the emphasis on the other traits in the breeding goal, which include traits that reduce the environmental impact and enhance the sustainability of broiler production.

Broiler welfare should not be considered in isolation, but in the context of feeding the world with the limited resources we have. According to one breeding company, to illustrate the importance of FCR, an increase of FCR of 0.01 throughout the EU is equivalent with an extra 300.000 ha of arable land for poultry feed production and an additional 2.2 million m<sup>3</sup> of water.

## **I.10 Background information for Chapter 10, Scenario 2: a mandatory scheme to maintain genetic diversity among broilers**

### **I.10.4 Impact on consistency with other EU policies**

#### ***Common Agricultural Policy objectives in particular food security***

It is unlikely that scenario 2 will have a different impact on CAP objectives compared to the baseline scenario. It will only impact on the businesses of the broiler breeding companies.

#### ***Regional effects***

Scenario 2 may cause the broiler breeding companies to move their pedigree breeding sites out of the EU if the additional cost of the mandatory scheme is deemed too high and brings back their operational flexibility and freedom to make the company management decisions they think is needed. All companies are private companies that do not accept government interference in company assets.

#### ***Employment***

If the broiler breeding companies would decide to move the pedigree breeding sites out of the EU, because they don't want to have political interference in their company policy, it may cause the loss of a few hundred jobs throughout the EU.

### **Genetic diversity**

Breeding companies pointed out that a mandatory scheme on maintaining diversity would not increase the diversity they have, as they already maintain diversity in a responsible way. Maintaining genetic diversity is their core business. The breeding companies indicated that they still have most of the lines from the companies that they acquired in the last decades and that they keep these lines as long as strategically, technically and economically feasible. If they move their stock out of the EU, the net effect would be a loss of genetic diversity in genetic lines for broilers in the EU, but not worldwide.

### **Environment, sustainability and climate change**

It is unlikely that scenario 2 will have a different impact on the environment, climate change or the sustainability of the poultry meat production chain, compared to the baseline scenario. It will only impact on the freedom of doing business of the broiler breeding companies.

### **Animal health**

There is only a potentially favourable impact on adaptability, robustness and health of broilers, if the mandatory scheme of scenario 2 actually improves the maintenance of genetic diversity within and between pedigree flocks. The breeding companies do not see how this could be done.

### **Meat quality**

It is unlikely that scenario 2 will impact on meat quality compared to the baseline scenario.

### **Food safety**

It is unlikely that scenario 2 will impact on food safety compared to the baseline scenario.

## **I.11 Background information for Chapter 11, Scenario 3: Routinely monitoring of welfare data in commercial environments (mandatory scheme)**

### **I.11.4 Impact on consistency with other EU policies**

#### **Common Agricultural Policy objectives in particular food security**

Monitoring welfare aspects in the breeding pyramid is not expected to have a big impact on food security and CAP objectives. Monitoring welfare aspects in commercial slaughterhouses and/or production farms may have an unfavourable impact if the cost of the monitoring scheme is too high. In case this scenario has cost price increasing effect, this will increase the consumer price and decrease the consumer demand for poultry meat inside and outside the EU, since the meat price has a high price elasticity. It will have a favourable impact 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.

#### **Regional effects**

Monitoring welfare aspects in the breeding pyramid is unlikely to have any regional effect, unless the cost and risk involved cause the breeding companies and their partners to move pedigree breeding sites and multiplication sites out of the EU. It will have impact for all chain parties if the cost price increase is so high that the international competitive position is influenced. Monitoring welfare aspects in commercial slaughterhouses and/or production farms is not expected to have regional effects, unless the cost of such a scheme is excessive and proves a competitive disadvantage compared to non-EU broiler production. In that case, the EU broiler production may be substantially reduced compared to the baseline scenario.

#### **Employment**

It is not expected that monitoring welfare aspects in the breeding pyramid will affect employment in the EU, but if the broiler breeding companies move the pedigree breeding sites and multiplication sites out of the EU, it may cause the loss of a few hundred jobs throughout the EU. Monitoring welfare aspects in

commercial slaughterhouses and/or production farms may create new jobs in monitoring, training people for monitoring, and advising broiler producers how to utilise the collected information.

#### **Genetic diversity**

Scenario 3 is not expected to have an impact on genetic diversity between lines and across lines, compared to the baseline scenario.

#### **Environment, sustainability and climate change**

Monitoring welfare in the breeding pyramid is unlikely to cause changes compared to the baseline scenario. Breeding companies indicate that they expect sanitary risks if selection and/or multiplication sites have to be visited regularly by outsiders. Monitoring welfare in commercial slaughterhouses and/or production farms stimulates improving welfare in the current production systems with the current genetic broiler products, which are in most cases fast-growing strains. It does not prescribe a solution (e.g. slower growing strains), but it sets targets, for management and genetics. Provided that there is a reasonably level playing field for EU broiler production and non-EU broiler production, it may be an appropriate way to improve welfare and sustainability of broiler meat production simultaneously.

#### **Animal health**

Improved monitoring schemes in slaughterhouses and/or production farms may also help to raise awareness and to promote improvements in certain aspects of broiler health, especially aspects that still can be observed at the point of slaughter. Striking is that the poultry processing industry has no confidence that this scenario will decrease the prevalence of contact dermatitis and heart and lung failure. The on-line questionnaire does not give an explanation why they have this opinion.

#### **Meat quality**

It is unlikely that scenario 3 will have an additional impact on meat quality compared to the baseline scenario.

#### **Food safety**

Only if aspects of food safety are also included in the monitoring of welfare aspects in commercial slaughterhouses, it would help the awareness, decision making and promotion of possible solutions for improvement.

## ANNEX II. MONITORING WELFARE IN COMMERCIAL BROILER PRODUCTION: CASE STUDIES OF SWEDEN, DENMARK AND CANADA

Information about monitoring systems in commercial broiler production was collected in three countries. In Denmark and Sweden the information was collected in face to face interviews and in Canada via e-mail contact.

### II.1 Interviews in Sweden and Denmark

Interviews have been performed in Sweden and Denmark in April 2012 using the script in Annex III.E. Interviewed parties were the Swedish Board of Agriculture (Statens Jordbruksverk, SJV, Ms Kristina Odén) and the Danish Veterinary and Food Administration (Fødevarestyrelsen, FVST, Ms Susanne Krarup Larsen and Ms Birte Broberg). SJV is the central competent authority for animal welfare in Sweden, involved in legislation, policy making and information to operators, farmers and the general public. Ms Odén is an administrator at the section of animal welfare, including animal health. FVST is the central competent authority for animal welfare control in Denmark and under the Ministry of Agriculture, Food and Fisheries responsible for legislation. Ms Krarup Larsen and Ms Broberg are responsible for guidelines and advice on legislation. Ms Broberg is also responsible for the international animal welfare related work for the central competent authority.

### II.2 Description of the broiler and broiler breeder sector in Denmark and Sweden

Table II.1 shows general figures on the size of the broiler and breeder production in both countries. The broiler industry in Sweden has been expanding gradually over the past 15-20 years, with a small increase in the number of houses and a stable house size. However, increasing imports are currently affecting the economy of the Swedish broiler industry in a negative way. In Denmark the number of broiler farms is decreasing but farm size is increasing thus the size of the broiler and broiler breeder sector remains equal. No major changes in the export market are reported.

Table II.1. General characteristics of the broiler and breeder industry in Denmark and Sweden.

|   | Sweden  | Denmark  |
|---|---|--|
| Number of broiler farms                             | 118   | 234  |
| Number of parent stock/grandparent (GP) stock farms | 59  | 60   |
| Number of broilers produced per year                | 79.4 million  | 115 million  |
| Number of breeders (parent and GP stock)            | 427 000   | No figures available   |
| Share of breeds                                     | Ross (60%), Cobb (40%), only fast growing strains <sup>1</sup>          | Ross fast growing strain (>90-95%), Ross slower growing strain, Hubbard 757  |
| Farm size (number of birds)                         | 40 000 (20 000 – 120 000)   | 50 000 – 100 000   |
| Number of slaughter plants                          | 5 <sup>2</sup>  | 4 <sup>2,3</sup>   |
| Percentage self sufficiency                         | 70%   | 146%   |
| Economic value of the broiler production chain      | No information available  | No information available   |
| Import of meat                                      | 58 800 tonnes/year  | 91 484 tonnes/year   |
| Import of breeding stock                            | GP stock only, no figures available                                     | No figures available   |
| Export of meat                                      | 16 600 tonnes/year  | 131 884 tonnes/year  |
| Export of hatching eggs and chickens                | Export of day old chicks (no figures available). No export of broilers. | Large export of day-old chicks including to 3 <sup>rd</sup> countries, no figures available.<br>9.38 million broilers for slaughter <sup>4</sup> . |
| Pure lines and GP stock present                     | No pure lines.  | No pure lines and GP stock.  |

|  |   |  |
|--|---|--|
|  | GP and PS stock imported as day-old chicks, $\pm$ 25 flocks/year. |  |
|--|---|--|

<sup>1</sup>Fast growing broiler strains are used for organic production. This is only a very small percentage of the total production.

<sup>2</sup>Slaughterhouses of significant size, thus excluding very small plants.

<sup>3</sup>Three plants licenced for export.

<sup>4</sup>Mainly to The Netherlands and Germany.

### II.3 National policies in Denmark and Sweden with respect to broiler welfare

Both countries completely implemented the EC Council Directive on the welfare of chickens kept for meat production (Council Directive 2007/43/EC) in the national legislation.

In Sweden the EC Council Directive is implemented into the Swedish Regulation and general recommendations on animal husbandry in agriculture<sup>167</sup>, and partly also into the official animal welfare programme of the Swedish Poultry Meat Association (SPMA), regarding the requirements on stocking densities above minimum animal welfare standard. The first (Swedish Regulation, L100) also includes national legislation which is stricter than the EC Council Directive. The animal welfare programme of the Swedish Poultry Meat Association has been approved by the Swedish Board of Agriculture and outlines a number of requirements, of which several go beyond legislation requirements, in relation to broiler housing and management. Other relevant regulations are the Swedish Welfare Act<sup>168</sup> and Ordinance<sup>169</sup>. In Sweden animal welfare and sustainability issues are perceived as important by consumers, producers and policy makers, although it is perceived that there is still room for improvement. Consumers prefer Swedish products (probably based on the reputation being free from Salmonella, plus animal welfare and environmental aspects). Imported products go to restaurants, catering etc.

In Denmark the national legislation partly goes beyond the EU Council Directive requirements. Relevant national legislation is 'Bekendtgørelse af lov om hold af slagtekyllinger' (broiler husbandry), 'Bekendtgørelse om hold af slagtrekyllinger og rugeægproduktion' (broilers and production of hatching eggs), and 'Bekendtgørelse om uddannelse og kvalifikationer ved hold af slagtekyllinger (training and qualifications for the broiler industry). The Danish authorities have adopted the rules perceived as necessary for an acceptable standard of broiler production. There is a large interest in broiler production, both from the general public and from animal welfare organisations.

Table II.2 lists the main welfare problems in the broiler production sector as perceived by the competent authorities in both countries, as well as how these (to their opinion) could be solved. Competent authorities of both countries mention leg problems and foot pad dermatitis as main welfare problems in broilers, but have a different opinion about other important problems (Table II.2).

*Table II.2. Main welfare problems as perceived by the competent authorities in Sweden and Denmark, as well as how these to their opinion can be solved. Note that this table illustrates the perception of the authorities, and is not necessarily supported by data.*

| Sweden              |                       | Denmark             |   |
|---------------------|-----------------------|---------------------|---|
| Welfare problem     | How to solve          | Welfare Problem     | How to solve                                    |
| Leg problems        | Breeding, nutrition   | Leg problems        | Breeding, management including light programmes |
| Foot pad dermatitis | Management, nutrition | Foot pad dermatitis | Management, including light programmes          |

<sup>167</sup> SJVFS 2010:15, Statens jordbruksverks föreskrifter och allmänna råd om djurhållning inom lantbruket mm, Saknr L100

<sup>168</sup> SFS1998:534, Saknr L1

<sup>169</sup> SFS1988:539, Saknr L2



|   |  |  |                                     |
|---|--|--|-------------------------------------|
| Catching, transport and slaughter (chain) | Management, knowledge/training of staff, logistics, surveillance | Genetically related problems (related to fast growth rate) | Breeding <sup>1</sup>               |
| Shackling of live, conscious birds        | Shift to gas stunning in transport modules                       | Feed restriction in breeding stock                         | Housing and management <sup>2</sup> |

<sup>1</sup> There can be only little influence on breeding programmes and prioritisation of welfare in selection process and programmes, as these are done abroad.

<sup>2</sup> Are currently not regulated in detail in Denmark.

## II.4 Monitoring of animal welfare traits: Sweden

### Monitoring programmes and traits

Animal welfare is inspected on the farms, mainly by resource-based and management-based measures in accordance with the EU Broiler Directive (such as light intensity, stocking density, availability of feed and water, alarm system, litter, etc). This is done by official animal welfare inspectors employed by the Country Administrative Boards. The National Board of Agriculture is responsible for the methodology. Cut-off levels can be found in the legislation (in accordance with the Broiler Directive for broiler farms) with respect to for example stocking density, light intensity, space at feeders and drinkers, number of birds in shed where alarm system is requested etcetera. Monitoring is done at all levels, thus at grand parent, parent stock and broiler farms. There are no GGP flocks in Sweden.

Industry-initiated on-farm inspections by the Swedish Poultry Meat Association (SMPA) are carried out by the national reference person, who is not employed by the SPMA, but not seen as a third-party audit. These inspections include broiler, grand-parent and parent stock flocks. The inspections also cover some animal-based measures such as flock uniformity, mortality, plumage cleanliness and lameness. None of these animal based measures are measured according to a particular standard or in a standardized way to a given threshold level, although it is indicated that an inspector will certainly react if there are many lame or dirty animals or the flock is obviously uneven. Animal-based measures are also recorded at slaughter. Prevalence and severity of foot-pad dermatitis (FPD) is routinely recorded at 100 birds from each flock sent to slaughter. The methodology has been developed by the Swedish University of Agricultural Science<sup>170</sup>. Cut-off levels (a total score of 40 and 80 points out of a maximum of 200 points for the two levels given) are unchanged, but the weighting factor has been changed in the 1990's (score 1 multiplied by 0.5 instead of 1). This was done in order to increase the relative importance of the severe (class 2) lesions. A flock score is calculated as follows: flock FPD score = (number of feet with score 0 \* 0) + (number of feet with score 1 \* 0.5) + (number of feet with score 2\*2)\*100/total number of feet scored. One hundred feet per flock are assessed. FPD monitoring is only done in broilers. If too high levels of foot pad dermatitis are observed (scores above 80 points) in a flock the stocking density should be temporarily reduced for the following batches until the problem has been solved. If no improvement is seen, further reduction of stocking density can be requested. If scores are between 40 and 80 points, the farmer will receive a warning/attention note and specific advice related to how to reduce the prevalence of foot pad dermatitis in the following next flocks.

In addition, as part of the mandatory meat inspection system, all birds slaughtered are inspected on the slaughter line by assistants under veterinary supervision. This includes welfare-relevant records such as emaciated birds, birds with ascites, birds displaying swollen hock joints or other apparent leg problems, birds with fractures, bruises, birds dead on arrival (DOA), birds with pathological changes in heart or lungs, muscle disorders etc. These records are reported by the official veterinarians at the slaughterhouses to the National food Administration (central competent authority for food safety), who is also responsible for the methodology. No cut-off levels apply but if levels are unusually high the Country

<sup>170</sup> Ekstrand, C., Carpenter, T.E., Andersson, I., Algers, B., 1998. Prevalence and control of foot-pad dermatitis in broilers in Sweden. British Poultry Science, 39: 318-324.

Administrative Board will be notified and an on-farm inspection will be carried out. Grand-parent, parent stock and broilers are monitored. The meat inspection system is the same for broilers, parent and grand-parent stock at slaughter. All farmers will receive a summary list of all rejections/downgrading and the reason behind them. Producers continuously monitor their flocks for any signs of lameness and cull lame birds, but this is not part of any standardized national monitoring system and not reported centrally. Mortality is recorded as required by Swedish legislation implementing the Broiler Directive and can be checked by any inspector.

Above described monitoring programmes have been running in the past ten years and there are no future changes planned in the welfare monitoring.

### Legal basis, institutional and practical arrangements

The legal basis for monitoring of broiler welfare is the Swedish Regulation and general recommendations on animal husbandry in agriculture<sup>171</sup> which also includes the possibilities of linking to the producer-initiated programmes. Also the EU hygiene package (882/2004 and 854/2004), and The Swedish Animal Welfare Act<sup>172</sup> and Ordinance<sup>173</sup> are included in the legal basis. The Swedish Board of Agriculture writes the legislation and coordinates the Country Administrative Boards. There are 21 of these Country Administrative Boards that employ animal welfare inspectors that are responsible for routine controls, including on-farm controls if the veterinarians on the slaughterhouses find alarming levels of injuries or disease. The animal welfare inspectors usually have 2-3 years university education in animal welfare, ethology, and control systems.

The National Food Administration employs the official veterinarians at the slaughterhouses, who are responsible for meat inspection including the signs of poor welfare as listed above. The Swedish Poultry Meat Association designs and runs the voluntarily broiler welfare programme with participation of 99% of the Swedish Broiler Producers. Prosanitas is the company carrying out the independent audits of broiler welfare during transport and slaughter. Official assistants carry out the routine controls of meat inspection and foot pad dermatitis at slaughter under the supervision of the official veterinarians. The assistants are employed by the food business operator, but have received special training both for general meat inspection and for the classification of foot-pad dermatitis. For foot pad dermatitis, standardization exercises have been carried out to compare with a 'golden standard', but no formal examination is done. The official veterinarians have gone through standard veterinary education at the university.

### Number of farms, slaughterhouses and broilers involved

The official animal welfare control (on-farm inspection) is done at all farms, i.e. 177 grand parent, parent stock and broiler farms. There are no figures on the frequency of visits per year per farm type available. Ninety-nine percent of the 118 broiler farms participate in the Swedish Poultry Meat Association (SPMA) broiler welfare programme. The farms are inspected by the National Standards Officer once every 1-1.5 years. All slaughterhouses that are member of the SPMA broiler welfare programme, i.e. the five major slaughterhouses and possibly also a few minor ones, are involved in the SPMA broiler welfare programme. Approximately 80 million broilers are slaughtered per year. For each flock of broilers, 100 feet are examined for foot pad dermatitis. General meat inspection is done in all slaughtered flocks, i.e. 80 million broilers and 0.5 million parent and grand-parent stock birds. All birds have to be examined for signs of injury, disease or neglect.

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<sup>171</sup> SJVFS 2010:15, Statens jordbruksverks föreskrifter och allmänna råd om djurhållning inom lantbruket mm, Saknr L100

<sup>172</sup> SFS1988:534: SaknrL1

<sup>173</sup> SFS1988:539, SaknrL2

### Trends in animal welfare indicators

After initiation of the SPMA broiler welfare program on foot-pad monitoring, the prevalence of foot-pad dermatitis decreased from 11% severe (class 2) lesions to 3-7% severe lesions on an annual basis. During 2008-2011, however, the prevalence has increased and is now stable at 10-12% severe lesions. The reason for this increase is unknown but probably related to feed composition. Other information, such as mortality figures and production data (feed and water consumption) from broiler as well as (grand)parent flocks are not stored in a central database and therefore not accessible for authorities, other than at individual on-farm inspections. There is also no central database accessible for the authorities with figures on lameness, plumage cleanliness etc. from the industry-initiated farm inspections. However, rejection figures from the slaughterhouses are reported and accessible to the authorities (Swedish Food Agency), but currently not further processed.

### Costs of monitoring programmes

The supervising veterinarians from the National Food Administration are paid by the government. The assistants carrying out the classification of foot-pad lesions are paid by the slaughterhouse. The time for examination of a flock is approximately 10 minutes. Handling of the data and feed-back to producers are paid by the SPMA. For costs is referred to a publication from 1998<sup>174</sup>. According to this publication, taking into account the costs of initiation and loss of production due to severe foot-pad dermatitis, the costs of the programme would be covered by reducing the prevalence of severe foot pad dermatitis from 10% to 9%. This is just a calculation indicating that at the time of this publication, a 1% reduction in foot pad dermatitis should cover the costs of the monitoring program. In reality, the reduction in foot pad dermatitis was substantially larger at the start of the monitoring program. There are no current figures on the costs of the monitoring programme.

### Socio-economic impact of monitoring programmes

There are no figures on the socio-economic impact of the monitoring programmes. The number of birds and slaughterhouses has not changed as a consequence of the monitoring programmes. Some observations at the start of the SPMA monitoring programme were that a few producers with very poor basic standard of buildings and management left the industry. It is generally agreed that the SMPA monitoring programme had led to improvements in housing and management of broilers and the FPD programme has put focus on animal-based welfare indicators. The general effects are however difficult to quantify as other changes, such as improved feed efficiency of the broilers, and genetic changes in growth pattern occurred simultaneously.

### Use of data

The SPMA broiler welfare monitoring programme was initiated to improve production standards, to improve the reputation of the industry and to achieve acceptance for industry practices. The results on foot-pad dermatitis are linked to the broiler welfare programme and the maximum stocking density allowed for each house (if too high levels of foot pad dermatitis are observed, the stocking density should be temporarily reduced until the problem has been solved). There is communication between producers and feed manufacturers related to the foot-pad dermatitis scores. Although it is likely that there is communication between the Swedish broiler breeder companies and their international counterparts, the competent authority is not involved in this.

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<sup>174</sup> Ekstrand et al., 1998.

## II.5 Monitoring of animal welfare traits: Denmark

### Monitoring programmes and traits

Foot-pad dermatitis and dirty plumage have been monitored in all flocks at slaughter since 2001. In addition hock burn, breast blister, dehydration, scratches, crop constipation and enlargement, variation in size (flock uniformity) and runts have been monitored in all flocks at slaughter since 2010. Slaughterhouses record rejections and reason of rejection (categories: runts, ascites, heart, skin, liver, joints, 'other') since January 2007. Mortality has been monitored since 2010 as required by the Broiler Directive (2007/43/EC). Mortality is recorded at slaughter based on information provided by the producer.

Monitoring of foot-pad dermatitis has been the main focus until the Broiler Directive came into force, but nowadays a more systematic approach is applied for the other slaughterhouse measures as well. The foot-pad dermatitis monitoring system has legally been introduced in Denmark in 2001, and the scoring system was launched in 2002, 3-4 months later. There was a transition period before the results of the foot-pad dermatitis scoring did actually have effect on the maximum stocking density allowed. Since 2010 (when the Broiler Directive came into force) the weighting of foot-pad dermatitis scores has changed from 1 for scores 1 to 0.5 for scores 2. Scores 3 are weighted by a factor 2. Calculation of flock scores and cut-off levels are the same as in Sweden. If a flock receives a score between 40-80 points, the farmer should improve the next flock. If the farmer does not succeed for the next flock, the local Veterinary Control Office should do a further investigation. If a flock receives a score of 80 points or higher, a report is sent to the local Veterinary Control Office for further investigation.

For plumage cleanliness, if more than 20% of the birds have 'medium' dirty plumage, the farmer should improve cleanliness of the birds. If the farmer does not succeed in this for the next flock, the local Veterinary Control Office should do a further investigation. If more than 10% of the birds has very dirty plumage, the local Veterinary Control Office should do a further investigation. When hock burn, breast blister, dehydration, scratches, crop constipation and enlargement, variation in size (flock uniformity) or runts are found in 5-20% of the inspected birds the farmer should show improvement in the next flock delivered at the slaughterhouse. If the farmer does not succeed in this for the next flock, the local Veterinary Control Office should do a further investigation. If more than 20% of the birds shows one or more of these problems, the local Veterinary Control Office should do a further investigation. If more than 3 % of the birds in one flock is rejected due to the same disease or if more than 5 % of birds in one flock is rejected due to different diseases the farmer should improve the next flock. If the next flock does not show improvement, a report is sent to the local Veterinary Control Office for further investigation. If severe problems are identified a report is sent to the local Veterinary Control Office for further investigation.

All welfare traits as described above are measured on broilers only and there are no future changes planned.

### Legal basis, institutional and practical arrangements

The legal basis of the broiler welfare monitoring is: (a) Bekendtgørelse af lov om hold af slagtekyllinger (broiler husbandry law), (b) Bekendtgørelse om hold af slagtrekyllinger og rugeægproduktion (broiler and production of hatching eggs legislation), and (c) Bekendtgørelse om uddannelse og kvalifikationer ved hold af slagtekyllinger (legislation on training and qualifications for broiler husbandry). There is also specific legislation about the control on farms: Bekendtgørelse om stikprøvekontrol af velfærd for landbrugsdyr og for heste, som ikke holdes med henblik på landbrugsmæssige formål (legislation about random sampling of animal welfare for farm animals and horses which are not kept for agricultural purposes). In addition the EU hygiene package applies (882/2004).

The on-farm inspections are carried out by veterinarians from the veterinary section of the Danish Veterinary and Food Administration (DVFA). They annually visit and inspect at least 50 broiler farms. The veterinary section of DVFA is also responsible for the inspections at slaughterhouses, but the actual operational control is performed by technicians (assistants). These technicians have received training courses, have practiced, participated in calibration courses and, for foot-pad dermatitis, participated in a system of test classifications before they were given the task. Veterinarians from the veterinary section of DVFA perform the possible follow-up on-farm inspection.

### **Number of farms, slaughterhouses and broilers involved**

All slaughterhouses, thus the four large ones and possibly some minor ones, are involved in the monitoring programme. All flocks slaughtered in Denmark (92% of the broilers, i.e. 106 million broilers) are involved in the monitoring programme. For foot-pad dermatitis, a sample of 100 feet per flock is used. Some feed-back is received from flocks slaughtered in The Netherlands, but this information is currently not used. For classification of plumage cleanliness, specific guidelines on how to assess this in the transport modules at the slaughterhouse are available. Basically, a systematic sample is taken from all flocks (10% of the crates or modules and if problems are detected in one or more crates or modules at least 200 birds should be further inspected). Hock burn, breast blister, dehydration, scratches, crop constipation and enlargement, variation in size (flock uniformity) and runts are scored at the slaughter line in 200 birds per flock. All birds at the slaughter line are inspected for diseases.

### **Trends in animal welfare indicators**

At start of the monitoring programme (2002) foot-pad dermatitis scores were 33% score 0 (no lesions), 43% score 1 (mild lesions) and 24% score 2 (severe lesions). In 2005 this was reduced to 64% score 0, 27% score 1, 9% score 2, and the figures are relatively stable since then. There is some seasonal variation. The competent authorities were not able to provide any data yet on trends in the welfare indicators collected since 2010, i.e. hock burn, breast blister, dehydration, scratches, crop constipation and enlargement, variation in size (flock uniformity) and runts. Concerning the rejections at slaughter the figures are with the industry, although the Danish Veterinary and Food Administration may have access upon request. If there has been any problem in plumage cleanliness for a flock the Veterinarian Control office has reacted but there is no central data registration.

### **Costs of monitoring programmes**

The producers pay a fee for participation in the foot-pad dermatitis monitoring programme (640 DKK for each flock delivered according to Bekendtgørelse af lov om hold af slagtekyllinger (broiler husbandry law) af 22 juni 2011, §18, stk. 1). There is currently no discussion on this fee. The other traits are part of the general control, covered by the general meat control system. The slaughterhouses pay a fee for the official veterinarians, and the technicians employed by the slaughterhouses.

### **Socio-economic impact of monitoring programmes**

There are no figures on the socio-economic impact of the monitoring programmes. The number of farms or broilers has not been changed as a consequence of the monitoring programme. There are other reasons behind the structural changes, such as the Mohammed drawings crisis, increased competition from South America and the bird flu crisis.

### **Use of data**

The foot-pad dermatitis monitoring data are used for feed-back to the DVFA. In case of any problems there will be a follow-up for the farmer (improvement of the next flock or report to the local Veterinary Office for further inspection if levels are too high or the farmer does not improve its next flock). There is a computerized data base, which is accessible over the Internet for both producers and veterinarians. The data base is a voluntarily industry-initiated system in which most, but not all producers participate. There might possibly be some feed-back from the industry to the breeders but the competent authorities are not involved in this. Other data such as plumage cleanliness or hock burn are currently not stored in a

data base. The Competent Authorities are waiting for a decision on EU level about the intended plan on data collection in broiler slaughterhouses according to article 6.2 in the Broiler Directive.

## II.6 Views towards the future

The Swedish competent authorities believe that there will still be both official animal welfare control and own or industry-initiated control. Hopefully there will be further improvements in coordination between different initiatives and inspections, and also improved transparency.

The Danish competent authorities believe that every EU country should agree on one level, one monitoring system, with the same cut-off levels for everyone. Foot-pad dermatitis is a useful indicator to start off with. There should be a standardized feed-back reporting system that works also between member states, as birds are often reared in one member state but slaughtered in another member state. The current use of mortality within the EU Broiler Directive is questioned as specific cut-off for stocking density. The experience in Denmark is that some producers that are alert and good at culling sick birds will end up close to the maximum allowed mortality rate and therefore reduce the culling rate, which is not beneficial from a welfare point of view. An alternative may be to use the ration of culled out of the total mortality, but this will probably difficult to control in practice.

## II.7 Monitoring of condemned broilers in slaughterhouses in Canada

### Description of the broiler production sector in Canada

The Canadian chicken industry operates under a system known as 'supply management'. This system matches production to demand within Canada. The system has three pillars: production planning, import control and producer pricing. Canada is just one of the few countries in the world with full control of production on poultry farms. Imports are controlled by tariff rate quotas in order to match supply and demand and to have stable food prices. The Canadian chicken industry produced in 2011 around 1 million ton chicken meat. Canada is ranked 15th listing the leading chicken producing countries. Compared to the USA (16 million ton) and the EU (9 million ton) Canada is a small chicken meat producer. Chicken export in 2011 (with USA as important destination) were around 0,120 million ton and imports were 0,16 million ton (mainly from USA and Brazil). It can be stated that Canada is self-sufficient for chicken meat. Canada has 2700 broiler farmers delivering broilers to 186 poultry processing plants.

### Monitoring condemned broilers

In Canada animal welfare gets serious attention. The Canadian Food Inspection Agency (CFIA) ensures that birds are treated humanely at farm level, during transport and also in the poultry slaughterhouse establishments. Chapter 12 of CFIA's Meat Hygiene Manual of Procedures<sup>175</sup> specifically provides guidance on Animal Welfare topics. The Canadian Food Inspection Agency (CFIA) verifies that meat and poultry products leaving federally-inspected establishments are safe and wholesome. The CFIA also monitors the condemnation and rejection of poultry. The results of this monitoring are reported. Effective April 1st, 2011, the CFIA switched from issuing or signing condemnation or rejection certificates for poultry to a "Poultry Condemnation Report", or to a "Poultry Rejection Process Control Evaluation Report", as applicable, for each lot of poultry for which the operator issues a Condemnation/Rejection report. A lot of poultry refers to a truckload of live poultry or all of the poultry sourced from one producer/grower for a production shift or one floor of a barn.

Figure II.1 gives an example of a report with the results in recent years. The comments section of the preceding reports may be used by the CFIA veterinarian for reporting on abnormal levels of condemnations or rejections, special lot conditions and/or new carcass deviations, or whenever a CFIA

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<sup>175</sup> <http://www.inspection.gc.ca/english/fssa/meavia/man/ch12/table12e.shtml>



official performs carcass-by-carcass detailed veterinary inspections. Such carcasses entered on the CFIA report should be included in the related operator's condemnation/rejection report and must be included in the monthly report. The largest cause of condemnations is "subcutaneous conditions". These are caused by E. coli infections and are largely a hygiene issue in the slaughterhouse and less of a welfare issue.

To collect information on the Canada monitoring program we did send a questionnaire to the CFIA. Dr Sukhpal Deol, national poultry Specialist of the Meat Programs Division, resulting in the following additional information. CFIA's Veterinarians are responsible for monitoring of the condemned broilers in slaughterhouses. Chapter 19 of Meat Hygiene Manual of Procedures 176 specifically deals with Poultry Inspection Programs. It is a compulsory program. CFIA Veterinarians and inspectors have full time presence in Canadian Poultry slaughter houses during evisceration procedures. Government pays for Inspection Staff salaries. The government recovers partial cost of providing service to regulated parties. CFIA Veterinarian provides feedback to farmers through signing condemn certificates (Establishments under Traditional Inspection) or rejection certificates (Establishment under Modernized Poultry Inspection Program). CFIA does however not provide any direct feedback from slaughter houses to poultry breeders.


|   |                                  |                                       |                |             |  |
|---|----------------------------------|---------------------------------------|----------------|-------------|--|
|    | Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada |                |             |  |
| <u>Poultry Condemnation Report by Species</u>   |                                  |                                       |                |             |  |
| 2011 - CONDEMNED PER 10,000 SLAUGHTERED   |                                  |                                       |                |             |  |
| Chicken   |                                  |                                       |                |             |  |
|   | CANADA 2011                      | CANADA 2010                           | CANADA 2009    | CANADA 2008 |  |
| TOTAL   | 137.34                           | 139.53                                | 152.74         | 160.05      |  |
| Number Found Dead   | 31.14                            | 32.02                                 | 37.97          | 35.33       |  |
| Conditions Total  | 106.20                           | 107.51                                | 114.77         | 124.72      |  |
| Sub-Cutaneous Conditions  | 69.03                            | 69.29                                 | 74.25          | 79.04       |  |
| Liver Conditions  | 9.89                             | 11.34                                 | 11.47          | 9.12        |  |
| Abdominal Oedema  | 8.29                             | 6.81                                  | 6.38           | 7.84        |  |
| Respiratory Conditions  | 8.24                             | 8.52                                  | 9.31           | 8.74        |  |
| Dark Coloured Carcasses   | 5.05                             | 5.33                                  | 5.68           | 6.09        |  |
| Emaciation  | 1.53                             | 1.84                                  | 1.99           | 2.63        |  |
| Others  | 1.42                             | 1.66                                  | 1.98           | 1.63        |  |
| Inadequate Bleeding   | 1.02                             | 0.98                                  | 1.36           | 1.25        |  |
| Bruising  | 0.70                             | 0.81                                  | 1.21           | 1.36        |  |
| Leg Conditions  | 0.52                             | 0.63                                  | 0.73           | 0.83        |  |
| Skin Conditions   | 0.51                             | 0.30                                  | 0.44           | 0.38        |  |
| Contamination   |                                  |                                       |                | 1.71        |  |
| Loss Of Identity  |                                  |                                       |                | 0.50        |  |
| Mutilation  |                                  |                                       |                | 2.67        |  |
| Overscald   |                                  |                                       |                | 0.93        |  |
| SLAUGHTERED   | 618,931,644                      | 622,053,891                           | 615,667,910.00 | 621,723,076 |  |
| Average Weight in KG  | 1.65                             | 1.64                                  | 1.63           | 1.81        |  |
| Source: Canadian Food Inspection Agency, as compiled by AAFC, Poultry Section   |                                  |                                       |                |             |  |
| Printed: 23-Mar-12 8:00:37 AM   |                                  |                                       |                |             |  |
| AIMIS   |                                  |                                       |                |             |  |
| <a href="http://www3.agr.gc.ca/apps/aimis-simia/rp/index-eng.cfm?menupos=1.01.06&amp;R=133&amp;LANG=EN&amp;ACTION=pR&amp;PDCTC=">http://www3.agr.gc.ca/apps/aimis-simia/rp/index-eng.cfm?menupos=1.01.06&amp;R=133&amp;LANG=EN&amp;ACTION=pR&amp;PDCTC=</a> |                                  |                                       |                |             |  |

Figure II.1. Example of a poultry condemnation report for broilers<sup>177</sup>

<sup>176</sup> <http://www.inspection.gc.ca/english/fssa/meavia/man/ch19/table19e.shtml>

<sup>177</sup> [http://www.agr.gc.ca/poultry-volaille/condmn\\_eng.htm# chicken](http://www.agr.gc.ca/poultry-volaille/condmn_eng.htm# chicken)



## II.8 Conclusions from the specific welfare monitoring schemes

Important information, that also might be standardised, can be obtained per flock at the slaughterhouse. Due to food safety regulations broilers are individually inspected already. Data on skin lesions (hocks, feet, breast), injuries, leg deformities, condemnations and uniformity provide an indication of health and wellbeing of the flock. The data from Denmark and Sweden indicate that there is a clear favourable response, if feet and/or hocks are scored at the slaughterhouse. The data from Canada indicate, that most lesions occur at a low level and the trend is towards less condemnations.

In accordance with the opinion from Denmark, it could be worthwhile to examine the introduction of standardised inspections of broiler flocks in the slaughterhouse and include registration of data on foot and hock problems in those inspections. As registration is on a flock basis also information on differences between hatcheries and feed manufacturers can be analysed. Benchmarking genotype, hatchery and feed manufacturer will stimulate reduction of foot and hock problems more effectively than benchmarking on genotype alone.

Incorporation of agreed cut off levels then could be considered across the EU in the Directive on broiler production. Important aspects for further examination are the costs of such inspections, as from the information from the 3 countries examined no clear information on such inspection costs could be disclosed.

The EU-funded EADGENE subproject 'data comparison', has investigated the data collection and sharing systems on cattle, pig and poultry in a range of EU countries. It was concluded that standardisation and comparability of data across countries would be important to improve health, but it can also be used to show welfare status at the farm or slaughterhouse level.