The surveillance system for **contaminants in the food chain** managed by the DGAL: report on the 2014 plan campaign

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Abstract
The Directorate General for Food (DGAL) of the French Ministry of Agriculture, Agri-food and Forestry manages a surveillance system for contaminants in food and feed. The system is complex and involves many stakeholders interacting with one another. Its main objectives are to verify if products are safe and to monitor trends in contamination over time.
In 2014, 25 surveillance programmes were implemented, across the different food sectors all along the food chain. No less than 58,179 samples were collected and approximately 800,000 analytical results were produced. As in previous years, contamination levels in food and feed were low. Data were processed on the one hand by the authorities to implement immediate risk-mitigation measures and to communicate about official actions, and on the other hand by the scientific community to conduct research work.
In 2014 again, when we look at the results, the surveillance system in place has shown evidence of effectiveness, despite many regulatory and methodological constraints, thanks to the strong commitment of the different stakeholders and the significant allocation of human and financial resources. However, a number of points could be improved to optimise the system and thus improve data quality and communication on the results.

Keywords
Surveillance, Food chain, Contaminant, Targeted surveillance, Random surveillance

Résumé
Le système de surveillance des contaminants dans la chaîne alimentaire piloté par la DGAL : bilan de la campagne des plans de surveillance et de contrôle en 2014
La direction générale de l'Alimentation (DGAL) du ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt pilote un système de surveillance de la contamination des productions alimentaires. Le système fait intervenir et interagir de nombreux acteurs. Son objectif principal est de vérifier la conformité sanitaire des productions et de suivre les niveaux de contamination susceptible de se retrouver dans les denrées alimentaires.
En 2014, 25 plans de surveillance ou de contrôle ont été mis en œuvre, répartis dans toutes les filières et aux différentes étapes de la chaîne alimentaire. Un total de 58 179 prélèvements ont été effectués et environ 800 000 résultats d'analyses ont été produits. Comme les années précédentes, les niveaux de contamination des denrées et des aliments pour animaux, et les taux de non-conformités évalués au regard des seuils réglementaires, sont faibles. Les données sont exploitées d'une part par les autorités pour la mise en place des mesures de gestion immédiates du risque et d'autre part par la communauté scientifique pour la réalisation de travaux de recherche. Elles permettent par ailleurs aux autorités de communiquer sur leurs actions. Au vu des résultats de 2014, le système de surveillance mis en place a montré son efficacité, malgré les contraintes réglementaires et méthodologiques, grâce à une implication forte des différents acteurs et aux importants efforts humains et financiers consentis. Cependant, un certain nombre de points pourraient être améliorés pour optimiser le système, et ainsi améliorer la qualité et la valorisation des données produites.

Mots-clés
Surveillance, chaîne alimentaire, contaminant, plan de surveillance, plan de contrôle

As part of the official controls implemented by the French authorities to ensure food safety, the Directorate General for Food (DGAL) of the French Ministry of Agriculture, Agri-food and Forestry (MAAF) manages a surveillance system for contaminants in primary animal and crop production, food of animal origin and feed. Within this system, various programmes are implemented targeting detection of a contaminant or specific class of contaminants in a given production sector (contaminant/product combination), in a specific stage of the food chain. These programmes are called surveillance plans (SPs) or control plans (CPs), depending on the objective and the sampling strategy. For SPs, sampling is random, so that the calculated level of contamination provides an estimate of that in the monitored production sector. For CPs, sampling is targeted and involves products for which health control is deemed inadequate or poor (products from areas potentially contaminated by organic pollutants) or for which the misuse of pharmacologically active substances is suspected.

The tested contaminants have a suspected or confirmed harmful effect on health, either in the short or long term, and may be: i) chemical substances (residues of veterinary drugs, hormones, plant protection products), ii) environmental or industrial chemical contaminants, iii) physical contaminants (radionuclides), iv) pathogens (bacteria, viruses, parasites), or v) antimicrobial-resistant bacteria. All food-production sectors are concerned, and the chosen sampling stage depends on the contaminant, the surveillance objective, levels of control of the related risk in the various stages of the food chain, and whether there are other surveillance systems or programmes.

Objectives of the surveillance system

The system of surveillance & control plans (SCPs) is part of the general organisation of the assessment and control of food safety. It meets several objectives. Firstly, it contributes to the verification of food safety and enables control pressure to be placed on operators in the agricultural and agri-food sectors (when the tested contaminant has a regulatory threshold for the monitored product). It also enables the monitoring of contamination in domestic and imported products, and the identification of trends and emerging contamination events. In addition, since some of the tested contaminants are inputs used

in agriculture (veterinary medicinal products, plant protection products), SCPs are able to detect the misuse of substances in agricultural practices (non-compliance with withdrawal periods for veterinary drugs, use of unauthorised plant protection products for a treated crop) or even fraudulent practices (use of unauthorised products). The system also contributes to the collection of data for estimating consumer exposure to food hazards and proposing risk-mitigation measures. Lastly, the system represents a health guarantee, for products imported from third countries and monitored at European border points, as well as for French products exported to foreign markets.

A number of contaminant/product combinations are monitored to fulfil specific European regulatory requirements. These SCPs thus contribute to the harmonisation of the sanitary quality of European products vis-à-vis certain health hazards.

How the system works

The official surveillance system for food-chain contaminants involves many stakeholders interacting with one another. The institutional organisation of the system is shown in Figure 1.

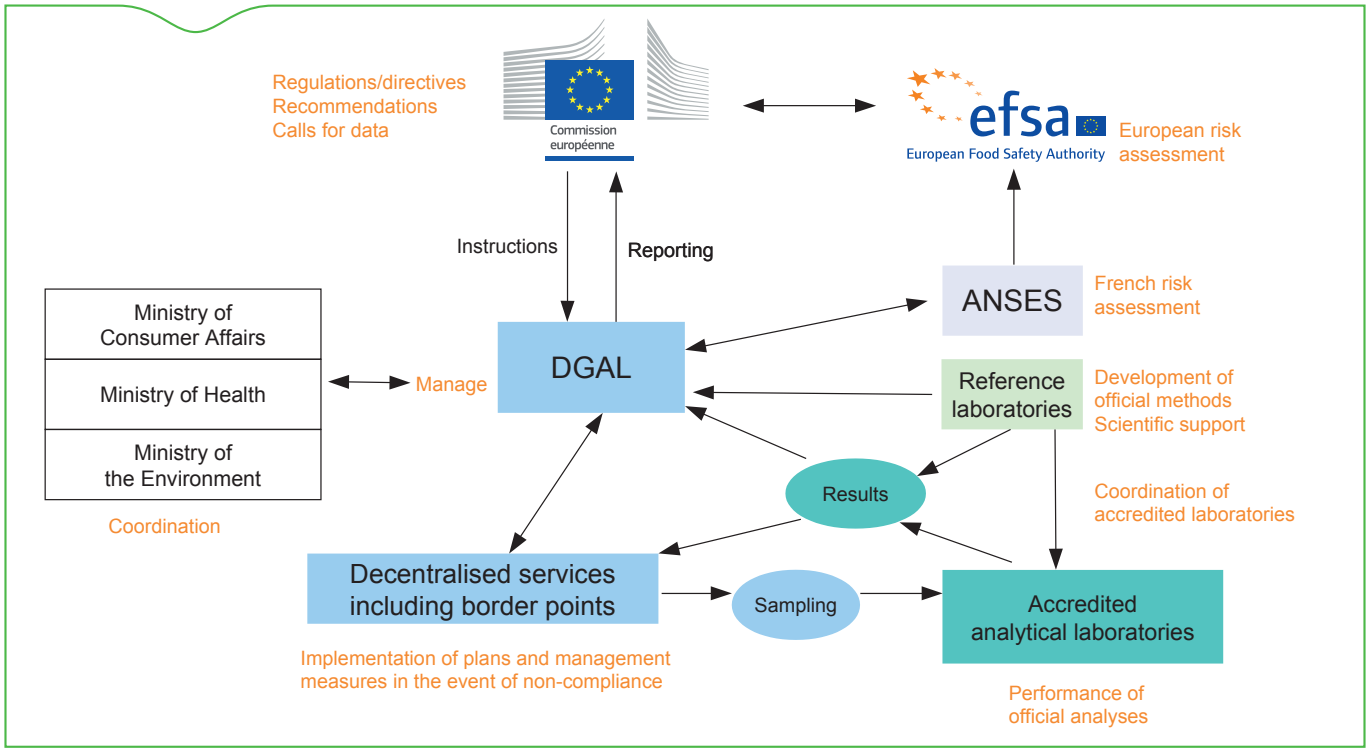

Figure 1. Institutional organisation of the official food-chain surveillance system

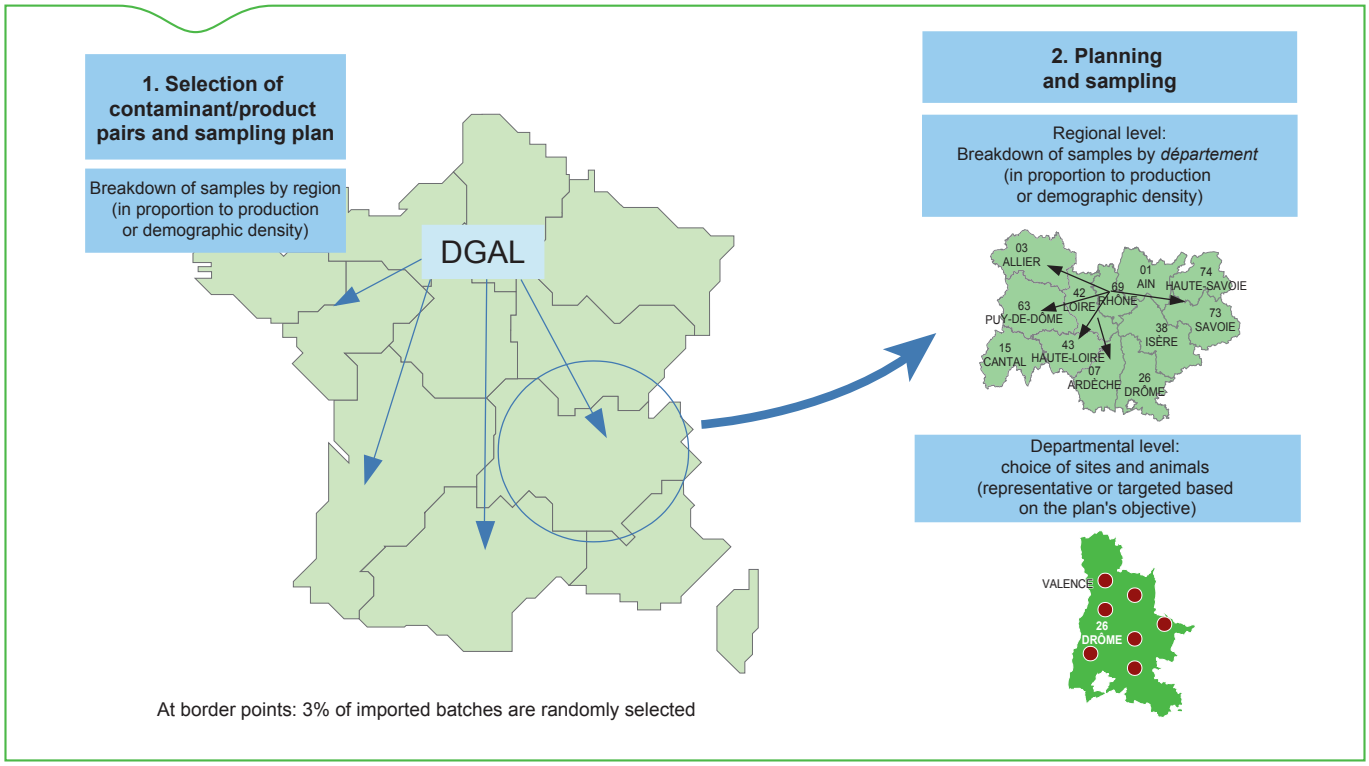

Figure 2. Functional organisation of the official food-chain surveillance system

The DGAL is in charge of the coordination of the system. Its role is to develop surveillance protocols and oversee their implementation. Every year, based on the available regulatory texts, European calls for data, risk assessment work and analytical capacities, it defines the national campaign. To do so, it selects the contaminant/product combinations that will be monitored, defines the sampling plan, and formulates the definition of a case (compliant, suspicious or non-compliant samples). This stage takes place in collaboration with other managers of surveillance systems and programmes and with the support of ANSES and the National Reference Laboratories (NRLs). At the same time, it ensures that networks of accredited laboratories, the sole recipients of samples taken in the context of SCPs, are operational to receive and analyse samples in accordance with official methods (international and national standards or methods developed and approved by NRLs). Once planning has been carried out at national level, samples are allocated to regions and *départements*, in proportion to their production for plans occurring upstream in the food chain, and to the human population size for plans taking place during distribution. Decentralised services are then responsible for selecting sampling sites and dates based on the characteristics of each plan, taking samples, and sending them to a laboratory (accredited laboratory or NRL). They manage the monitoring of results as they come in; in the event of non-compliant results, they have to implement suitable mitigation measures to reduce the risk of consumer exposure and impose sanctions on operators when necessary. Figure 2 illustrates the functional organisation of the system.

Results of the 2014 SCP campaign

In 2014, 25 programmes were implemented, across the different food sectors all along the food chain, from production to marketing, in the field of DGAL's mandate (Table 1). No less than 58,179 samples were collected and approximately 800,000 analytical results were produced. The budget allocated by the DGAL to the implementation of these SCPs totalled approximately €12 million for analytical, sampling and logistical costs alone. The number of inspectors assigned to take samples and monitor planning corresponded to approximately 110 full-time equivalent days worked (FTEW).

In the animal production sector, the large majority of samples were taken on farms and at the slaughterhouse (91%), *versus* 4.5% at the retail stage and 2% at the processing stage. The productions with the highest sampling rates were the livestock and poultry production with 57.1% and 21.9% of samples respectively. The fishery products were in third position with 7.2% of samples. The tested contaminants were primarily anabolic substances, banned or undesirable substances (38.8% of samples) such as chloramphenicol and hormones, and residues of veterinary drugs (28.4% of samples) such as antibiotics and anti-inflammatory drugs. Testing for environmental and industrial contaminants accounted for 12.5% of samples, and testing for biological contaminants (including toxins) accounted for approximately 11.6% of samples.

In the crop production sector, 1525 samples were taken to screen for plant protection product residues. They were taken in the primary production stage, at harvest, primarily from fruits and vegetables, in support of controls among users of these products or otherwise.

Figure 3 shows the breakdown of the samples by class of contaminants and by production.

This breakdown reflects the fact that, in the division of competences between the various administrations in charge of food safety, the DGAL is in charge of primary animal and crop production, and that foods from the "slaughter animals', "poultry" and "fishery products" sectors are the most commonly consumed foods. In this stage of production and in these sectors, unauthorized substances, veterinary drug residues, environmental contaminants and residues of plant protection products are the hazards that require the highest level of vigilance. In 2014, there was an increase in samples for the detection of industrial and environmenta contaminants, which pose a chronic health risk and are of major concern to consumers.

Table 1. The DGAL's surveillance and control plans for the 2014 campaign

Surveillance of the chemical and physical contamination of animal products
Control plan for chemical residues (anabolic substances, banned substances, veterinary medicinal products, pesticides, polychlorinated biphenyls (PCBs), dioxins, trace metals (TMs)) in slaughter animals, poultry, rabbits, game, farmed fish, milk, eggs, honey
Surveillance plan for the contamination of foods of animal origin derived from land animals by certain brominated flame retardants (BFRs)
Surveillance plan for the contamination of foods of animal origin by radionuclides
Surveillance plan for the antimicrobial resistance of certain sentinel and zoonotic bacteria in poultry and swine
Surveillance of the biological contamination of terrestrial animal products
Surveillance plan for the contamination of marinated poultry and pork meat by *Salmonella* spp. in the production stage
Surveillance plan for the contamination of fresh poultry meat by *Salmonella* spp. at the slaughterhouse
Surveillance plan for the contamination of raw-milk cheeses by Shiga toxin-producing *Escherichia coli* (STEC) in the production stage
Surveillance of seafood and freshwater products (excluding aquaculture)
Surveillance plan for phycotoxins and chemical contaminants (TMs, dioxins, PCBs, pesticides, polycyclic aromatic hydrocarbons (PAHs), BFRs) in bivalve molluscs
Surveillance plan for chemical contaminants (TMs, dioxins, PCBs, pesticides, PAHs, BFRs) from the aquatic environment in fishery products
Surveillance plan for veterinary medicinal products in farmed fishery products placed on the market
Exploratory plan for the detection of methylmercury in fish placed on the market
Surveillance plan for histamine in fishery products
Surveillance plan for *Escherichia coli* contamination in live bivalve molluscs
Surveillance of animal feed
Surveillance plan and control plan for undesirable substances and products in raw materials and compound animal feed
Surveillance of primary crop production
Control plan for residues of plant protection products in primary plant products
Surveillance plan for residues of plant protection products in primary plant products
Surveillance of imported products at border points
Surveillance plan for food and feed of animal origin originating from third countries
Surveillance plan for the contamination of animal feed of non-animal origin originating from third countries

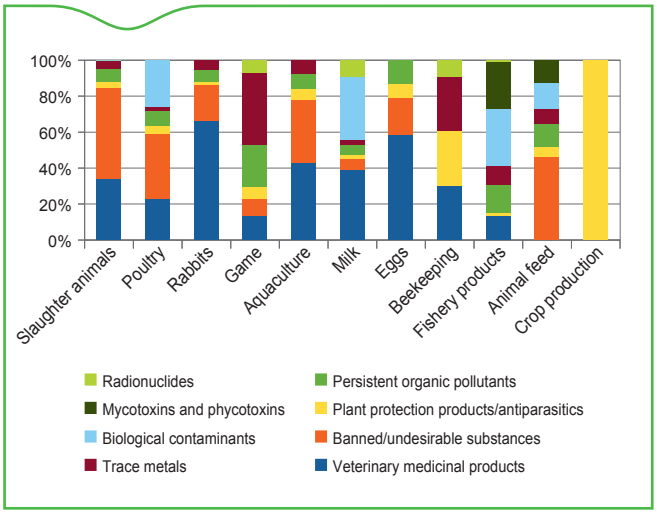

Figure 3. Breakdown of samples by class of contaminants and by sector in 2014

Table 2. SCP non-compliance rates for the 2014 campaign

Description of the plan: contaminant/product	S	C	Monitored contaminant or class of contaminants	Monitored products	Non-compliance rate (95CI)*
Chemical residues/slaughter animals		X	Anabolic substances, banned substances, veterinary medicinal products, environmental contaminants	Cattle, sheep/goats, swine, equines	0.1% (0.1-0.2)
Chemical residues/poultry		X		Spent hens/roosters, broiler chickens/ cockerels, turkeys, other	0.0% (0.0-0.1)
Chemical residues/rabbits		X		Meat rabbits	0.0% (0.-0.8)
Chemical residues/game		X		Small game birds, large game animals	0.3% (0.1-1.6)
Chemical residues/milk		X		Whole raw cow's, sheep's, goat's milk	0.1% (0.0-0.4)
Chemical residues/eggs		X		Chicken eggs, quail eggs	0.4% (0.1-1.0)
Chemical residues/farmed fish		X		Sea and freshwater (lakes, ponds) fish	0.2% (0.0-1.1)
Chemical residues/honey		X		Local honey	0.7% (0.1-3.8)
Animal feed	X		Chemical and microbiological contaminants (excluding PAPs)	Animal feed of animal and plant origin	0.1% (0.0-0.5)
		X	PAPs		0.3% (0.1-1.0))
Histamine/fishery products	X		Histamine (+ 3 biogenic amines)	Histaminogenic fish	0.4% (0.1-1.3)
Phycotoxins/bivalve molluscs	X		Lipophilic toxins, PSP and ASP	Mussels, oysters, scallops	0.4% (0.2-1.1)
Escherichia coli/live bivalve molluscs	X		*Escherichia coli*	French and imported bivalve molluscs	3.8% (2.4-5.8)
Persistent organic pollutants/fishery products (excluding aquaculture)	X		Dioxins, DL-PCBs, NDL-PCBs, BFRs, PAHs	Sea and freshwater fish, shellfish, cephalopods, molluscs	1.0% (0.4-2.4)
Trace metals/fishery products (excluding aquaculture)	X		Cadmium, lead, mercury	Sea and freshwater fish, shellfish, cephalopods, molluscs	1.8% (0.9-3.5)
Escherichia coli STEC/raw-milk cheeses	X		*E. coli* STEC	Raw-milk cheese from cows and small ruminants	0.2% (0.1-0.7)
Salmonella spp/marinated meat	X		*Salmonella* spp	Marinated poultry and pork meat	3.9% (1.8-8.2)
Residues of plant protection products/primary crop production		X	Plant protection products	Fruits and vegetables	5.7% (4.2-7.6)
Residues of plant protection products/primary crop production	X		Plant protection products	Cereals, leafy vegetables, storage cereals	2.8% (1.9-4.2)
Products of animal origin presented at border inspection points	X		Chemical and biological contaminants	Products of animal origin (food and feed)	0.4% (0.2-0.8)
Animal feed of non-animal origin, presented at designated entry points	X		Chemical and biological contaminants	Plants, minerals, additives, pre-mixes	0.0% (0.0-3.4)

S = surveillance plan; C = control plan; 95CI = 95% confidence interval
* calculated with OpenEpi software (http://www.openepi.com/Proportion/Proportion.htm)

As in previous years, contamination levels and non-compliance rates in food and feed, assessed against the regulatory thresholds, were low. Table 2 shows SCP non-compliance rates for the 2014 campaign.

In animal production, non-compliance rates ranged from 0.0% to 3.8%. The surveillance of fresh poultry meat at the slaughterhouse showed 14% prevalence for *Salmonella*. Contamination thus remained very high, in particular in the "fattening turkeys" production, but with a very pronounced slaughterhouse effect (most of the strains were isolated in a limited number of slaughterhouses). CP non-compliance rates were generally higher than those for SPs since they targeted at-risk products. Their value thus depended on the level of contamination and the definition and fulfilment of targeting criteria.

In crop production, non-compliance rates were 2.8% for the SP and 5.6% for the CP regarding residues of plant protection products. Once again, the difference might be due to the different sampling strategies, which is risk-based for the CP. The results of this CP were lower than those from 2013 (8.8%) but this decrease is not statistically significant.

Analysis of the surveillance system

In 2014, the surveillance system demonstrated its effectiveness, with the coordinated management of approximately 60,000 samples in a framework limited by regulatory and methodological constraints, thanks to harmonised procedures shared by the various stakeholders. While the system's main objective was the surveillance of food-borne human health hazards, it also served as an operational and functional framework for the deployment of plans outside this scope (testing for contaminants in pet food, exploratory plan for the detection of methylmercury in fish), in order to optimise resources.

The allocated budgets and the very high sampling rate demonstrated the significance of this mission for the DGAL and its decentralised services. Central government officials were heavily involved in the development of relevant surveillance protocols, likewise, officials from decentralised services were committed to ensuring compliance with the planning. Data were evaluated at various levels. They were used by the authorities to implement immediate risk-mitigation measures in the event of non-compliant results, to

communicate about their actions to professionals and consumers[1] and to promote French products to commercial partners. They were added to contamination databases, which were used by the scientific community to undertake research work and in particular by risk assessors for consumer exposure studies.

However, a number of points could be improved to optimise the system.

For example, the monitored contaminant/product combinations are currently chosen on the basis of sectoral prioritisation, by production or by class of contaminants. While there are a number of collaborative actions with other public and private surveillance programme managers, there is no coordinated overall prioritisation for refining the scope of surveillance covered by the SCP system and ensuring optimal coverage of the food chain in terms of surveillance.

Furthermore, the development and implementation of plans are subject to regulatory provisions that are more or less binding depending on the programme and are often not harmonised from one production or class of contaminants to the next. This complicates the coordination of the system and the implementation of surveillance protocols (difficulties accessing certain matrices, complying with the sampling strategy, etc.) and is not always in line with national concerns (requirement to monitor certain non-priority contaminant/product combinations in France). Some surveillance protocols lack a scientific basis for the definition of the sampling plan (sample size, sampling methodology, etc.), which can cause biases in the interpretation of results; implementation constraints are sometimes poorly anticipated, which leads to implementation problems in the field and therefore failures in terms of compliance with the sampling and data collection requirements. Ongoing and end-of-campaign feedback provided to the system's various stakeholders (especially decentralised services and accredited laboratories) is not specific to each group of stakeholders and does not secure their full support for the system's procedures. Lastly, the quality of data related to samples and analytical results still needs to be improved, in order to optimise their analyse and use, by the DGAL to implement suitable mitigation measures and coordinate the system, and also by the scientific community at French and European levels for contamination and exposure studies.

Expected improvements to the system

Despite the solid "quantitative" performance of the SCP system, the results of the 2014 campaign have identified areas for improvement to optimise the role of SCPs in the overall food safety scheme, in particular in terms of data quality. Various actions, in all stages of the surveillance system, could contribute to this improvement in data:

i) more robust prioritisation of the contaminant/product combinations to be monitored and improvement of the epidemiological and operational quality of surveillance protocols, ii) enhanced coordination of the system to increase the participation of field stakeholders and thus improve compliance with requirements relating to planning, sampling strategies and data collection, iii) provision to the authorities and NRLs of a tool for analysing the quality of data entry (automated indicators) and facilitating the activities the networks they supervise. Moreover, the system should undergo robust and ongoing evaluations, in order to assess its performance and cost-effectiveness.

Some areas for improvement have already been translated into concrete actions. In the framework of the action plan that followed the report on the mission for the assessment of the food safety policy in France, conducted at the request of CIMAP (Interministerial Committee for the Modernisation of Public Action), ANSES was asked to investigate two issues: the optimisation of the official surveillance of chemical contaminants in foods, and the prioritisation of microbiological and chemical hazards to be targeted for official controls to be targeted. As part of the establishment of the Food Chain Surveillance Platform[2], a project is under way to improve the quality of the data produced by SCPs, founded on the coordination of the surveillance system and the monitoring of automated indicators.

1. Annual surveillance campaign results are available on the Ministry of Agriculture's website at the following address: http://agriculture.gouv.fr/plans-de-surveillance-et-de-contrôle.

2. Under Order 2015-1242 of 7 October 2015 on the organisation of surveillance in the fields of animal health, plant health and food, pursuant to the French Act on the future of agriculture, food and forests (LAAAF).