HEALTH AND ANIMAL WELFARE

RUMINANT FARMING AND ANIMAL HEALTH

« How is the good health of animals guaranteed in ruminant farming? »

1

Farmers keep their herds in good health by applying biosecurity measures on a daily basis, whether these are regulatory or the result of initiatives by farmers and their sectors.

The aim of these preventive measures is to limit the introduction of pathogens into farms and the outbreak of disease, the establishment and circulation of infectious agents within the farm and their spread outside farms.

2

Preventing disease on farms helps to limit the use of medecines, whether antibiotics, anti-parasitics or, more generally, antimicrobials. In particular, it is part of the **fight against antibiotic resistance** undertaken by all animal production sectors. Thanks to concerted action by livestock farmers and health professionals, the use of antibiotics in livestock farming has fallen considerably, as have the associated risks of antibiotic resistance and, as a corollary, the impact of these drugs on the environment.

3

Animal health is closely linked to human health. Taking action to preserve the health of animals is fundamental not only to their well-being and to food safety, but also to limiting the transmission of diseases to humans in the event of zoonoses.

4

"Regular" checks on the health status of livestock are a guarantee both for public health and for controlling epizootic diseases.

5

Improving the robustness of animals (resistance and/or resilience) is also a way of guaranteeing their good health, in particular through genetic selection, boosting immunity and understanding the relationship between nutrition and health.

6

Nevertheless, when health crises do occur, they are managed by farmers (or people in contact with animals) and the food chain, in collaboration with the government and all those involved in the health sector, in order to protect the health of both animals and humans.

7

Preserving animals' health helps to ensure productivity and reduce losses, and is therefore a key factor in sustainability.

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RUMINANT FARMING AND ANIMAL HEALTH

WHAT ARE WE TALKING ABOUT?

Farm animals are exposed to viruses, bacteria and parasites that can affect their health. Animal health is a constant concern for farmers and their partners. Farmers and others involved in animal health work on a daily basis to prevent and control diseases affecting animals. Generally speaking, France is renowned for the excellent health of its livestock. Nevertheless, new health threats are emerging in the context of climate change, wildlife management and the globalisation of trade.

The management of animal health in livestock farming meets a number of challenges. Working to preserve animal health helps to protect public health, animal production, animal welfare, farmers' welfare, food safety, rural economy and environment. In fact, animal health is part of the "One Heath" approach (one health for living beings and ecosystems) which describes a multi-disciplinary and global approach to health issues (Anses, 2023d).

KEY FIGURES

In dairy farming, 3/4 of farmers have an isolation place for sick or injured animals (Idele, 2021a).

75% of farmers trim their animals' feet. 41% do so as a preventive measure and 35% as a curative measure (Idele, 2021a).

Bacteriological monitoring of water from private catchment areas is carried out in over 90% of cases where used in buildings and in almost 70% of cases where used in grazing areas (Idele, 2021a).

1 Preventive measures

Farmers protect their herds by implementing preventive measures (biosecurity)

On all livestock farms, there is a constant risk of diseases being introduced and transmitted. Outside contributors (feed deliverers, vets, inseminators, traders, etc.), visitors, introduced animals, pests (rodents, insects, birds), wildlife, equipment or vehicles entering the farm site are all potential vectors of pathogens. Biosecurity refers to all the protective measures taken on a farm to prevent or limit the introduction of these pathogens, their spread within the farm and their spread to other farms and the environment. These preventive health measures contribute to the health and well-being of animals and farmers (www.gdsfrance.org).

Farmers are improving health management on their farms:

- **by applying the basics of biosecurity:** treatment or disinfection of buildings, zoning of the farm (breeding zone, professional zone, public zone), the principle of forward movement (care given first to fragile animals, then to healthy animals and finally to sick or recently introduced animals);
- **by limiting the introduction of diseases into the farm:** management of farm workers (e.g. provision of a water point for washing hands and boots outside the buildings or the rearing area), management of animal introductions (favoured self-renewal of livestock, number of animal suppliers limited to a minimum, isolation of animals as soon as they arrive until the results of the introduction examinations), management of "animal" vectors such as pests, domestic animals and wild fauna (maintain the surroundings of the farm and fences, avoid watering farm animals at places accessible to wild fauna), cleaning of shared equipment before and after use and between each site, attention paid to the production and storage of wet feed, management of contact between animals from different herds or workshops;
- **by limiting the spread and circulation of pathogens on the farm:** isolation of sick animals in an infirmary area while maintaining contact (visual, olfactory) with their fellow animals to promote their well-being and subsequent reintroduction, quality of care to maintain animals in good health and good immunity (quality of feed and watering, comfort of housing, preventive or curative medical measures, adapted and reasoned, and in general, striving for good conditions and well-being), management of births, cleaning/disinfection, veterinary monitoring;
- **by preventing pathogens from spreading outside the farm:** identification of animals and recording of their movements to ensure traceability throughout the food chain, management of effluents (storage away from the path taken by visitors and animals, away from water points, on land without slopes, sufficiently long storage), management of animal products (identification of sick animals whose meat or milk may be unfit for consumption, keeping them out of the commercial circuit for the necessary, regulated time), management and elimination of corpses by keeping them away from the herd, in a place protected from farm animals and predators (GDS France, 2022), application of the above traffic and hygiene measures when leaving the farm (zoning, vector management, etc.).

By complying with biosecurity and husbandry recommendations, farmers not only ensure the good health of their herds, but also improve the technical and economic performance of their farms (lower level of expenditure on health, lower rate of losses, improved growth performance, etc.). It also helps to reduce the daily hassle (fewer treatments required, etc.) and increases job satisfaction (Idele, 2022).

Despite the care and preventive measures put in place, health risks persist, some of which are linked to interactions with wild animals. Wildlife can act as a reservoir (tuberculosis, brucellosis, etc.) or as a vector for pathogens (in the case of emerging diseases such as Epizootic Haemorrhagic Disease). In these situations, and depending on the nature of the infections involved (classification, emergence), farmers are faced with regulatory, technical, economic and/or social constraints.

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« Ruminant farming and animal welfare ».

2 Medecines

Whether it's a question of antibiotics or antiparasitics, preventing disease in livestock farming means limiting the use of medicines.

Reducing animals' exposure to antibiotics

Antibiotic resistance is the ability of bacteria to resist the action of an antibiotic. Globally, the widespread use or misuse of antibiotics in our societies (particularly for human health management purposes) has increased the phenomenon of antibiotic resistance. The loss of effectiveness of antibiotics affects human health, animal health and the health of ecosystems.

As part of the Green Deal for Europe, the European Commission has set a new target of reducing overall sales of antibiotics for farm animals and aquaculture in the EU by 50% between 2018 and 2030 (Anses, 2022). In view of the globalisation of trade in foodstuffs, animals and people, the fight against antibiotic resistance must not be considered solely at national and European level. International coordination is essential (Urban *et al.*, 2022).

It should also be remembered that fewer compounds or families of compounds are currently authorised for use in veterinary medicine than in human medicine, and that their use is strictly controlled.

In France, a number of measures have been in place for several years, including successive "EcoAntibio" plans drawn up by the Ministry of Agriculture. This public policy concerns all animal sectors (including pets) and all regions of France.

- In livestock farming, the rapid and concerted mobilisation of all stakeholders (private and public), and particularly livestock farmers and vets, under the first EcoAntibio plan (2012-2017) has led to a 36.5% reduction in animal exposure to antibiotics in 5 years (Anses, 2022). This success is due to the implementation of actions such as the launch of major national communication campaigns, initial and in-service training modules for vets and livestock farmers, applied research and the organisation of numerous events. Legislative and regulatory measures have been introduced to support this overall drive, including a framework for prescribing and dispensing critically important antibiotics, the drafting of guides to good practice in the use of antibiotics in veterinary medicine and the inclusion of this issue in the veterinary code of ethics.
- The EcoAntibio 2 plan (2017-2021) focused more on incentives than regulations. It aimed to continue reducing animals' exposure to antibiotics and provided for communication and training initiatives, access to alternatives to antibiotics and improved prevention of animal diseases (Ministry of Agriculture, Food and Forestry, 2017). One of the sub-objectives was to reduce exposure to colistin in the cattle, pig and poultry sectors by 50% over 5 years, as it is an antibiotic of last resort for certain human infections. This target has been largely exceeded, with a 72% reduction in 2022 compared with the 2014-2015 average.
- The EcoAntibio 3 plan (2023-2028) is a continuation of the previous plans, with the aim of following up the good results obtained over more than 10 years. For the first time, the EcoAntibio 3 plan includes resistance to other antimicrobials and antiparasites (Ministry of Agriculture and Food Sovereignty, 2023c).

KEY FIGURES

-26% in sales of veterinary antibiotics (all species) in 2022 compared with the previous year (Anses, 2023b).

Between 2011 and 2022, a **23%** reduction in the use of antibiotics in cattle (Anses, 2023b).

Between 2013 and 2020, a **45,3%** reduction in the use of antibiotics in veal calves (Chanteperdrix *et al.*, 2023)

Between 2011 and 2021, the number of intramammary treatments per dairy cow decreased by **33,9%** (Anses, 2022).

Complementary medicines such as homeopathy, phytotherapy and aromatherapy are respectively used by **37%**, **23%** and **23%** of farmers (Idele, 2021a).

RUMINANT FARMING AND ANIMAL HEALTH

2 Medecines

Technical levers used on ruminant farms to fight antibiotic resistance

Three main technical levers are being used to target and rationalise the use of antibiotics on farms:

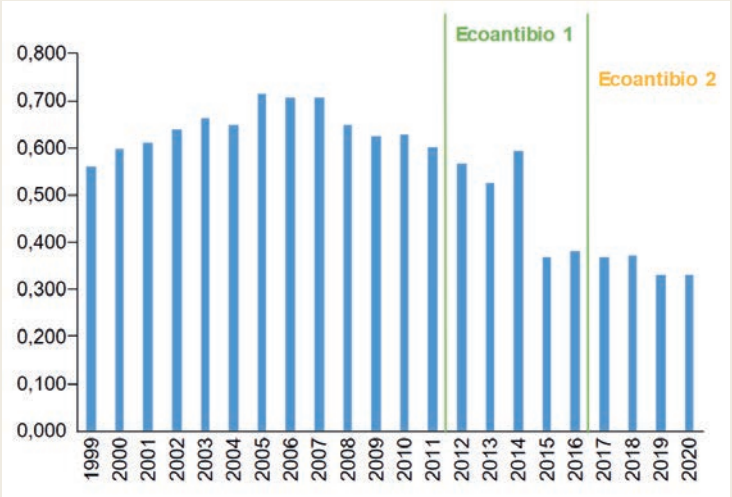
- prevention of the appearance and spread of diseases through biosecurity, reinforcement and/or development of certain farming practices, design and maintenance of livestock buildings, genetic selection incorporating certain health-related criteria, and vaccination;
- more rational use of antibiotics by changing prescriptions in line with the recommendations of Anses and of EcoAntibio plans, including, by way of illustration: the implementation of selective dry-off treatments against mastitis or the promotion of curative trimming when lameness occurs (to be reasoned out according to the aetiology);
- the use of complementary medicine, sometimes referred as alternative medicines, where possible and relevant (implementation to be reasoned according to the diseases and the intensity and nature of the signs observed) (David *et al.*, 2018).

Livestock industry initiatives to fight antibiotic resistance

Over the last fifteen years, livestock industry initiatives have led to significant progress in reducing the use of antibiotics. In ruminant farming, these initiatives consist of:

- the publication of guides to good practice for the proper use of antibiotics, with recommendations depending on the disease (SNGTV 2017 for cattle; SNGTV 2018 for small ruminants) and updated to take account of scientific, technical and regulatory developments (revisions in 2023);
- the distribution of a charter of good practice in dairy farming to help farmers in improving their practices, a charter to which almost all farmers adhere; similar initiatives have been developed in goat farming (mutual code of good practice) and guides to good practice have been drawn up in all sectors;
- the introduction of an awareness-raising campaign in veal calf production launched by Interbev and embodied in an inter-professional charter for good health control and the proper use of medicinal treatments.

In addition, in order to measure the use of antibiotics in the industry, data collection systems have gradually been put in place. This is helping to support the sectors in their progress (Urban *et al.*, 2022).



EVOLUTION OF EXPOSURE TO ANTIBIOTICS SINCE 1999 IN FRANCE (ALEA) (Urban *et al.* 2022)

KEY FIGURES

Between 2011 and 2022, the EcoAntibio 1 and 2 plans have led to a **52%** reduction in the exposure of animals to antibiotics in France and a **90%** reduction in the exposure of animals to certain veterinary antibiotics that are critical for human health (Ministry of Agriculture and Food Sovereignty, 2023c).

3 Animal health and human health

Limiting the emergence of zoonoses: a public health issue requiring coordination between stakeholders

Zoonoses are diseases or infections that can be transmitted between animals and humans. They may be caused by bacteria, viruses or parasites, or may involve non-conventional agents (prions). Depending on the agents involved, they can be transmitted by direct contact with humans or indirectly, *via* food, water, air or, more broadly, the environment (World Health Organisation, 2020). These diseases have an impact on health, environment, economy and society. Among known zoonoses, Q fever is a bacterial zoonosis, present in 30% of cattle farms and more than half of goat and sheep herds (GDS France, 2021a). Brucellosis is also a bacterial zoonosis. France has been officially brucellosis-free for cattle since 2005. Most of France's départements also enjoy this status for brucellosis in sheep and goats (GDS France).

Farmers are one of the people who can help to limit the occurrence or spread of these diseases. They monitor their animals on a daily basis, implementing compulsory scheduled surveillance measures as well as internal and external biosecurity measures. They are supported in the field by their vet and advisors. Other players work together to prevent and deal with the threat of zoonoses and their health, social and economic repercussions: the livestock industry, hunting associations (wildlife surveillance), analysis laboratories, the World Health Organisation, national governments, universities, regional and international partners, etc.

KEY FIGURES

France has been declared officially free of bovine brucellosis since 2005 (Anses, 2023c).

Animal health is closely linked to human health *via* food

Farm animal health is central to food safety and quality. It is a fundamental element of the European Union's "Farm to Fork" strategy, which aims to make food systems fair, healthy and respectful of the environment.

The risks of contamination by food-borne pathogens or chemical contaminants are controlled and managed at every stage of production, right through to the consumer's plate. In ruminant farming, good husbandry practices, good sanitary practices and, more generally, the management of animal health by farmers are key elements in this control.

The role of the industry and public policy is to prioritise food safety and to take it into account in a "One Health" approach (the health of human beings, animals and the environment treated simultaneously). This approach is coordinated by the FAO, the WHO (World Health Organisation), the World Organisation for Animal Health and the United Nations Environment Agency.

RUMINANT FARMING AND ANIMAL HEALTH

4 Regular controls

Regular monitoring of the health status of livestock is also a guarantee of public health and the control of epizootics

An epizootic is a disease that simultaneously affects a large number of animals of the same or different species in a short space of time, in a given region (www.gouvernement.fr/risques/risques-epizootie).

Animal health in livestock farming involves a set of regulatory measures (in France and at European level) specifically targeting diseases considered to be priority health hazards in terms of risk to animals and/or humans. They involve collective prevention, surveillance and, where necessary, control measures. For example, brucellosis (which has been absent from French territory since 2005) and tuberculosis are strictly monitored, giving rise to regular checks to ensure that livestock are qualified (by obtaining health status) and that production, movements and trade are secure.

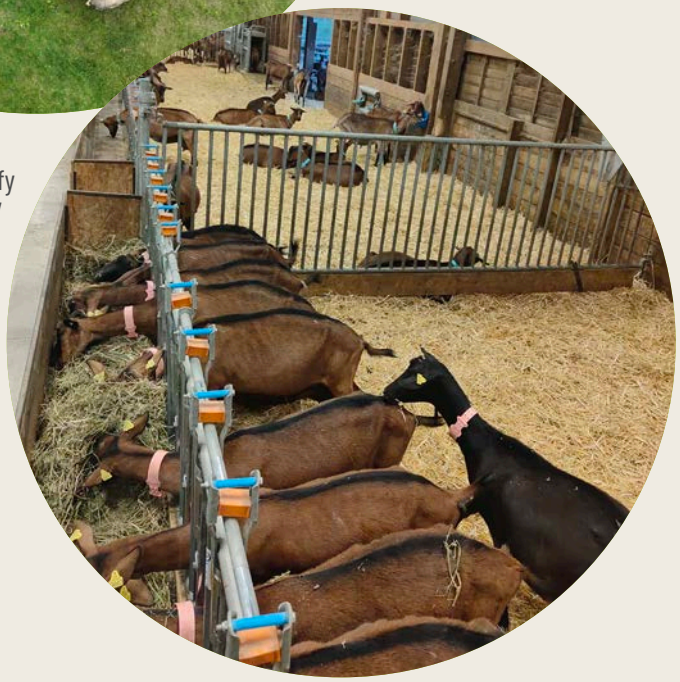
A number of statutory visits help to control animal health, such as the health visit, with the introduction of exchanges between vets and farmers on new topics defined in consultation with the industry. Livestock health check-ups (BSE) also contribute to regular health monitoring of livestock and the supervision of animal care.

KEY FIGURES

Depending on the sector, a health inspection is carried out either **once a year** (for most farms) **or every 2 years.** In addition to these visits, farmers can call on their vet as and when required.

The example of CVAE, a viral infection that is widespread in goat farms

CVAE (caprine viral arthritis encephalitis) is a slowly progressing disease, resulting in chronic inflammation of the joints and udder, and more rarely of the central nervous system and lungs. The virus can spread from infected animals, whether or not they show clinical symptoms, mainly through the ingestion of colostrum and direct contact between animals (most often) or indirectly (airborne, milking, etc.). Inter-species transmission with sheep has also been observed. There is currently no vaccine against this disease. As a result, farmers are having to implement preventive measures such as separating kids from their mothers or using heat-treated colostrum. The eradication strategy of screening and eliminating seropositive goats is not an option in France, given the very high levels of seroprevalence within and between farms.



GDS France established a new standard in May 2021 (Anses, 2023) to identify CVAE-free farms. This is a voluntary initiative in which farmers formally undertake to carry out annual individual screening and to separate sheep and goats on mixed farms. To qualify, three successive annual checks are carried out on all animals over 12 months of age and on newly-introduced animals. Thereafter, the guarantee can be maintained thanks to an annual spot check to detect a minimum seroprevalence of 2% (GDS France, 2021b).

5 The animals robustness

Improving the robustness of animals, a lever for ensuring their good health

Improving robustness is one of the levers for ensuring that animals remain in good health over the long term. In fact, it is one of the 4 areas of research and development in the UMT Ruminant Health Management project. One of the objectives is to identify and assess the levers for action that promote the resilience or resistance of ruminants to infections, in particular through genetic selection, boosting immunity or understanding the relationship between nutrition and health (Idele, 2020).

6 Health crisis management

Health crises are managed by livestock farmers and other stakeholders to protect the health of animals

In livestock farming, health crises can be partly explained by the increase in movements of people and animals, and are encouraged by climate change. For example, the emergence and rapid spread of epizootic haemorrhagic disease (EHD) in France was facilitated by favourable weather conditions for populations of Culicoides, the vectors of infection: wide geographical distribution, increasing abundance, reduced periods of vector inactivity. First detected in France in 2023, the disease mainly affects cattle and cervids (more rarely sheep, which could act as a reservoir). In addition to specific control and prevention measures, the detection of outbreaks of EHD in France has led to restrictions on animal movements at national level and to other EU Member States not affected by the disease, and even to third countries for all farms located within a 150 km radius of the outbreaks (Ministry of Agriculture and Food Sovereignty, 2023b).

The management of such crises is therefore the joint responsibility of breeders and the industry, and involves all the stakeholders in the health sector (vets, GDS network) at both local and national level (SNGTV, GDS France, Races de France, DGAL, La Coopération Agricole, reference laboratories and even research teams). In the field, veterinarians and GDS advisers are responsible for informing farmers about diseases and providing technical support. They advise them on any measures they need to take (www.gdsfrance.org) and help them implement them.

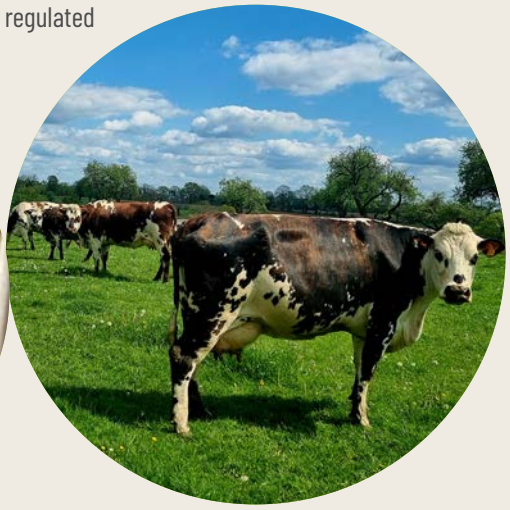
7 Optimising productivity

Optimising the health of farm animals means avoiding losses in animal production due to disease

Production losses are an economic issue. They can be of various kinds:

- sick animals are often less productive and their products may be unfit for consumption and therefore discarded;
- in the case of medicinal treatment, animal products are not marketed during the withdrawal periods defined for each speciality and each indication;
- regulatory slaughter may be ordered for animals suffering from certain regulated diseases (e.g. bovine tuberculosis);
- by protecting the health of their herds, livestock farmers are doing everything they can to keep production losses to a minimum.

In dairy production, the average financial loss is estimated at €224 per case of mastitis, but there is considerable variation around this figure (Raboisson *et al.*, 2020).



ACTIONS AND TOOLS IMPLEMENTED BY THE SECTORS

The Joint Technology Unit (UMT) Ruminant Health Management (PSR)

The UMT is a partnership between Institut de l'Elevage, Ecole Nationale Vétérinaire de Toulouse and INRAE. It promotes the pooling and complementarity of skills around common objectives: to move from managing health as a situation to which we are subjected to to Health Management, based on innovative diagnostic methods to prevent and anticipate deterioration in the state of health and well-being of ruminants. The aim of the UMT PSR project is therefore to develop, propose and disseminate new health management tools that take account of individual, collective and regional aspects. It is organised around 4 areas of work:

- the development and evaluation of health indicators: from the specific diagnosis of diseases to the definition of general health indicators;
- on an individual level, improving the resistance, resilience and robustness of ruminants to increase their longevity;
- at herd, population, system and regional level, adapting health management to changes in biotic, societal and environmental constraints;
- the co-construction of references and transfer to ensure that tools, methods and knowledge are appropriated by all those involved in health, including farmers, and to optimise dissemination (Idele, 2020).

Animal Health Epidemiosurveillance Platform

The role of this multi-partner platform (signatory organisations: Adilva, Anses, CIRAD, DGAL, Fédération nationale des chasseurs, GDS France, INRAE, La Coopération Agricole, OFB, Santé publique France, SNGTV) is to improve the efficiency of surveillance:

- develop, adapt and promote a monitoring system;
- health monitoring;
- help develop synergies between surveillance and research;
- develop synergies with the plant health and food chain surveillance platforms, with a view to 'a single health;
- ensure that the various stakeholders involved work together to develop surveillance methods, taking into account scientific advances in the field;
- produce summaries of the epidemiological situation with regard to health hazards;
- to understand the determinants of significant health phenomena in order to develop appropriate surveillance measures.

The field of action concerns any health hazard that has or could have an impact on animal health and/or public health (zoonosis) and for which surveillance is desirable or required in animals, at the level of all or part of the national territory (www.plateforme-esa.fr/fr).

The Mutual Code of Good Practice for Goat Farming

The Code Mutuel de Bonnes Pratiques en Élevage Caprin (Mutual Code of Good Practice for Goat Farming), first introduced in 2004 by the Association Nationale Interprofessionnelle Caprine (ANICAP), is a collective progress initiative designed to help farmers control their practices and highlight their day-to-day work. It has evolved over time to adapt to changes in the challenges facing the industry. In 2021, following a process of co-construction with all the stakeholders in the goat dairy industry, ANICAP has developed a new version of this approach. It takes greater account of society's expectations (environmental assessment, enrichment of the goats' living environment, etc.) and includes a point dedicated to raising awareness of biosecurity when welcoming people from outside the farm.

Nearly 2,000 farmers are now Code Mutuel members, 110 technicians have been trained to carry out visits, and Code Mutuel brings together 63 organisations (dairies, livestock advisory bodies, Chambers of agriculture, goat unions, GDS, etc.) (ANICAP, 2021).

The Charter of Good Livestock Farming Practices

Set up in 1999 and constantly evolving, the Charter adopted a new ambition in 2022: to be the tool for deploying the France Terre de Lait social responsibility approach in dairy farming. It sets out the dairy industry's progress objectives in order to meet society's expectations. The Charter is therefore a suitable approach for supporting changes in farming practices and the implementation of collective commitments within France Terre de Lait. Each of the 7 chapters of the Charter defines objectives to be achieved and areas for improvement:

- animal traceability;
- herd health;
- animal feeding;
- milk production hygiene;
- social sustainability;
- environment;
- animal welfare.

By the end of 2023, the Charter had 55,000 members.

ACTIONS AND TOOLS IMPLEMENTED BY THE SECTORS

MASTITIS, I ANTICIPATE

The aim of the national 'preventing and reducing mastitis in dairy farming' project is to bring together experts in this field to update and strengthen technical knowledge and provide all the information needed to improve mastitis control. The mastitis plan also provides farmers and advisors with tools enabling farmers to self-assess the preventive practices implemented on the farm and enabling advisors to quickly and easily assess the cost of mastitis on a farm.

This programme contributes to the Ministry of Agriculture, Food and Forestry's Ecoantibio plan (https://les-mammites-j-anticipe.com/).

SECURIVO

Self-assessment tool for biosecurity on veal calf farms. The SECURIVO project, requested by the Interbev trade association and supported by Institut de l'Elevage, has been funded by the French Ministry of Agriculture as part of the EcoAntibio2 plan.

SECURIVO is available on a free website (www.securivo.idele.fr/accueil). It offers a "global" self-assessment for a quick, general overview in 30 basic questions, and a detailed self-assessment for a complete and precise overview of each biosafety topic in 123 questions.

The tool enables you to:

- provide personalised reports, specific to each situation, in the form of visual summaries (graphs);
- highlight the main 'strengths' and 'weaknesses' in each of the 10 biosafety themes;
- offer practical advice, tailored and specific to each farm, to help farmers make progress;
- provide 12 technical and illustrated brochures setting out the basic principles, standards and regulations in force.

DEPABIOS

The DEPABIOS (Participatory Approach to Improving Biosecurity) project, to be launched in 2021 with funding from FranceAgriMer, aims to provide ruminant farmers with better support in improving biosecurity practices on their farms. Raising farmers' awareness of biosecurity and facilitating a change in their practices requires the support of all the stakeholders involved: farmers, vets and livestock advisors. That's the aim of this project, to co-construct biosecurity support methods for ruminant farms, using a regional, multi-stakeholder approach.

ALONGE

Longevity is the result of two key factors: renewal (entries) and culling (exits). This is why the ALONGE project aims to rethink renewal and culling management strategies, in order to provide the best possible response to the challenges of agro-ecological transition in dairy farming systems.

One of the challenges is to raise only the number of animals needed for renewal, while limiting the number of culled animals, without penalising performance. This better management of herd demographics will make it possible, for equivalent production, to reduce the number of animals on the farm, thus contributing to a reduction in inputs (less need for feed resources) and mitigating environmental impacts, by reducing greenhouse gas emissions.

Far from proposing a single, uniform solution, ALONGE is intended as a possible solution to the diversity of French dairy systems and the specific situation of each farm. By precisely identifying premature culling from birth, this project will encourage virtuous practices that are good for the health of the animals. ALONGE thus promotes four of the five agro-ecological principles for innovative farming systems put forward by Dumont *et al.* (2013):

- integrated animal health management;
- reducing the inputs required for production;
- reducing pollution;
- strengthening the resilience of farming systems.

ACTIONS AND TOOLS IMPLEMENTED BY THE SECTORS

RUMIGEN

The consequences of global warming are already visible. In this context, the adaptation of livestock farming and the animal populations that make it up is essential. The aim of the European RUMIGEN project is to propose relevant tools for selection adapted to this challenge and meeting societal demands. The tools that will be developed aim to achieve a balanced selection between production and sustainability, incorporating new concepts such as heat tolerance. RUMIGEN is also interested in maintaining genetic diversity, in particular to take better account of the diversity of different breeds in genomic selection, especially small breeds and regional breeds.

In particular, RUMIGEN's work will enable us to better measure and characterise:

- the adaptation to heat stress;
- the sensitivity to stress environmental stress;
- the bovine epigenome.

RUMIGEN is a 5-year programme involving 18 partners, including 13 European universities and research institutes. The three partners of the UMT eBIS (Institut de l'Elevage, INRAE and Eliance) are taking part in this programme.

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