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in animal welfare

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# List of abbreviations

| | |
|---|---|
| BIN | National Level Broiler Innovation Network |
| BP | Best Practice |
| $CO_2$ | Carbon dioxide |
| GP | Good Practice |
| GPET | Good Practice Evaluation Tool |
| $NH_3$ | Ammonia |
| TEN | Thematic Expert Network |

# Executive Summary

This report summarizes the results for the Broiler*N*et WP 3 "Animal welfare". The three priority challenges that were identified by the National Level Broiler*N*et Innovation Network (**BIN**) groups of each participating country were "Farmer training", "Genetics & Breeding", and "Barn climate". The BINs proposed in total 43 Good Practices (**GP**) as innovative best practice solutions to the identified challenges. Those GPs were evaluated by the Thematic Expert Network (**TEN**) with the use of the Good Practice Evaluation Tool (**GPET**). This evaluation resulted in a Top 10 of GPs for each challenge, out of which the TEN selected a Top 5 of Best Practices (**BP**) based on the technical quality, impact, and probability of success of a GP. For each challenge, one BP was awarded as Broiler*N*et Champion. The Broiler*N*et Champions were "Internal audits regarding on-farm euthanasia" (Farmer training), "Elevated platforms as enrichment material" (Genetics & Breeding), and "Foot Health Program" (Barn climate). In addition, a literature review was conducted with regard to the three challenges, which is also briefly described in this report.

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# Chapter 1: Introduction of the three challenges

## 1.1 Farmer training

Nowadays, broiler farmers are operating in a context that requires them to acquire more knowledge and skills given the rising public concern for sustainability and animal welfare besides the rapidly evolving information technologies (Rios et al., 2020; Azarpajouh et al., 2022; European Commission, 2023). For instance, on-farm animal welfare assessment is rapidly evolving due to the development and utilization of new information technologies. Sensors, cameras, machine learning, wireless systems, and mobile software applications are all elements of the information revolution called Smart Farming/Precision Livestock Farming (Li et al., 2020; Rios et al., 2020; Azarpajouh et al., 2022). Many of these technologies are now being applied to animal production systems to help in the management of farms and to better control an animals' condition and their environment through automated capturing, measuring, and processing great volumes of data in real time (Rios et al., 2020). Accordingly, the great potential of information technologies relies on early warning, which allows farmers to take timely actions at early stages of welfare problems or diseases (Li et al., 2020). Yet, most farmers do not have the skills to utilize new technologies effectively, and it is time consuming to combine and analyse the data coming from sensors in different formats and frequencies (van Hertem et al., 2017; Azarpajouh et al., 2022;). Training farmers how to use sensor data can enhance the utilization of the data for effective monitoring (van Hertem et al., 2017). Moreover, there are also other welfare topics that may require more knowledge that is practical. For instance, situations will arise that require animals to be euthanized, yet knowledge about on-farm killing methods and legislative restrictions (e.g. the limitations on body weight and number of birds that may be killed by one person per day) seems to be rather low among broiler producers (Linares et al., 2018; Rioja-Lang et al., 2019; Watteyn et al., 2020; Woods and Shearer, 2021). Additionally, nowadays many farm workers come from abroad, which can cause difficulties regarding communication on farm during daily farm routines but also during training events (EuroGroup for Animals, 2020). Multilingual training on, for instance, national regulations for broiler welfare and handling may reduce the risk for welfare problems due to a lack of knowledge among farm personnel (Rioja-Lang et al., 2019; Grandin, 2021).

Although training exists for certain professionals such as veterinarians and animal scientists, there is a great need for training related to animal welfare for people engaged in handling, transport, slaughter and euthanasia (Fraser et al., 2009; Rioja-Lang et al., 2019). Training can help to create awareness of animal welfare and a greater understanding of the significance of animal welfare for successful animal production (Fraser et al., 2009; Yang et al., 2023). Moreover, training may ultimately lead to the implementation of new procedures that improve animal welfare outcomes (Fraser et al., 2009; van Hertem et al., 2017; Ceballos et al., 2018). Generally, training refers to the process of teaching a particular skill or type of behaviour through practice and instruction over a period of time. This can be achieved through online or onsite training. Online training offers opportunities for compact knowledge transfer in a short time period by using for example video material (Michaelis et al., 2022; Yang et al., 2023; Leicher, 2023). The absence of travel hours and travel expenses contributes to a higher training efficiency, although on-site training events are considered suitable occasions for the sector participants to meet and interact (Michaelis et al., 2022). Granting there is a trend for digitalization, on-site training could be less at risk of failure from technical equipment (Michaelis et al., 2022; Yang et al., 2023; Leicher, 2023). Overall, the development of effective education, training and intervention programs is required to reduce animal suffering and increase the implementation of good animal welfare practices in the broiler sector (Fraser et al., 2009; Rioja-Lang et al., 2019).

## 1.2 Genetics & Breeding

Since the 1950s, the demand for chicken products such as eggs and meat increased, which has led to a specialisation of production directions and breeding goals. This specialisation resulted in two

different breeding targets, such as high laying performance and high fattening performance, which are negatively correlated. As a result, hybrids were bred for laying and meat production. Over the last decades, the efficiency of the growth rate of fast-growing broiler chickens increased by over 400% (Zuidhof et al., 2014). The focus on the efficiency of growth rate and feed conversion has affected other traits negatively (Nielsen et al., 2023). Various animal welfare issues such as leg disorder, cardiovascular diseases, high mortality, bone problems, and foot quality can be directly linked to rapid growth (Hartcher and Lum, 2020; Nielsen et al., 2023). These problems lead to economic losses on the one hand and poor animal welfare on the other. In addition, consumer demand for better-reared animals plays a major role in modern livestock farming. For this reason, slower-growing breeds are increasingly receiving attention, because they show fewer welfare problems due to genetic predisposition and exhibit higher welfare regardless of the husbandry conditions, for instance, slower growing chickens show more natural behaviour such as pecking and scratching or comfort behaviour.

Fast- and slower growing breeds differ in growth rate, behaviour and body composition (Torrey et al., 2021). The growth rate of fast-growing hybrids is over 60 g/d, usually even 70 g/d depends from the target body weight. In contrast, slower-growing breeds reach the same weight (i.e. 2 kg live body weight) in more days or take twice as long (growth rate 28-53 g/d). The high growth rate of fast-growing broilers is achieved through long feeding and resting times compared to slower-growing genetics (Dixon 2020). This results in less activity time (Malchow et al., 2019a) away from the feed trough, which can lead to longer lying times in the litter and increased incidences of foot pad lesions and hock burns. Natural behaviours such as pecking, scratching or comfort behaviour are hardly observed in fast-growing genetics (Nielsen et al., 2023), and commercial husbandry systems do not support opportunities to express them. The animals are often kept in low-stimulus housing environments, with food and watering lines and littered floors provided. To support natural behaviour patterns in young chickens, for instance, pecking materials and elevated structures in form of perches and platforms can be provided (Riber et al., 2018). The enrichment of housing conditions with various elements has a positive effect on activity and walking ability in broiler chickens that can be improve broiler welfare (Wallenbeck et al., 2016; Riber et al., 2018; Malchow et al., 2019b), regardless the growth intensity. Overall, housing conditions can be adapted to the different genetics, as fast-growing broilers use environmental enrichment differently compared to slower-growing broilers (i.e. they are less mobile due to their body weight). However, broiler welfare can only be improved on the long term through genetic selection, as this influences growth rates, feed conversion rates and predispositions. In order to produce a general welfare and health improvement, especially for fast-growing broilers, other traits such as foot pad condition and walking ability must also be included in genetic selection (Hartcher and Lum, 2020).

## 1.3 Barn climate

Animal health is an important welfare indicator (EFSA, 2012). In broiler production, barn climate has a major impact on the well-being of the chickens, and thus also on the economic results. Whether the climate in the barn is right depends on many factors that constantly vary and influence each other. The most important components of the stable climate are air temperature, relative air humidity, air velocity, ammonia (**$NH_3$**) and carbon dioxide (**$CO_2$**) concentration (Moura et al., 2010; Almuhanna et al., 2011) Understanding and controlling these environmental conditions is critical to successful poultry production and animal welfare.

Heat stress is one of the most important environmental stress factors affecting poultry production worldwide (Lara and Rostagno, 2013; Wasti et al., 2020). Heat stress, together with high stocking density, are the main cause of impaired performance in broilers (Goo et al., 2019). As explained by Wasti et al. (2020), there is a connection between heat stress and body weight gain, feed intake, feed conversation rate and mortality of broiler chickens, and pointed out the importance of controlling ambient temperature in this context. At high ambient temperatures feed intake decreased, which results in economic losses in the event of heat stress (Mascarenhas et al., 2018; Kpomasse et al. 2021). Most commercial poultry barns worldwide are standardly equipped with a combination of tunnel ventilation and evaporative cooling system to overcome heat stress (Brink et al. 2022). According to Brink et al. (2022), these systems tend to saturate the house air with moisture (>70% relative humidity), which counteracts the bird's physiological ability to cool itself

through hyperventilation (evaporative heat loss). Additionally, an increase in humidity can lead to an increase in litter moisture and increased litter moisture content not only caused severe footpad dermatitis, but also reduced broiler performance and carcass yield and negatively impacted other aspects of welfare (de Jong et al., 2014). Moreover, litter moisture has been proven to be a main cause of footpad lesions (Toppel et al., 2019). This is a painful condition (de Jong et al., 2014), and major welfare issue in broiler production (Rioja-Lang et al., 2020).

Overall, barn climate and litter quality control are significant welfare concerns to the broiler industry (de Jong et al., 2014; Rioja-Lang et al., 2020; Oluwagbenga and Fraley, 2023) and this concern will intensify as climate change continues to elevate environmental temperatures. Therefore, environmental strategies focused on enhancing management practices, such as optimizing ventilation systems, poultry house designs, and adjusting stocking density, are needed (Oluwagbenga and Fraley, 2023) to improve animal welfare.

# Chapter 2: Overview and description of the literature database

In order the facilitate knowledge exchange among relevant stakeholders within the European broiler sector, a database was established containing both scientific and grey literature. The database consists of, among others, scientific research and review papers, practical guidelines, project reports, and industry reports. Those sources relate to all three challenges for animal welfare and can contain knowledge about broiler welfare and examples of potential good practices.

***Development of the database*** For each challenge both scientific and practice-based knowledge were collected. To this end, Web of Science and Google Scholar were used to search for scientific literature, and search engine Google was used to search for grey literature. For the challenge "Farmer training", the search criteria included: (stock-keepers OR stockmen OR farmers OR producers OR farm personnel) AND (training OR education OR best practices) AND (animal OR broiler) welfare. For the challenge "Genetics & Breeding", search criteria included: broiler chickens AND genetic AND animal welfare, broiler AND (slow growing OR fast growing) AND activity, and broiler housing system AND genetic; Masthühner AND langsam wachsende AND schnell wachsende. For the challenge "Barn climate", search criteria consisted of: (broiler OR welfare) AND (stable climate OR climate OR thermal comfort OR ventilation OR weather OR heat stress OR stocking density OR featherless OR wintergarten OR sprinkler OR gas) AND (improve OR feeding OR free range OR reduce OR litter OR growth rate OR floor OR elevated structures). Only those sources with full text available and English or German language were included. Other exclusion criteria were relevance, sources published prior to 2010, and publications about backyard production systems.

***Usage of the database*** In total the database includes 141 references. For the purpose of simple and quick searching, key words are available for each source within the database. Those could be used by the end user to downgrade the number of sources within the database. For each source, not only the author and reference details are listed, but also an original abstract plus summarized main results of the source are included. By these means, the end user can find the most important information directly inside the database, although a digital object identifier/website link to the original source is also available. The database for animal welfare can be found as separate file.

# Chapter 3: Good Practices

## 3.1 Short description of the GPET

The GPET was used by the TEN to evaluate the good practices suggested by the BINs. In total 43 good practices were brought forward by the facilitators of the 13 countries (see Table 1-3). Good practices were scored based on their technical quality, impact on the sector, and probability of success using a 3-point scale. Experts assigned scores and comments to each good practice listed. For each good practice, the mean score of the TEN was calculated and used to identify the Top 10 of good practices for each challenge.

## 3.2 Overview of all Good Practices including GPET results

### 3.2.1 Farmer training

A total of 16 different good practices from ten partner countries were collected for the challenge "Farmer training" (Tab. 1).

*Table 1. Overview of all good practices for the challenge "Farmer training" including scoring results of the GPET, ranking and a short description*

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Farmer training | Online | Training materials for farmers (through tutorials, webinars, or on-demand training) | France | 38.2 | 1 | Tutorials on the use of barn equipment, webinars on specific topics (i.e., ethology and the needs of chickens), and on-demand training courses at the request of rearing technicians targeting farmer. |
| Farmer training | Online | ITW annual online training | Germany | 36.7 | 2 | The "Initiative Tierwohl (ITW)" is an alliance of food retailers, farmers and the meat industry. One of the conditions of ITW is to participating annual training. In addition to various face-to-face events, there is an online training program. This includes comprehensive training for poultry farmers and caretaker. |
| Farmer training | In person | Training farmers to master the house atmosphere | France | 36.7 | 3 | In order to apply management procedures routinely and also to learn new techniques, it is necessary to have regular training and practices in dealing with organisation tools. |
| Farmer training | In person | Training course for keepers of chickens kept for meat production | Italy | 36.4 | 4 | The keepers of the chickens must take a part of a specific training course and they shall hold a certificate that is recognised by the Competent Authority, attesting to the completion of such a training course including methods of culling practised in holdings, to persons employed or engaged by them to attend to chickens or to catch and load them. |

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Farmer training | In person | Educating and involving the staff in animal welfare | Sweden | 36.1 | 5 | It is important that the staff knows WHY certain routines are carried out and that the staff is involved in evaluation of both production- and animal welfare parameters after each flock. All staff have to fill in a daily diary about the flock. |
| Farmer training | In person | Training on Farm Micro Climate Management | Greece | 35,6 | 6 | The farmer will be trained on evaluating and managing the microclimate of the broiler farm. This training can possibly reduce broiler stress. Animal scientists and veterinarians are training the farmer to assess microclimate conditions and provide relevant training material. |
| Farmer training | In person | Internal audits | Spain | 35.2 | 7 | All farmers are trained on animal welfare in Spain by law. Euthanasia of unfit animals is of utmost importance on welfare grounds. However, training certifications do not guarantee that the farmers euthanise unfit animals. For this reason, the integrator company internally audits the farm to verify if the farmer is euthanising unfit animals. If they detect an abnormally high prevalence of animals with moderate or severe lameness, it means that the farmer is not euthanising unfit animals. |
| Farmer training | Exchange | Exchange group between farmers | France | 35.0 | 8 | Building of an independent network group consisting of poultry farmers. The purpose of the group is to exchange and share good practices, questions, and difficulties related to a chosen theme for each meeting. Meetings are planned for two to three times per year. |
| Farmer training | Device | Stunning device for culling suffering birds | Italy | 34.6 | 9 | It is an instrument for electrically stunning suffering chickens before subjecting them to cervical dislocation and bleeding. The good practice was developed to facilitate the application by farmers of European Regulation 1099/2009 and European Directive 43/2008. |
| Farmer training | Label | Animal Welfare Labelling | France | 34.5 | 10 | The Animal Welfare Labelling Association (AEBEA), in collaboration with NGOs, production organizations, and distributors & restaurateurs, has created a label based on 235 criteria tracing their welfare from pre-birth to slaughter, evaluated through annual audits. The label score ranging from A to E and indicates the production method. It is a voluntary initiative. |

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Farmer training | Device | Mechanical broiler catching/loading in darkness by applying the newest catching machine | The Netherlands | 33.9 | 11 | Careful catching/loading of broilers with the least bruising and injuries and best welfare for employees/catchers through usage of a catching machine and catching/loading in darkness/darkening the house. |
| Farmer training | In person | Transversal training for all caretakers in the field of animal protection at breeding sites. Training in accordance with legislation on the transportation of live birds | Portugal | 33.6 | 12 | Training producers/operators. On-site euthanasia and operator training by creating a system that informs the producer on a daily basis of any injuries detected at the slaughterhouse as a result of possible animal welfare damage. |
| Farmer training | In person | Poultry passport - professionalise the sector to adapt to new knowledge | United Kingdom | 32.5 | 13 | Staff training/ knowledge needs to consider the role of technology and data e.g. artificial intelligence (AI) so producers know what can be monitored and what resulting action to take accordingly. |
| Farmer training | In person | Mandatory contributions covering training costs | Poland | 32.3 | 14 | Each farmer is obliged to pay a contribution based on production volume. This is dedicated to cover costs of sector wide initiatives. One of those are regularly held trainings for farmers (3-4 times a year) covering new regulations and technology in farming. |
| Farmer training | In person | Customized farmers training on genetic material welfare requirements | Greece | 31.8 | 15 | Customized training on modern technologies that improve farm welfare. Animal scientists, veterinarians and genetic material experts are informing the farmer in ways to improve farms welfare practices. |
| Farmer training | Device | Moving loading container using tracked vehicle | The Netherlands | 29.5 | 16 | Developing a tracked vehicle with remote control, with which the containers can follow the catching staff while catching the broilers. |

### 3.2.2 Genetics & Breeding

A total of eight different good practices from four partner countries were collected for the challenge "Genetics & Breeding" (Tab. 2).

*Table 2. Overview of all good practices for the challenge "Genetics & Breeding" including scoring results of the GPET, ranking and a short description*

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Genetics & Breeding | Communication | Communication of emerging welfare issues to genetic material vendors | Greece | 35.5 | 1 | Timely communicate welfare issues to genetic material vendors. All welfare issues are recorded and evaluated. Those that could apply to genetic material and emerging to higher than normal level is communicated to genetic material vendors. |
| Genetics & Breeding | Communication | Selection for better bone structure quality | France | 33.3 | 2 | Different genetics are suited to different husbandry conditions and have a genetic predisposition to certain diseases. Recommendations for suitable genetics and special husbandry conditions should be communicated. |
| Genetics & Breeding | Housing | Elevated platforms as enrichment material | Spain | 31.7 | 3 | Provide the farms with elevated platforms as a mitigation strategy of the negative effects of genetic selection for rapid growth on lameness. |
| Genetics & Breeding | Selection | Selection for increased resistance | France | 30.4 | 4 | Genetic selection for an intermediate strain with average daily weight < 50 g/d and increased robustness while remaining competitive. |
| Genetics & Breeding | Feeding | Consider indicators of intestinal flora | France | 29.9 | 5 | Include the intestinal flora and digestive sensitivity into the genetic selection of broilers. |
| Genetics & Breeding | Communication | Balanced breeding programme | United Kingdom | 29.7 | 6 | Breeding programme that includes key health and welfare indicators. |
| Genetics & Breeding | Housing | Sexing | Spain | 27.5 | 7 | Growing males and females separately in the same house. Females until 3-4 weeks of age (approx. 1.8 kg) and males until the required weight at the end of the rearing cycle. It is a way to reduce densities when the animals are bigger and to be more efficient in the differential capacities of growth and conversion. |
| Genetics & Breeding | Communication | Strain evaluation/accreditation by an independent organization to be defined | France | 25.1 | 8 | This practice could help broiler producers in their management of a specific strain, |

### 3.2.3 Barn climate

A total of 19 different good practices from eleven partner countries were collected for the challenge "Barn climate" (Tab. 3).

*Table 3. Overview of all good practices for the challenge "Barn climate" including scoring results of the GPET, ranking and a short description*

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Barn climate | Audit | Smart Farm physical monitoring | Greece | 37.4 | 1 | Farmer auditing the farm at certain critical hours of the day to check whether ventilation, heating, etc. need adjustment. These hours change on different seasons of the year. A certain program is followed according local conditions. |
| Barn climate | Indicator | Foot Health Program | Sweden | 37.2 | 2 | All flocks are scored on foot pad lesions at slaughter. The results act as a base for regulating the stocking density. If the farmer delivers birds with high score on foot pad lesions, the stocking density is reduced for next coming flocks, according. Also, a production advisor contacts the farmer to investigate why foot pad scores was high and helps to make management corrections to lower the scores to the next flock. |
| Barn climate | Technology | Remote technologies for farm welfare monitoring | Greece | 37.0 | 3 | New remote technologies can provide farm remote surveillance on various production parameters. These parameters (water consumption, $CO_2$, temperature, ammonia, etc) are evaluated as rapid welfare warning systems. |
| Barn climate | Audit | ITW barn climate check | Germany | 36.8 | 4 | Participants in the label program are obliged to have the barn climate checked once a year. The relevant expert checks all components of the barn climate control system (e.g. supply air, heating, alarm devices) using a detailed checklist. Weak points must be eliminated for label certification. |
| Barn climate | Technology | FARMCONTROL: Environmental data monitoring, control and alarm systems | Portugal | 36.0 | 5 | Installing environmental monitoring systems such as control and recording of temperature, humidity, $CO_2$, ventilation and window opening allows for alarms to be set up to prevent accidents caused by a certain climate change. |

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Barn climate | Technology | Misting | France | 35.4 | 6 | Misting devices (high-pressure water via nozzles that atomize water into mist) are installed to cool/lower the temperature for poultry in a farming facility in case of heat stress. |
| Barn climate | Feeding | Use of crude fibre concentrate additive in feed for broiler chickens | Poland | 35.1 | 7 | Feed additive ARBOCEL® is characterised by a very high-water binding capacity. Water is absorbed in the upper part of the intestine and then released in the lower part of the intestine under osmotic pressure. The released water is reabsorbed back into the body through a process of dizzy resorption and does not increase the moisture content of the litter. |
| Barn climate | Technology | Water circulation central heating with renewable energy | Finland | 35.0 | 8 | Compared to gas heating, the air humidity is lower when using a central heating with water circulation. Ventilation control is easier and it consumes less energy. The condition of litter improves, which is good for bird welfare. Moreover, fire safety improves. |
| Barn climate | Management | Automatic window adjustment for natural ventilation | Italy | 34.1 | 9 | Use of a control unit to open and close the shed ventilation panels. The system allows the degree of opening of the panels to be increased or decreased in relation to the age of the animal. |
| Barn climate | Technology | Polyvalent ventilation device: LEAD EXP'AIR | France | 33.3 | 10 | A polyvalent ventilation device that combines heating functions (indirect combustion gas or hot water coil), heat exchanger (up to 3500 m3/h), and extraction (up to 6000 m3/h). It likely contributes to better bird health and thermal comfort, helps to reduce humidity in the building when used effectively, resulting in better-quality litter. |

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Barn climate | Management | Ways to ensure bird comfort | United Kingdom | 33.2 | 11 | Include climate training and support within poultry passport (or however training is rolled out). Stocking density and breed type changes birds' ability to adapt to the climate. |
| Barn climate | Management | Extreme Conditions Farm Preparedness Actions | Greece | 32.9 | 12 | Prepare the external environment of the broiler farm so it can endure extreme weather phenomena. Create ditches to cope with flooding, reduce vegetation to avoid wildfires, create extra water storage for water shortages, etc. |
| Barn climate | Management | Addressing birds crowding in one place | Poland | 32.8 | 13 | Reduce crowding, and there with bird thermal comfort, by adding an additional layer of mulch in certain parts of the stable, which would create an artificial mound, by adding physical boundaries inside the stable, and using an artificial source of noise to trigger mobility in case of crowding. |
| Barn climate | Audit | Bonus system for broiler house standard | Sweden | 32.7 | 14 | Modern, insulated broiler houses, with high standard ventilation systems and back up- system if something fails can receive a high score, which permits a higher stocking density (maximum 36 kg/m2) to stimulate producers to invest in their barn and new technologies. |
| Barn climate | Management | Extra layer of mulch | Poland | 32.5 | 15 | Additional layer of litter helps to keep the barn well ventilated. It also lowers overall stable humidity. |
| Barn climate | Technology | Use of a litter turning machine | Italy | 32.3 | 16 | Use of a machine to turn the litter and ensure a dry floor about every 4-5 days, which can lower the prevalence of pododermatitis. |
| Barn climate | Management | Raising feeders | Spain | 31.6 | 17 | When very high temperatures are predicted, the farmer raises the feeders at least 3 hours before the predicted peak of temperature. This practice reduces the mortality of the flock by avoiding increases in body temperature. It could be replaced by or complemented with darkness during this period. |

| Challenge | Keyword | GP title | Country | Score | Rank | Short description |
|---|---|---|---|---|---|---|
| Barn climate | Technology | Radiant floor heating | Portugal | 31.2 | 18 | Implementation of underfloor heating (heating through the circulation of hot water in pipes under the floor) in broiler houses for more stability of production, homogeneity of the flock, fewer cases of pododermatitis and lower ammonia emissions; |
| Barn climate | Technology | Transport canvas/curtain cloth for broilers | The Netherlands | 31.1 | 19 | Roll up cloth on the floor, chickens are placed on this cloth together with the litter at the start of rearing. At the end of the round, the producer can roll up this cloth and separate chicks and litter resulting in no injuries and no stress for the broilers and catchers due to the catching. |

# Chapter 4: Top 5 Best Practices & Broiler*N*et Champions

## 4.1 Top 5 Best Practices per challenge including abstracts

By means of surveys and intensive discussions during the TEN meeting, the Top 5 BPs and the respective Broiler*N*et Champion for each challenge were selected. The Champions included those good practices that were the most innovative and potentially ready-to-use ideas that could be implemented in the various European regions. For each challenge, the five BPs (including the respective Broiler*N*et Champion) will be described below.

### 4.1.1 Farmer training

*ITW annual online training (Germany)*

"Initiative Tierwohl" (ITW) is an association of food retailers, farmers and the meat industry in Germany. Since 2015, the Animal Welfare Initiative supports farmers in implementing measures for the welfare of their animals that go beyond legal standards. One of the requirements is that farmers must complete annual training. In addition to various face-to-face events, there is now also an online training program (www.gefluegelbesserwisser.de). This includes a comprehensive training for poultry farmers, which can be carried out at any time from home and serves as annual proof of training. Various modules provide knowledge on topics such as animal welfare, barn climate, flock management and feeding in the form of photos, diagrams and videos. At the end of each module, knowledge is tested and only those who pass the test receive the required certificate for the corresponding module, as well as an overall certificate for completing the entire training program. The big advantages of online training are flexibility, saving travel time and costs, but also the fact that a multilingual offer is easier to implement than for face-to-face events. The risk is that a certain level of trust must be placed in the candidate to complete the online training diligently. Moreover, there is a risk for lack of understanding, as open questions cannot be directly answered. This training program is free of charge to all members of the initiative, as all trading partners involved plus gastronomy pay a surcharge. The online offer was designed together with the Osnabrück University of Applied Sciences and the Ulmer Verlag Corporate Media and is intended to be continuously updated according to new findings.

*Training on Farm Microclimate Management (Greece)*

The farmer is trained on evaluating and managing the microclimate of the broiler farm. Animal scientists and veterinarians are training the farmer to assess microclimate conditions and provide relevant training material. The training is carried out mostly at small groups of farmers and in some cases, it can be individual training. Physical meetings are preferred over remote training, as various practical aspects can be better communicated during on-site training. After the training there seems to be an increased awareness of welfare issues during daily farm management routines. Daily mortality rates reduce, and there is improved flock performance besides health improvements of the flock. Additionally, improved quality of the final product has been noted. This practice can easily be implemented on practically every farm. Some limitation might arise at farms with operators that have poor local language communication skills. Overall, a trained farmer is more confident and more effective in its management. Applying this practice costs approx. 2000 euros/year/farm and results in an increased profit of 0.15-0.20 euros/bird. Farmer training on Farm Microclimate Management can be an important part of the annual farmer training program. It can be organized by integrators, farmers associations, official authorities, universities or any other institution or individual that has relevant expertise.

*Training course for keepers of chickens kept for meat production (Italy)*

The implementation of this GP increased awareness of farmers' role in animal welfare: healthy animals will have health benefits and thus a positive impact on the use of antibiotics. In Italy the course is offered and organized by the National Association of Poultry Meat sector, in cooperation with the animal health authority and the veterinarian in charge. The veterinarian is centrally trained as official trainer for breeders, and is responsible for the certificate. The implementation of this GP requires an available Veterinary Competent Authority and an association active on the territory that provides its expertise free of charge and is able to involve the veterinarians of its member companies. This practice can be performed in e-learning modality or face-to-face mode. The association needs to apply to the competent local authority for a permission to hold the course and to set up an examination commission. This commission should contain at least one official veterinary expert in animal welfare, as head of the course, with the task of verifying the regularity of the examination, and a farm veterinarian from the supply chain, as course instructor. In the face-to-face mode, at least two lecturers are required to cover all the scheduled subjects. The owner/keeper will have to train personnel responsible for unloading/loading animals and for vaccinations. The cost of the certificate ranges from 5 to 20 euros, depending on the local competent authority. Indirect costs include the need for more controls and inspections on the farm.

*Internal audits regarding on-farm euthanasia (Spain)*

All farmers are trained on animal welfare in Spain by law. Euthanasia of unfit animals is of utmost importance on welfare grounds. However, training certifications do not guarantee that the farmers euthanize unfit animals. For this reason, the integrator company internally audits the farm to verify if the farmer is euthanizing unfit animals. If they detect an abnormally high prevalence of animals with moderate or severe lameness, it means that the farmer is not euthanizing unfit animals. The integrator carries out these audits as an additional tool to promote and maximise animal welfare. This practice has been in place for 2-3 years and is carried out by the farm veterinarians or other technical staff. The audits take place when birds are around 30 days old in 5% of the randomly selected barns. The aim is to reduce avoidable suffering of animals which, for whatever reason, are not in good condition. This action leads to an improvement in the training of the poultry farmers and in general the welfare of broilers. At the same time, it improves the production rates of the farm by euthanizing animals that may be consuming feed and water and, after all, will be potential birds unfit for transport or future DOAs (dead on arrivals) at the slaughterhouse.

*Exchange group between farmers (France)*

Farmer exchange groups indirectly enhance animal welfare by facilitating the sharing of best practices and addressing questions or challenges faced by farmers. Therefore, the corresponding departmental Chambers of Agriculture managed a farmer exchange group in various French departments. These groups operate with an annual farmer subscription fee of €230. This fee covers the organization of meetings and provides advisory services on farm housing, equipment, and economic results. The frequency of meetings varies according to the synergy of each group but typically involves 3 to 4 annual in-person day-meetings. During the first half of the day-meeting group, a representative from the Chamber of Agriculture presents a topic chosen by farmers in the previous meeting, such as ventilation, energy or chick quality, followed by discussions. The second part of the day consists of a farm visit hosted by a group member or a visit in a broiler sector company, such as a hatchery. Feedback from these groups has been highly positive, with members continuing to exchange information between meetings using a WhatsApp group. This collaborative environment suggests potential future meeting topics addressing additional animal welfare challenges, such as on-site euthanasia or environmental enrichment. The ongoing exchanges of knowledge between farmers and the potential implementation of best practices following these meetings would be beneficial to further improvements in animal welfare, contributing to sustainable farming.

### 4.1.2 Genetics & Breeding

*Communication of emerging welfare issues to genetic material vendors (Greece)*

After applying timely communication for welfare issues to genetic material vendors, a better balance between growth rate, bird comfort and product quality was achieved. Communicating about welfare issues to genetic vendors can also improve animal health, final product quality. All reported welfare issues are recorded and evaluated systematically. In addition, the veterinarians and animal scientists are monitoring and evaluating welfare findings during their visits to the farms. Those that can be directly attributed to genetic material are evaluated statistically and immediately communicated to the relevant vendors. Animal scientists and veterinarians are also issuing a report when there is a statistically significant issue of a relevant welfare issue. Through this feedback genetic material vendors are encouraged to provide a better balance between growth rate and bird welfare. It should be noted that normally it takes time, sometimes years, to resolve genetic issues. Yet, it can be applied to the whole sector and other types of poultry production. It is very easy to apply, especially at fully integrated broiler production and the cost for this practice is minimal.

*Elevated platforms as enrichment material (Spain)*

The enrichment material consists of offering elevated platforms with easy access, such as ramps, for the broiler chicken at all stages of their growth at the poultry farms. These platforms are aimed at mitigating the occurrence of leg injuries resulting from rapid growth due to genetic selection and support species-specific behaviour, for instance, perching and resting. Modern fast-growing broilers spend excessive periods resting and their activity further decreases with age. Inactivity has been suggested to affect walking ability and the incidence of leg disorders negatively. Elevated platforms bring additional possibilities for locomotion to broilers and seem to improve their leg health. The platforms are incorporated into the barns before the arrival of the chicks, and it has been immediately observed that they climb onto them. The platforms are made of plastic material by the farmer using old slats from hen farms. Their size is approximately 3 x 0.70 m, and the ratio is $0.3m^2$/1000 chickens. No improvement element has been quantified or observed regarding productive rates or the level of injuries.

*Sexing (Spain)*

In general, broilers are reared as mixed-sex chickens throughout the entire fattening period. In this practice, males and females are kept separately in one barn. The female broilers are kept until the third or fourth week of life and the male broilers until the sixth week of life or the target final weight. It is a way to reduce densities when the chickens are older and to be more efficient in the differential capacities of growth and conversion. The separation of females and males is achieved by installing a fence in the barn. Once the female broilers have been turned out, this fence can be removed and the males can use the entire area of the barn. On the one hand, separation makes it easier to pre-catch the female broilers and reduces stress for the male broilers. Furthermore, the stocking density can be better calculated after the females have been depopulated, as the growth intensity is more homogeneous and the body weight uniformity can be higher than when mixed-sex animals are kept. Sexing can be applied to both fast and slower growing broiler hybrids.

*Selection for increase resistance (France)*

Broiler chicken meat essentially relies on fast-growing standard genotypes farmed in indoor and intensive farming systems across Europe. However, they raise concerns about animal welfare such as leg health, heat stress and behavioural restrictions. Although economically attractive, this production system faces criticism from European animal protection associations and consumers. An alternative to standard broiler chicken farming is certified broiler chicken farming, adopting an intermediate growth rate (< 50g/day), referring to ECC (European Chicken Commitment) production systems. This represents a compromise between standard broiler chickens and those

raised under the Label Rouge (slow growing) production system. ECC farming promotes the use of intermediate growth rate genotype that are more resilient and less prone to production diseases (ascite, myosite, locomotory issues, etc.), along with measures such as lower stocking density, natural light, perches and substrates for pecking. These measures aim to address animal welfare concerns and consumer demands. ECC farming therefore favours specific genetic, including Hubbard Redbro, Hubbard Norfolk Black, JA757, JACY57, 787, 957 or 987, Rambler Ranger, Ranger Classic or Ranger Gold. Among these, Hubbard Redbro is the most widely used strain for ECC in France. While transitioning to an intermediate growth rate improves welfare and health, potential issues related to surface area utilization may arise if meat production quantities remain constant and stocking density decrease. However, to conclude, adopting an intermediate strain is beneficial to better welfare and health and meets consumer expectations while also ensuring competitiveness compared to slower growing genetics, contributing to sustainable broiler farming.

*Considering indicators of intestinal flora (France)*

Broiler chickens have undergone significant genetic selections to meet the demands of modern farming, leading to accelerated growth rates and enhanced feed conversion efficiency. However, these genetic advancement challenges the overall welfare of the birds, often manifesting in issues such as skeletal and locomotor abnormalities, cardiovascular problems, and compromised immune function. Addressing these challenges requires a holistic approach, and recent research suggests that the intestinal flora plays an important role in broiler chicken health and welfare. The intestinal microbiota, comprising a diverse community of microorganisms within the chicken's gut, influences various physiological processes, including nutrient absorption, immune system development, and disease resistance. Therefore, incorporating traits of intestinal flora into the genetic selection processes would be a promising practice for the overall health and welfare of broiler chickens. Selecting birds with a balanced and resilient intestinal flora can contribute to improved digestion, nutrient utilization, and immune function in subsequent generations, as well as offering other benefits such as enhanced productivity (including growth rates and feed efficiency), and reduced veterinary costs. The positive environmental impact of this practice (i.e. less antibiotics used, better nutrient utilization and manure quality) further enhances its value. In conclusion, integrating traits of intestinal flora in selection processes is a practical and beneficial approach for farmers, aligning with consumer expectations, industry trends, and the sustainability of broiler farming.

### 4.1.3 Barn climate

*Remote technologies for farm welfare monitoring (Greece)*

New monitoring technologies are widely available now and can provide farm remote surveillance on various production parameters. These parameters include water consumption, carbon dioxide, temperature, ammonia, etc. They are continuously evaluated and can operate as a rapid welfare warning system at farm level. It is very important that those parameters provide the ability for immediate corrective action in order to minimize broilers stress. This GP can be implemented on every rearing cycle of the farm. In some cases, less bird mortality was observed. There is a great variability for reduced mortality per farm, ranging from 0.3% to sometimes 100%. There is a small risk of false alarms, which can easily be verified by a barn visit. No unintended consequences were observed during the application of this practice. A lesson learnt after applying this practice is that more parameters can be included at the remote monitoring systems to have better welfare monitoring. For example, more alarm points for feed consumption. The estimated cost per farm for this GP is approx. 800 euros. Increased price per bird for remotely monitoring welfare cannot be estimated as it largely depends on how often this system is activated in critical situations.

*Smart farm physical monitoring (Greece)*

The physical presence of farmer or operator is very critical to assess barn conditions that impact welfare of the flock. Timely proper management reduces the possibility of stress for the broilers,

and, in some cases, the duration that broilers might be under stress is also significantly reduced. In this GP, the farmer is auditing the farm at certain critical hours to check whether ventilation, heating, etc. need adjustment. These hours usually change on different seasons of the year. Here, a certain auditing program is followed according to the local conditions, as critical hours that environmental conditions (temperature, relative humidity, etc.) fluctuate are different in each season of the year. This practice can increase body weight approx. up to 5 gr day extra gain. Moreover, additional reduced mortality up to 3% can be achieved. The health performance of the flock is also positively related to Smart Farm Physical Monitoring. The price received per bird that can be attributed to the implementation of GP is 0.05 euros. It is a practice that can easily be applied and adopted across Europe, especially at areas with seasonal climate variations.

*FARMCONTROL: Environmental data monitoring, control and alarm systems (Portugal)*

The installation of environmental monitoring and control systems aims to ensure the stabilization of environmental conditions in poultry farms at optimal levels by providing comfort and well-being to animals, minimizing health risks, and maximizing productivity. Alarm and control systems for monitoring environmental parameters allow automating or accelerating responses to the occurrence of undesirable variations in temperature (heat and cold), concentrations of identified gases ($CO_2$, $NH_3$, etc.) or humidity by activating automatic ventilation and window opening systems besides other automatic procedures, or human interventions that are necessary to ensure the environmental stabilization of the facilities. The definition of the parameters to be monitored, as well as the critical levels that trigger automatic procedures or alarms, can be adjusted to the needs and reality of each barn, allowing those responsible to establish the standard values that best fit their management strategies. The activation of the systems can be phased according to the economic and operational possibilities of each farm. Optimizing environmental conditions in the animals' living condition allows for productivity gains by maximizing growth rates and reducing mortality and health risks.

*Foot Health Program (Sweden)*

The Foot Health Program was introduced in Sweden in 1994 and is mandatory to be allowed the maximum stocking density of 36 kg/$m^2$. Foot pad lesions are a key indicator for animal welfare. Causes for foot pad lesions could be related to barn climate, animal health or a problem with the feed composition. The program was developed by the Swedish University of Agricultural Sciences. Since the implementation, every broiler flock is scored at slaughter according to a standard and interventions are put in place if the foot pad scores are too high. The scoring is done on 100 feet, randomly selected to represent the whole barn. Interventions when foot pad score are too high include a reduction of the maximum stocking density combined with advice from a production consultant. When the farmer makes corrections the maximum stocking density is increased again. This GP has improved the general animal welfare and barn climate resulting in healthy birds and good litter quality. A dry litter encourages the birds to perform natural behaviours, such as dust bathing and feed searching behaviours. The mean foot pad score in 1994 was 43 and the result from 2023 was 6 (scale 0-200). One important conclusion from the program is that the economical punishment of reduced stocking density is an incentive for the farmer to make improvements. The key factor with regards to animal welfare is that the farmer gets support from an advisor to identify the key issues for the high foot pad scores and receives help to find solutions to the problem.

*Misting (France)*

The use of misting in barns to reduce heat stress in the poultry industry is not universal. Misting (i.e. high-pressure water through nozzles creating a fine mist that helps cool broiler chicken houses) is a good practice with multifaceted benefits. While some farmers hesitate to invest in a misting system, it is already widely used in certain regions in France during heat waves. Misting positively affects health and animal welfare by mitigating heat stress and mortality. Based on a farmer information, it could also potentially lower the prevalence of colibacillosis, although this GP requires careful humidity management as excessive moisture during heatwaves could lead to wet

litter and pododermatitis issues. According to farmers, misting can also ensure a more continuous growth and feed intake, resulting in more homogeneous growth patterns. This is attributed to regular feed intake due to reduced heat stress facilitated by misting during heat waves. From the farmer's perspective, despite installation costs from €7,000 to €18,000 based on building size and equipment, misting system enhances their control of the house atmosphere, while it also reduces summer mortality and provides better thermal comfort to animals and humans workers. However, farmers highlight the need for proper building ventilation and occasional maintenance of nozzles. Misting may not be cost-effective for free-range farming (as animals can choose outdoor areas), but it is beneficial for indoor farming. Despite the initial cost, farmers highlight the rapid return on investment and sustainability of misting systems, which contribute positively to broiler welfare and overall farm performance.

## 4.2 Broiler*N*et Champions

For the challenge "Farmer training", BP "Internal audits regarding on-farm euthanasia" was selected as Broiler*N*et Champion by the TEN experts. This practice was considered to be most innovative, also because it addresses a sensitive topic (i.e. for both farmers and public opinion).

For the challenge "Genetics & Breeding", BP "Elevated platforms as enrichment material" was selected as Broiler*N*et Champion. This good practice can be adapted to different genetic strains. Experts concluded that there is solid scientific evidence for this good practice, and this practice is ready-to-use for many European regions.

For the challenge "Barn climate", BP "Foot Health Program" was selected as Broiler*N*et Champion. Foot pads are commonly used as welfare indicator. The experts concluded that such a program could stimulate broiler producers to invest in barn design and new technologies to enhance barn climate and with that foot pad scores (and thus broiler welfare).

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