Animal Welfare: from Science to Law, 2019 - ISBN 978-2-9512167-4-7 [PDF]
All articles: http://www.fondation-droit-animal.org/proceedings-aw/

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Initiatives and achievements by farmers and the livestock sector in favour of animal welfare

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Abstract

Driven by citizens' concern and supported by the European legislation, animal welfare has become a non-negotiable issue for livestock breeders. Initiatives and achievements are numerous and diverse in their approach to reduce behavioural restrictions. To name a few, calf rearing has evolved with the introduction of collective pens, laying hen production has been transformed thanks to enriched cages, loose housing or aviaries, and tethering and individual cages have been banned for sows and force-fed ducks. Concurrently, a large number of specifications, codes of practice and assurance systems have developed. Following the results from European projects such as Welfare Quality® or European Food Safety Authority (EFSA) reports that have shown the benefits of an approach to welfare with animal-based measures when investigating risks of multifactorial origin, the animal-centred approach is now implemented in projects managed in the poultry, pork and dairy sectors. In the future, new technologies in precision livestock farming will enable earlier detection of behavioural problems, improved risk management and lifetime traceability of animal welfare. To conclude, we reiterate that the human-animal relationship is relevant to the search for solutions to improve animal welfare but also systems efficiency and the implementation of practices to reduce the need for therapeutic methods. Progressively, it is also taking a central place in reference guides and training content.

Introduction: Livestock breeding in France and animal welfare

1. Reminder of the roles and challenges in livestock breeding in France

Livestock breeding is a major activity in France, both in terms of the economy and land use. France is Europe's largest producer of cattle (22% of European production), eggs and chickens (14% of European production each), the second largest producer of milk after Germany (17% of European production), the fourth largest pork producer (9%) and the fifth largest sheep producer (8%) (Eurostat data). The livestock sector represents 37% of French agricultural production in terms of turnover excluding subsidies, which places it just behind the wine and liqueur sector. The dairy sector also has a strong positive impact on the trade balance with a net balance (difference between exports and imports) of €3.4 billion in 2014 (Agreste, 2015). The livestock sector also significantly contributes to employment. A specific quantification carried out by the scientific interest group (SIG) Élevage Demain (Lang *et al.,* 2016) shows that the livestock sector represents 703,000 full-time equivalents (a little over 800,000 jobs in total), namely 3.3% of the active French population, of which half are directly employed in livestock and half indirectly (agricultural supplies, feed, buildings, collection and processing, industrial supplies, veterinarians, training, etc.). This figure is all the more important given that it largely covers jobs in rural areas where there are often few job opportunities, meaning the livestock sector contributes significantly to the vitality of France's territories. Metropolitan livestock breeding also contributes to biodiversity conservation by using 11.5 million hectares of permanent pasture, paths, etc. and 2.7 million

hectares of seeded pasture (in total, 45% of France's utilised agricultural area (UAA)). These surfaces and associated structures (field edges, hedges, embankments, ditches, etc.) are a source of specific and genetic biodiversity (botanical, invertebrates, microbial) and are home to wildlife.

But French farming is in great difficulty, on farms and in downstream industries alike. These difficulties are undeniably greater for meat than milk and dairy products, even though the current crisis illustrates the fragility of these balances. This drop in the sector's competitiveness can be explained by the deterioration of the meat trade balance, which dropped from €0.27 billion in 2000 to -€1.58 billion in 2014. At the same time, the dairy sector's trade balance increased from €1.84 billion to €3.17 billion (Agreste, 2015) which places this sector just behind wines and liqueurs and cereals. Animal production is also losing ground in terms of volume with a decrease in production (pork: -5%; poultry bred for meat: -20%; veal: -20%; beef cattle: -9% since 2000). There are several reasons for these difficulties. Against a backdrop of rising agricultural production costs, the liberalisation of the global trade in agricultural and food products, and widespread public distrust of the agricultural sector in general and livestock breeding in particular (protest against "large-scale farming", opposition to biotechnologies and the opening of new farms, greater coverage by TV, radio, press etc. denouncing "the industrialisation of agriculture", criticism of meat consumption), farmers are struggling to generate enough revenue to invest, upgrade and innovate. In addition, livestock breeding businesses are still much smaller in France than in most of the competing production areas, which limits economies of scale and makes it harder to generate a return on their investments. For example, by 2007, farms of more than 1,000 fattening pigs already represented 81% of production in Denmark, 75% in Spain and 63% in the Netherlands compared to only 43% of pig farming in France (IFIP, 2013). Downstream companies (transport, slaughter and processing), often small and medium-sized enterprises (SMEs), also have very small profit margins and, due to a lack of finances, are unable to carry out the necessary steps to upgrade and innovate, although these very same SMEs are the lifeblood of the local economies. The sector is subject to stiff European competition, whereby certain areas have benefited from more lenient regulations (cost of labour in Germany, for example) and excessive specialisation in mass-produced products where the "end product price" remains the key competitive factor.

2. The issue of animal welfare

The modern concept of animal welfare came about in the 1970s. The following 40 years profoundly changed French and European livestock breeding with the almost widespread abandonment of the most restrictive systems for animals, such as calves in small individual cages or tethered sows. On an ethical level, European policy on animal welfare has proven to be effective as well as insightful given changing attitudes worldwide. This policy could only be introduced because farmers were willing to make changes for a goal they work towards on a daily basis.

Today, the sector must address the two core issues of improving animal welfare and eliminating pain in order to meet the demands of our citizens, who are increasingly mindful of livestock breeding and slaughter conditions. Many associations recommend that livestock breeding and processing practices are improved (Delanoue and Roguet, 2015). Citizens' animal welfare expectations focus on several simple principles of obligation of means: restricted size of farms, low animal density, freedom of movement, supply of moveable materials (notably straw), access to separate areas of buildings (for feeding, sleep, exercise) and above all, fresh air (small courtyard or outdoor areas for granivores, pasture for herbivores), and absence of mutilations.

The French livestock industry is somewhat ambivalent to this issue, which our citizens sometimes have trouble understanding. Given the range of livestock breeding methods (access to pasture and paths, diversity of biotopes, etc.) and the existence of small family businesses (comparative to other European production areas), the French people's expectations in terms of

"naturality" are partly met (for example, Label Rouge chickens). However, these advantages can also become weaknesses where investments are needed, given the financial constraints mentioned above - and the smaller the business, the greater these constraints become - but also because progress needs to be made in several hundred thousand farms spread across the country, as the sector is much less densely concentrated in France than it is in rival production areas, and much more varied in terms of livestock species and consequently in terms of specific requirements that need to be integrated into the approach. This requires heavy investment from the sector in terms of human and financial resources but also knowledge and time.

The principles of agroecology applied to livestock breeding were recently described (Thomas & al., 2014). Animal welfare can and must be seen as a component of agroecology applied to farming systems, as should the related integrated management of animal health, control of functional biodiversity or management of element fluxes (nitrogen, phosphorus, carbon) to reduce emissions. Animal welfare is a natural process that needs to be expressed as well as possible in order to develop sustainable, efficient farming practices that allow the farmer to feel like his/her work is valued. For example, it has been established that group changes in cattle (cows or young bulls) reduce production over periods of various length (for example, Mounier & al., 2005). Livestock breeding systems must reduce constraints on animals as much as possible and respect their behavioural repertoire and animal-environment interactions. There is no opposition between the introduction of more ecologically neutral systems and the improvement of welfare through an ethological approach to animal husbandry, as demonstrated by the changes to broiler chicken runs or improvements to pasture through grazing, for example.

This text aims to analyse the strategic commitment priorities of farmers and the livestock sector to improve animal welfare and eliminate suffering in farming during live animal transport and slaughter. It also aims to describe what new understanding needs to be achieved in order to make further progress on the issue of animal welfare. The few examples cited do not constitute an exhaustive list of what has been achieved. Various initiatives and projects have been undertaken in order to develop new farming systems, as shown by the labels regularly awarded by animal protection associations.

Sector initiatives and achievements for livestock breeding conditions

1. Implementation of European regulations

Europe took on board the issue of animal welfare in 1976 with the European Convention for the Protection of Animals kept for Farming Purposes. This Convention stipulates that the farming environment must comply with the biological needs of the farmed species, at least with regard to the current understanding of its needs. This Convention led to several recommendations (for cattle, pigs, ducks, turkeys, etc.), put to the signatory parties to the Convention (including the European Union (EU)). In accordance with this convention, the European Union adopted several directives (calves, laying hens, sows) or recommendations on a Union-wide level (cattle, sheep, pigs, ducks, turkeys, etc.). The directives take steps to remove housing that induces major behavioural restrictions for animals (individual cages, bare cages, tethers) and painful interventions or at least the use of induced pain (castration, tail docking, etc.). At the same time, several EU regulations and directives have addressed transport and slaughter conditions. Prompted by new insight, the EU opened the path to a renewed approach to the issue in the 2000s by including animal-based and result-based objectives (directive on broiler welfare) along with obligations of means in the field of housing, and by supporting ad hoc scientific projects (Welfare Quality®, AWIN).

Europe can now been seen as the most advanced region in the world in terms of farm animal welfare. America became aware that it was falling behind on the issue and in 2015 the National

Research Council (NRC) published a manifesto calling for further research into livestock production in order to increase productivity in a sustainable development context, paying more attention to animal welfare in particular. American standards are well below European standards and today the US sees this as a competitive edge for European exports in a global context where there is an increasing worldwide demand for animal products.

2. Progress made through regulatory changes

Since the early 1990s there has been progress in nearly all sectors thanks to changes to regulations and standards. Initiatives and achievements are numerous and diverse in their approach. To name a few, the introduction and widespread use of collective pens for calf rearing, laying hen production being transformed by enriched cages (perches, nests), loose housing or aviaries, duck farming where individual cages are no longer allowed, pig farming where sows are allowed to live in groups (currently affecting 80% of sows) except, of course, during birthing where priority is given to reducing the risk of piglets being crushed. These changes have required heavy investment from the sector, with very few government subsidies, unlike investments made to control pollution. Technical institutions have been able to quantify the level of investment. The figure reaches approximately €98 million for the veal sector (Mounaix & al., 2007), $1 billion for laying hens (and not all "chicken" farms are entirely up to standard), €100 million for ducks and $250 million for the pork sector. Other livestock sectors are not directly concerned by these regulatory changes given that they have already made strong commitments, as is the case in organic farming.

3. Initiatives taken by the livestock sectors

In addition to the regulations gradually being put into place and evolving, some sectors have taken a proactive approach and made voluntary commitments. This is the case with the introduction of a charter on sheep and cattle farming processes. This farming charter mirrors that of the "Red Tractor" scheme set up in the United Kingdom in the 2000s, which is often cited as an example. The information required for the two schemes is nearly identical (figure 1). Initially, the Red Tractor scheme was made to create added value by promoting animal welfare as a means to cope with the lack of competiveness of the livestock sector.

Figure 1. Comparison of the French good practices charter and the Red Tractor scheme used in the UK

Red Tractor	French good practices charter
United Kingdom	France
Around 11 500 dairy farmers and 24 700 sheep and beef farmers	Around 90 % of French cattle farms
Cleanliness of animals	Cleanliness of animals
Ventilation of the premises and natural light Daily physical activity for tethered animals One stall per cow and recommendations on surface needed per animals	Ventilation of the premises and natural light Tether accepted all year round/ Tether accepted but not all year round
Housing conditions adapted to minimise injury risks	Housing conditions adapted to minimise injury risks
Natural or artificial shelter in pastures	Natural or artificial shelter in pastures
No use of cattle prod and adapted restraint techniques	Handling without cattle prod and adapted restraint techniques
Disbudding and dehorning under anaesthesia	Disbudding recommended and use of analgesic when dehorning

These schemes can also be applied on a world scale as the guide on good practices in dairy farming shows (International Dairy Federation Guide, 2008) for animal welfare in dairy production, 2008 (Rev. sci. tech. Off. int. Epiz., 2009, 28 (3), 1173-1181). Key economic actors, the industrial players are now trying to work on standardising World Organisation for Animal Health (OIE) recommendations in terms of animal welfare on an international level. As a result, food industry players are behind an ISO standardisation project with the aim of formalising the rules of implementation for OIE animal welfare standards.

Other networks have been built in France around the product quality - animal welfare pairing. This can be seen with label initiatives, which are primarily aimed at improving the gustative quality of the products but also respect for animal welfare and the environment. The most famous of these is the 'Label Rouge' brand, whose primary aim was to provide a better quality product (in comparison to standard products) and which is now explicitly linked to improved animal welfare and environmental qualities. For example, for some time 'Label Rouge' broiler chicken or laying hen breeders have been setting the benchmark in terms of welfare and are committed to being proactive in providing runs that meet the behavioural needs of the birds (Mirabito *et al.*, 2002; Lubac *et al.*, 2003) or more generally ensuring the sustainability of their systems including environmental aspects and biodiversity (Lubac *et al.*, 2016).

It is however important to note that this labelled production initiative is very French, even though it is also being developed somewhat in Italy and Spain. In other European countries, Germany for instance, progressive improvement systems have been implemented by the livestock and distribution sectors, which inevitably results in a more expensive product for the consumer (Roguet *et al.*, 2016).

In France, initiatives can also be taken by cooperatives or distributors who want their suppliers to exceed current regulations. This is the case of the Cooperl cooperative in Brittany, which has a network supplying intact (non-castrated) male pigs. The main purpose of castrating male piglets is to improve the quality of male pig meat by removing odours due to sex hormones (androsterone and to a lesser degree skatole), which most consumers find repellent. In Europe, 80% of male piglets are castrated. In France, as with most other European countries, castration is done surgically, without anaesthesia or pain relief. It is sometimes done by chemical immunisation (less arduous for the animal). Welfare is improved by eliminating the pain of castration (Le Neindre *et al.*, 2009). The Cooperl cooperative supply chain has eliminated all animal castration, whether surgical or immunochemical. The carcasses are sorted at the time of slaughter and any pieces containing too many odorous compounds are removed from the meat market and recycled as processed products because the processing greatly reduces consumers' ability to detect the odours. This strategy requires a change in farming practices (separation of sexes, increase of available space) in order to protect the other pigs because intact males are more aggressive (Prunier *et al.*, 2013).

Supermarkets can also become key actors in the area of animal welfare by imposing certain standards. The supermarket chain Carrefour has been offering a greater range of alternative products. Carrefour-Belgium seems to be more proactive than Carrefour-France with regard to welfare, offering non-battery farmed rabbit meat, for example. The sale of free-range eggs is also growing rapidly. The success of this market is due to the small difference in price, as the price of an egg itself is very low.

In fact, a large number of specifications, codes of practice and assurance systems have developed. The combined technology network (RMT) on animal welfare and farming systems (*Réseau mixte technologique "Bien-être animal et systèmes d'élevage"*) recently produced a summary of these various systems which clearly shows the diversity of approaches and goals.

4. Individual initiatives taken by farmers

Some farmers have taken individual steps to implement projects to develop alternative paths at the level of their farm. These strategies give priority to improving animal welfare, which drives changes in production but is also generally paired with other goals, particularly the reduction of the negative impact of farming on the environment and a desire to improve the quality of their products (and therefore has an impact on prices). The most high-profile example is certainly that of Thierry Schweitzer's pig farm in the Bas-Rhin region. Schweitzer chose to produce "*in keeping with society*" as he puts it, using a farming system entirely based around the welfare of the animals: sows raised in groups and housed on straw, then allowed outdoors so they can build their nests for birthing, no systematic teeth cutting and no surgical castration, which is replaced by immunological castration, all while respecting organic farming specifications. A pork butchery was created to process products from this farm and the farmer has his own selection of "organic" products, all of which he sells under the Schweitzer label. This type of change to the system shows that pioneering farmers can successfully undertake radical changes themselves and create niche markets, at least in the beginning. They must be encouraged and rely on consumers' willingness to pay. However, we still need to satisfy the majority of consumers who demand the lowest prices possible.

Handling of pain in farms and slaughterhouses

1. Potential improvements to avoid sources of pain in farming

Changes in farming conditions seen in Europe and North America over the past 50 years have led to widespread practices such as dehorning, castration (pigs, calves, sheep, chickens, done through caponisation for the latter), docking (cattle, sheep, pigs) or debeaking. These mutilations are often justified as a means to reduce the risk of illness or injury from other animals (pecking, cannibalism), improve product quality (castration in pigs, cattle and chickens produces more marbled meat with a sensory quality preferred by consumers), or make farm work safer (dehorning for example) or easier. These practices however cause pain to the animals. There was a significant shift in the social, political and scientific context around these issues following the *Rencontres Animal et Société* event[1] in 2008 in France and the collective scientific report on pain in animals compiled in 2009 by INRA at the request of the French Directorate General for Food (Le Neindre *et al.*, 2009).

There are alternatives but this is not always the case, and these alternatives themselves come with drawbacks. For example, in pig farming, physical castration may be replaced by immuno-castration (a vaccine has been authorised in Europe since 2009) but this technique has met with consumer reluctance towards a vaccine designed to suppress sex hormones. Carcasses also need to be checked to verify that the immunisation was effective after vaccination and all boar taint has been removed. As it stands, there has been little documentation of the vaccine's effects on animal welfare. From this point of view, the aforementioned Cooperl initiative that examines the issue of castration at a supply chain level is interesting.

There are also alternatives to tail docking. Tail docking of dairy cows is an interesting case of a very old, painful practice that was abandoned without any economic or health repercussions after it was demonstrated that there would be no adverse effect to udder cleanliness if it was not done. In pig farming, tail docking prevents tail biting, which is a behavioural disorder. Environmental enrichment through provision of bedding and maintenance of stable groups reduces but does not entirely eliminate the risk of this. Tail docking is not practiced in organic farming, where animals are reared on bedding. For laying hens, it is possible not to debeak the White Leghorn breed, although there is still a risk of occasional episodes of pecking and cannibalism. However, this

application, used in the Netherlands, is not available in France, where the consumer mainly buys brown eggs. Projects (Casdar funding[2]) involving various stakeholders are being carried out to make the use of these farming prevention factors more popular.

Sector-led initiatives can help improve the situation where there are no alternatives. This is the case for dehorning in cattle which, when practised without analgesia or anaesthesia, is known to be painful. An operational project involving all actors (farmers, veterinarians, technicians, trainers, scientists, non-governmental organisations (NGOs), government) was conducted in France as part of the combined technology network on animal welfare and farming systems. Officially, dehorning was to be done by veterinarians but in practice, since 2011, farmers have been authorised to perform the procedure without any specific training. After taking into account the viewpoints from the various actors, this project led to a consensus between different actors (farmers and veterinarians) to facilitate the implementation of a pain management protocol that includes the use of local anaesthetic. The project also led to the experimental validation of a dehorning protocol (horning done as early as possible, with cauterisation of zones that produce horns at less than one month when horns are still absent), the development of practical guidelines and training methods for those performing the procedure (including farmers), test training sessions and an analysis of changes in farmers' practices before and after training. The project actors received government backing and the programme will be gradually rolled out with support from interprofessional and professional training organisations.

2. Limiting pain at the time of slaughter in farm animals

Animal slaughter conditions are a key point in how farming is accepted by our Western societies, not only in terms of respect for the animal but also due to food safety concerns. European and national regulations provide a framework to protect animals at the time of slaughter.

In France, the slaughter of livestock for consumption purposes is regulated by Articles R214-63 and R214-72 of the Rural Code. Article R214-67 stipulates that all slaughter areas, installations and equipment must be designed, built, maintained and used in such manner as to spare animals from any preventable agitation, pain or suffering. Particular provisions are provided in the Rural Code (Articles R214-73 to R214-45) for ritual slaughter (animals are not systematically stunned before being bled). This must take place in a slaughterhouse, after mandatory mechanical immobilisation for sheep, goats and cattle, before and during the bleeding. Bleeding must be done by a priest authorised to sacrifice by certified religious organisations. Current knowledge does not allow us to confirm the existence or absence of pain associated with this practice.

While stunning has been mandatory since the mid-1960s in France, the latest text adopted on the subject, the Council Regulation (EC) No. 1099/2009, imposes a performance target and requires that the animal has been rendered insensitive, which must first be verified by systematic checks followed by representative sampling. This high standard of quality is strengthened by the need for companies to appoint an animal protection manager, develop standardised operating methods and internal control procedures; while responsibility remains with the administrative control authority. From 2008 onwards, the French livestock sector addressed these issues through a joint project that led to a collective formalisation of control regulations (amounting to a complete overhaul of some procedures) for operations in the restraining-stunning-bleeding cycle and internal control procedures by producing a reference guide on slaughterhouse good practices. All actors and stakeholders involved in the issue in any way were involved in achieving the performance target. After a draft version of the guide was compiled, it was then reviewed by various sector actors, the French Directorate General for Food (DGAL), NGOs involved in the protection of animal welfare as well as representatives of various religious faiths. Following these discussions, a more detailed document was produced and appraised by the French Agency for

Food, Environmental and Occupational Health & Safety (ANSES) before the final version of the *Guide des bonnes pratiques* (good practices guide) was validated by the DGAL and submitted to the European Commission. It is important to note that the whole process was very long because the initial working group was set up in 2008 and the DGAL's final validation did not take place until 2014. To our knowledge, this is the very first guide of its kind at a European level resulting from a wide consultation beyond sector actors.

The good practices guide for managing the protection of cattle in abattoirs (2014) is now a reference tool for cattle professionals and will soon be validated for the sheep and pig sectors (a poultry guide, *Guide de la filière volaille,* is currently being drafted). Other than their technical content, these guides have prompted a variety of research that has improved our knowledge of the area. This is the case for stunning methods, for example, the use of a stunbolt gun for cattle in conventional and ritual slaughter, or electronarcosis settings for sheep and poultry. It is also the case for the development of loss of consciousness indicators (a project being developed to provide an automatic support system for cattle and pigs, indicator and delay of loss of consciousness in ritual slaughter), and for restraint techniques (Borest project). This action was paired with training and assessment that in less than three years saw all operators receive their first training on the key areas of animal protection at the slaughterhouse.

Although subsequent efforts have been greenlit, there are still reports of derogations from animal protection, and in some cases serious breaches have been noted. These events, when proven, are of course no longer tolerable and were condemned as such by the sectors. A general inspection carried out by the government shows that there are very few such cases. It must be stressed that France is still rich and has 150 small local slaughterhouses that are SMEs (CGAER, 2011) and supply retail butchers, meaning that greater value is added to local production, which contributes towards keeping the activity in often underprivileged areas that without the local farms and slaughterhouses would be deserted. Powerful industrial groups (Bigard-Socopa, Elivia, SVA, Tradival) on the contrary have modern, well-equipped slaughterhouses (often on an industrial scale). Even if there is not necessarily a correlation between the size of the business and bad practices, the businesses' diversity makes it difficult to systematically roll out good practices, where this often goes hand in hand with insufficient financial resources to introduce new tools (for example, small communal slaughterhouses) and the human factor. In particular, training agents must be a priority. This is a real difficulty and political choices must be made in order to balance compliance with good slaughter practices (and have them evolve in the future in light of new findings) and the need to maintain business activity throughout our regions while reducing live animal transport.

Management of welfare when transporting live animals

Animal transport is also the object of an impressive body of regulations. In France, this concerns 380,000 farms, approximately 1,500 traders and over 800 companies. It also concerns 1.2 million cows, 0.9 million sheep, 71,000 pigs and 7,000 horses. There are many reasons for transporting live animals. Other than transport to the slaughterhouse, breeders may sell their calves to fatteners, dairy farmers transfer their male calves to stockbreeders for fattening, horses are transported for competitions, etc.

There are very specific regulations governing road transport that include journey planning, vehicle equipment and duration and means of transport (breaks, food, water). Horses, for example, cannot be transported for more than eight hours straight. They need a break of at least one hour every eight hours to drink and rest before the journey can start again. They must be given 24 hours' rest upon arrival. Cattle transport is subject to the same regulations but with 14-hour transport shifts. The youngest animals (live weight of less than 100 kg) must have 0.4 square metres in the

lorry and the heaviest animals (700 kg or more) must be given at least 1.6 square metres. Piglets can be transported for 24 hours straight (while of course respecting the highway code that limits how long drivers can drive before taking a break) provided that they are given a permanent supply of water and that the animal density of the lorry does not exceed 235 kg per square metre. The spread of standards and good practices is achieved through similar training to that provided for slaughter professionals.

In 2007, with support from the Institut de l'élevage (French livestock institute), French professionals proposed a transportability assessment guide, a key component of animal protection during transport, which was then used as an example by European organisations (European Livestock and Meat Trades Union, Eurogroup for Animals, Federation of Veterinarians of Europe) to draft a European guide. A self-evaluation tool was developed to allow transporters to assess the quality of their transport. This involves an assessment of loading and unloading stages, an assessment of practices, and monitoring of animals and transport conditions during the journey. The tool is used on a voluntary basis and relies on a self-evaluation process that allows the driver to improve his or her practices.

International transport regulations require animals to be unloaded at control stations during very long journeys. The European Union agreed to provide significant funding for setting up "high quality" control stations (welfare, health, working conditions) by financing the development of an audit reference matrix and subsidising renovation programmes for around ten of these stations.

Better understand and assess to progress

1. Assessing welfare in farming using animal-based indicators

The issue of providing an objective assessment of animal welfare has been a common thread in research carried out in European countries for many years.

The Welfare Quality® project funded by the European Commission (2004-2008) has led to the development of European animal welfare assessment standards in livestock farms. The original nature of this project was to define a welfare assessment method based not on an obligation of means or the implementation of a practice (for example, cage size for poultry) but on animal-centred measures, which makes it possible to detect risks to welfare of multifactorial origins. The criteria chosen were based on scientific understanding at the time as well as societal expectations recorded by focus groups and citizen juries. The assessment criteria include feed conditions (absence of hunger and thirst), housing (thermal comfort, ease of movement, comfort at rest), health (absence of injuries, disease and pain) and expression of behaviours (social behaviours, human-animal relationship, other behaviours, emotional state). A final welfare score is calculated from these data. Assessment protocols were developed for pigs, cattle and poultry. The concept of welfare developed as part of Welfare Quality® has set the benchmark and has been used in most projects developed since then (for example: AWIN for the transport of horses, goats and sheep). Key methodological improvements have been made: the definition of 12 assessment criteria, the development of algorithms to progress from simple measurements to quantitative assessments on value scales, and the development of an original aggregation model to provide an overall judgement of the level of animal welfare at a farm.

This animal-centred assessment approach is today used by the livestock sector in France as part of several projects with funding of various origins (minister, sector, cross-sector actors, etc.) and involves all stakeholders to develop pertinent indicators recognised by all. The aim of these projects is to develop Welfare Quality®-inspired methods that are easier to use on the ground. To name a few, the "Ebene" Casdar project which covers poultry and rabbits, a project on pig indicators (INAPORC[3] funding), recent work carried out in the dairy industry at the initiative of the

NGO Slowfood backed by the European Food Safety Authority (EFSA). The list could go on with the many initiatives of this kind in France and abroad. These projects also aim to outline so-called "sentinel" indicators that are used to detect potential problems early on.

2. The use of new precision farming technologies

Visual animal scoring systems to assess their welfare can only be used at specific times whereas animals change over time and so do their responses. There are age and/or development cycle-based dynamics at play. The needs of a 10 kg piglet or a 80kg pig are not the same. There are also natural physiological cycle dynamics involved. Dairy cows are much more sensitive to mastitis at the start of lactation than at the end. New precision farming technologies and digital technologies can help us provide a near real-time assessment of the animal throughout its life (including at the time of slaughter) that is much easier for the farmer. These systems, due to their scanning frequency, can detect things the human eye cannot see. They can also provide continuous management and make it possible to act prior to problems in order to prevent them, but also provide a trace of an animal's welfare throughout its life. As with other human activities, livestock farming could benefit from these technological breakthroughs. For example, it is now possible to provide real-time measurements of an animal's body temperature, locate it within a building or outside, analyse its sounds and in the future recognise its expressions. Provided that this raw data can be analysed to generate reliable data (development of new indicators: biomarkers, behaviour and health monitors, augmented reality, etc.), it is becoming possible to detect problems one to two days before they appear and therefore act in advance. There are many possible applications. Other than the daily management of livestock, we must also look at what can be done through big data, such as adding value to data via a data-sharing and statistical analysis system, or developing new training and publication tools (online training, virtual reality), which would facilitate access to training courses and/or enrich the traditional content of current courses.

A project financed by the European Commission recently looked into precision farming and how it can be used to improve animal welfare and health. For instance, this project examined new real-time monitoring of broilers' behaviour: it is now possible to detect feed line problems or the mood in a building based on changes in animal activity rates and how evenly they are spaced throughout the building. Similarly, in dairy farming, by detecting cow activity (position of an animal in the stable using GPS-type technology) and analysing the daily profile of this activity and its changes from one day to the next, it seems possible to detect in advance the appearance of mastitis or lameness (Mialon *et al.,* 2015). Again in dairy farming, camera analysis of the movement and position of cows' feet can be used to detect lameness. This technology can also be used to analyse a horse's gallop or trot. These new technologies show great potential for making progress in the assessment and improvement of animal welfare. However, these are still only prototypes and for the time being, farmers are very pragmatic in the way they use systems proven to help them better manage their livestock (heat detectors, for example). While precision farming offers great hope, we must avoid falling into certain pitfalls such as "technology for technology's sake", which should first and foremost be at the service of animals and farmers. This means we must first set goals and determine which technologies are interesting/necessary to achieve these, while avoiding a proliferation of systems where there is no harmonisation of technical specifications or data validation methods, and where users lack training in these new tools, especially when it comes to detecting and managing risk.

3. Contribution of genetic selection

The possibilities offered by animal genetics are still to be explored. Several genetic selection paths are being explored to see how this could contribute to animal welfare and health. The most

important approach is to take into account so-called functional selection characteristics, such as sturdiness, resistance to disease (mastitis in dairy cows for example), calving ease and "hardiness" that can be defined as the ability to easily adapt to a range of farming conditions. Selection can also be done to eliminate painful practices, such as the genetic selection of odourless pigs to prevent castration of piglets, or hornless cows to prevent dehorning.

4. Need to acquire new knowledge

The first challenge is to better assess welfare. Welfare is a multidimensional concept that must be given a multicriteria assessment. To make progress in this area we need to combine animal-based indicators to assess the level of welfare with resources and practices to identify risk factors. More research needs to be done to confirm the robustness of the criteria used today and develop new ones based on continuous recording systems with data processing algorithms to detect problems early on. These assessment systems need to then be adopted on a large scale by all farms. The European Innovation Partnership set up as part of the European Horizon 2020 programme can be an effective tool for this.

The second challenge is to continue to improve animal welfare by improving farming conditions. Progress will also come from better understanding of animals' affective experiences, including their emotions, which should help develop innovative livestock breeding practices that take into account the cognitive capacities of animals. Acknowledging animal welfare in farming should not consist only of reducing stressful experiences and minimising constraints to which they are subjected but should also favour positive experiences throughout their lives, particularly by respecting their behavioural needs and interactions with other animals and the farmer.

Progress also requires innovative approaches because animal welfare is a sensitive subject that involves many stakeholders. Globally, welfarist NGOs want fast progress with animals having greater access to the outside, more comfortable buildings where animals have more space, and the end of painful practices. On their part, farmers would like to make progress but stress the economic constraints related to the investments required and lack of market recognition for improved products in terms of animal welfare. Joint progress approaches involving all stakeholders are undoubtedly vital for there to be a widespread acceptance and understanding of the issues and solutions at hand. INRA recently began setting up a *"Laboratoire d'innovation Territoriale"* (territorial innovation laboratory) for the Grand Ouest region (Normandy, Brittany, Loire) (LIT Ouesterel) dedicated to welfare and reducing the use of antibiotics in poultry, pigs, and dairy cows, the main livestock sectors of these three regions. With the help of public authorities, elected representatives, the sector and partner welfarist associations, the LIT Ouesterel now comprises public and private actors from the entire research, development, training/transfer, production and consumption continuum, in order to develop innovative solutions together. The aim is to jointly build new farming models and livestock sectors, sell animal products from these and re-establish connections between farming and society. The idea is to provide socio-economic and ethical responses for both breeders (knowledge, tools, training) and citizen-consumers (information, labelling and certification of products from these new sectors) in a virtuous collective circle. This experience, which improves the mutual understanding of actors who in theory have differing points of view, aims to publish its findings throughout France. In 2018, the LIT Ouesterel was one of the 24 winners of the Call for Expression of Interest launched by the *Secrétariat Général Pour l'Investissement* (General Secretariat for Investment) as part of the *Programme d'Investissements d'Avenir* (Investments for the Future Programme) to build a *Territoire d'Innovation de Grande Ambition* (Territory of Innovation of Great Ambition).

Conclusion

The acknowledgement of animal welfare and elimination of pain (dehorning, castration, tail docking, debeaking, etc.) have become more prevalent issues and are now central to the sustainability of farming. Livestock actors are aware of this and the first steps have been taken with normative approaches (norms in housing, space, temperature, hygrometry) as well as joint initiatives involving breeders, veterinarians, NGOs acting to improve animal welfare and public authorities. Today, approaches based on animal-centred measures have proven relevant, and a greater understanding of the state of the animal based on more accurate visual indicators and, more automatically, new precision farming technologies, has allowed us to imagine a new generation of progress, even if this should not lead us to overlook the importance of the "naturality" component that remains a key discussion point between stakeholders.

Livestock sectors can and must always do better. Much work remains to be done in terms of the expression of animals' natural behaviour and acknowledgement of their sentient nature. The joint approaches to making progress by involving all stakeholders are certainly difficult to set up but are vital for there to be a widespread acceptance and shared understanding of the stakes and solutions at hand, and have already proven their pertinence and effectiveness. The development of new participatory research tools such as the *"living labs"* are opportunities that must be taken in order to create innovative farming systems that incorporate animal welfare right from the design phase.

Spreading progress remains a difficult task due to the diversity of farming styles in France and the number of actors involved (300,000 farmers, 250 slaughterhouses). The improvement of welfare incurs extra expenses for farms as well as the livestock sectors at large. The various sectors therefore need to be able to create added value by, for example, the consumer agreeing to pay and/or new opportunities to export animal products to higher-demand, solvent markets. There are undoubtedly opportunities to be taken but demand is currently largely focused on cheap and convenient processed products.

Translator's notes

1. The *Rencontres Animal et Société* meetings were a concertation organized by the French government with members of the parliament and local elected representatives, agricultural professional organisations, animal protection non-governmental organisations, scientists and representatives of the ministries. Four topics were subject to discussion: the status of animals, animals in the city, animals, economies and territories, and bullfighting. Those meetings resulted in 4 reports with 56 proposals in total.
2. Public funding allocated to rural and agricultural development projects.
3. INAPORC is the national inter-branch organisation for the pig sector.

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To cite this article (suggested): Peyraud J.-L. & Mirabito L., "Initiatives and achievements by farmers and the livestock sector in favour of animal welfare" [PDF file], In: Hild S. & Schweitzer L. (Eds), *Animal Welfare: From Science to Law*, 2019, pp.141-153.