SCIENTIFIC COMMITTEE
OF THE BELGIAN FEDERAL AGENCY FOR THE SAFETY
OF THE FOOD CHAIN

ADVICE 28-2010

Subject : Development of a barometer of the safety of the food chain: methodology and case study: 'food safety barometer' (Dossier Sci Com 2009/09)

Advice validated by the Scientific Committee on September 10th 2010

Summary

The aim of this advice is to present an instrument to measure and monitor the safety of the food chain on a yearly basis. The 'Pressure-State-Response' (PSR) model, which has already proven its appropriateness in the environmental sector, was used as a basis. The 'State' can be considered as a measure or barometer for the safety of the food chain. The 'Pressure' and 'Response' on the other hand need to be considered as additional information in order to interpret and explain the actual barometer of the safety of the food chain.

In this advice the safety of the food chain is divided up into 3 domains, namely food safety, animal health and plant health. Since the state of these 3 aspects can differ strongly and is not always interrelated, it was chosen to measure them separately with 3 different barometers.

To measure the 'Pressure' on the food chain, an inquiry of the stakeholders of the food chain in Belgium is proposed using the Las Vegas method, in order to obtain a prioritization of the observed pressures.

In order to measure the 'State' of the food chain it is proposed to use a basket of indicators of which the composition can change in time. Quantitative data need to be available for these indicators in order to allow a follow up in time. In regard to the case study 'food safety barometer' a basket of indicators is elaborated in this advice. In total 30 food safety indicators (FSI's) were identified. An important difficulty for the elaboration of the indicators was the recovery of appropriate historical quantitative data, so that a comparison over different years is possible. Indeed, the way of reporting different controls, and mainly the degree of detail, has changed over time. For a number of indicators, data became only recently available.

Based on 30 food safety indicators it is concluded that food safety in Belgium is situated on a very high level. Compared to 2007 (reference year) no significant change of the global food safety occurred in 2008.

In a second phase, a basket of indicators will be elaborated for the barometer of animal health and the barometer of plant health.

For the measurement of the 'Response' it is also proposed to conduct an inquiry of the stakeholders linked to the one on the 'Pressure'. The proposal is to investigate, on the basis of 3 questions, how the stakeholders of the food chain have reacted on the observed pressures.

Finally, a proposition for the visual presentation of the barometer food safety is elaborated.

Keywords
Indicators - Barometer – Food safety – Food chain

1. Terms of Reference

1.1. Question

This dossier was started following a request made by the Advisory Committee of the Belgian Food Safety Agency (FASFC) in regard to the identification of a number of indicators that can be used to measure the impact of the current FASFC food safety policy.

This dossier also links up with one of the objectives in the business plan drawn up by the Chief Executive Officer of the FASFC, in the sense that an instrument needs to be developed for the measurement and follow-up of the food safety evolution: a barometer for measuring the safety within the food chain.

1.2. Scope

This dossier encompasses the **safety of the entire food chain** ('from farm to fork'). This means that both the safety of foodstuffs (food safety) and the animal and plant health status are involved.

The barometer of the safety of the food chain will thus be composed of three partial aspects: the food safety barometer, the "animal health" barometer and the "plant health" barometer.

This dossier mainly focuses on the development of the concept with regard to measuring and monitoring the safety within the food chain via a "barometer", for which a case study is elaborated for the "food safety" barometer. In a later stage, the 'animal health' and 'plant health' barometers will be elaborated in an analogous way.

While the animal health and the plant health barometers are intended to measure the health status of animals and crops, the food safety barometer, on the other hand, will not give an indication as to the health status of the human population, except for a limited number of indicators. Safe food is a *conditio sine qua non* for protecting consumer's health. However the relationship between food and health is much wider than the food safety aspects that are specifically defined in this dossier. This is because, for example, unbalanced nutritional habits are responsible for a major part of disease and mortality rates due to, among others, cardiovascular diseases, diabetes and cancer (WHO, 2010). Due to the consumption of highly energetic foods (and a lack of exercise), an increasing part of the population is suffering from obesity. On the contrary, consumption of adequate quantities of vegetable, fruit and fish will contribute to a better health (Kreijl et al., 2004). The implications of these nutritional aspects for public health have not been included in this food safety barometer.

Besides the nutritional aspects of foodstuffs (energy intake, nutritional composition, balanced dietary pattern), the general quality aspects of food (e.g. organoleptic qualities, ease of use) have also been left out of consideration. As a consequence, the scope of the food safety barometer is limited to aspects relating to the chemical, physical and microbiological hazards within the food chain. Exposure of people to these hazards through other sources than food (i.e. exposure to benzene by inhalation) is not considered in the barometer.

However, as far as this issue is concerned, namely measuring the impact of the food safety policy, the outcome is often measured in terms of effects on consumer's health, more in particular with regard to diseases. In this context, reference is often made to a drop (or rise) in the number of reported cases of food poisoning or epidemiological information from sentinel laboratories with regard to reported individual cases. This information is however subject to a bias, such as an inadequate efficiency of the reporting systems used for the determination of the total disease burden, and insufficient clarity as to whether or not the reported disease cases are food related. In this dossier, we opted for the measurement of food safety mainly at the level of exposure, because the latter shows a more direct and measurable relationship with the implemented food safety policy and to a lesser degree at the level of the impact on public health, as the relationship of the latter with overall food safety is less direct and more biased by large number of other variables.

A number of food crises that occurred in the '90 (e.g. the BSE-crisis and the dioxin crisis) have shown that ensuring food safety can best be achieved by using a chain approach, whereby all respective stakeholders within the food chain bear their own responsibility for the food safety as a whole. In Belgium, such an approach was first initiated by the "Federaal Agentschap voor de Veiligheid van de Voedselketen" (FASFC or "Food Agency"), which was created in pursuance of the Law of February 4, 2000 (BS 18/02/2000). In creating a barometer of the safety of the food chain, it is clearly not the intention to develop an instrument for the assessment of the functioning of the FASFC itself.

This study aims to develop a method to measure the safety of the food chain on a national level and on a yearly basis and must be situated within the scope of the expectations of society with regard to the competences of the FASFC for safeguarding the safety of food on one hand, and animal and plant health on the other hand.

1.3. Definitions

In this dossier, the following definitions are used:

- **Food chain:** Any and all possible stages that are gone through
    - during the course of breeding and rearing of animals and growing of crops, starting from the biological material and all necessary raw materials or resources,
    - during the course of production of foodstuffs and fodders, from the stage of production up to the stage of consumption.

- **Safety of the food chain:** the general sanitary status of the food chain with regard to biological, chemical or physical hazards (including animal and plant/crop health), for which all respective chains within the food chain bear their own responsibility, ensuring that safe food is offered to the consumer (i.e. without hazardous presence of biological, chemical or physical agents, and also taking into account the circumstances under which the product is normally being used by the consumer and the information that is available for the foodstuffs concerned).

- **Food safety:** the condition of the foodstuffs in all stages of production, processing and distribution, required to guarantee protection of consumer's health, also taking into account normal circumstances of use and information available for the foodstuffs concerned.

  Food safety thus means the absence of biological, chemical or physical agents (hazards) in the foodstuffs concerned (EC regulation n° 178/2002).

- **Food or foodstuffs:** all substances and products, whether processed, partially processed or unprocessed, that are intended for human consumption or that may reasonably be expected to be consumed by humans. This notion also includes beverages, chewing gum, or any other substance, including water, that is intentionally added to the foodstuffs concerned during the course of their manufacturing, preparation or treatment. (EC regulation n° 178/2002).

- **Food safety policy:** the dynamic whole of actions (preventive and corrective) taken by the government over the entire food chain, with the intention of achieving a high-grade sanitary status for plants and animals and offering safe food to the consumer.

- **Indicator:** a measure for rendering and analyzing certain problems or issues. An indicator synthesizes or simplifies relevant data about the status or evolution of a number of phenomena or symptoms. An indicator represents a reality that is in itself

not entirely perceptible. It is an instrument that is intended for communication and support in the decision making process, and it can assume either a quantitative (cardinal) form or a qualitative (nominal or ordinal) form. (Source: 'Indicators, goals and visions for durable development' – Federal report on durable development, 2009).

- **Food Safety Indicator ('VVI' = Dutch abbrev. - FSI):** an indicator that provides broad-scoped information about the overall food safety situation. The Food Safety Indicator is not a performance indicator, in the sense that it is not being used for evaluating the performance level of a certain (set of) activities, as is often done in a management context were the goals have been clearly set. The term 'Food Safety Indicator' does not necessarily give an appreciation of the actual performance level with regard to any given activity.

- **Barometer for the safety of the food chain:** a visual rendering of the safety of the food chain, consisting of a food safety barometer, an animal health barometer and a plant health barometer.

- **Food safety barometer:** an instrument based on several Food Safety Indicators, used for providing a visually attractive representation of the food safety situation on a national level.

- **Key Activity:** an activity that forms part of the food chain and represents a considerable production volume, and/or may have a considerable impact on the food chain safety because of the very nature of the activity.

After due deliberation of the work group meetings of April 20, 2009, June 3, 2009, August 25, 2009, September 22, 2009, October 30, 2009, November 23, 2009, December 18, 2009, January 15, 2010, March 2nd, 2010, and the meetings on occasion of the workshop of the Scientific Committee on November 27, 2009 and the plenary sessions of March 19, 2010, April 23, 2010, and September 10, 2010,

the Scientific Committee recommends as follows:

2. Introduction

The idea of a barometer to measure the safety of the food chain must be viewed within the context of the prevailing trend towards measurable objectives, indicators, assessments, score systems and the like. This idea is also being inspired by the introduction of similar notions in other sectors, such as the inter-federal poverty barometer[1] and the durability barometer (Task Force Durable Development, 2009).

The barometer of the state and the safety of the food chain consists of several parts, namely:
- a food safety barometer (safety status of foodstuffs);
- an animal health barometer;
- a plant health barometer.

These barometers are not aimed at providing an exact and complete image of all possible hazards and risks within the food chain. They rather serve as an instrument for communication and trend analysis with regard to the safety status of the food chain, intended towards a broader public and/or to the respective stakeholders in the food chain. Therefore, it is not the intention to draw up a comprehensive scientific report giving an exact image of the

[1] (http://www.mi-is.be/armoede_100323-1350/pages_nl/startMenu.html)

presence and status of all potential dangers within the food chain, nor is it pretended to carry out any form of risk assessment.

The barometers must be seen as a practical instrument giving a mere **indication** of the safety status within the food chain (on the food safety, animal health and plant health levels), as based on measurements obtained through a limited number of carefully selected indicators which relate to the respective hazards and partial aspects of the food chain, and which, as a whole, will provide a representative image of the actual situation. The selection of the indicators, as well as a number of assumptions included in the case study for this safety barometer are further discussed below.

The concept for the development of a food chain safety barometer is based on the OECD "Pressure-State-Response" model (see below).

Besides a barometer for the safety status within the food chain, a measuring system will also be set up in order to chart the 'pressure' (see below) exerted on the food chain, as perceived by the respective stakeholders as having a potential impact on the food chain safety. In connection with the latter, another system will be set up for measuring policy-level initiatives developed by the stakeholders within the food chain in order to guarantee its safety ('response', see below).
These measuring systems for 'response' and 'pressure' will allow framing and interpretation of the overall safety status of the food chain (i.e. the "barometer") for use in a broader sociological context and/or policy.

3. Work method

3.1. Development of a research method

In order to be able to identify which indicators are suited for determining the safety of the food chain in a well-substantiated way, a research method was developed, consisting of several steps.

3.1.1. Step 1: Defining the research area

Despite the fact that the notions of "food safety" and "food chain safety" have well penetrated into our society, one has come to the conclusion that accurate definitions for these notions are lacking, both in the broad literature as in national and European legal reference documents. The drawing up of accurate definitions and interpretations of the scope thus constituted an important step in this process (see above).

3.1.2. Step 2: Identification of the policy objectives with regard to the safety within the food chain

It has been noticed that the policy objectives regarding safety of the food chain are not being accurately defined, neither in European documents nor in national documents. That is why, via a retrospective examination of historical reference documents, it was reverted to the social and governmental expectations regarding food safety during the dioxin crisis of 1999 and its aftermath, at a time when the FASFC was yet to be created (Coosemans, 2009).

The creation of the FASFC (Law of February 4, 2000, on the creation of the FASFC) was a milestone for the integrated supervision of the food chain in Belgium. Since that time, a long road has been travelled, requiring major efforts from the government as well as from the operators.

In order to be able to check the real evolution of the safety of the food chain since the time the FASFC was created, a synthesis has been prepared based on the expectations that were

then formulated. This period was concluded by the Royal decree of November 16, 2001, which entrusted further assignments to the FASFC. From that moment onwards, the FASFC has been enjoying all of the competences it has to this date, and the actual organisational work could be initiated, whether or not formalized in legislation texts.

The following expectations were drawn from a large number of documents. These expectations are primarily of a administrative and organizational nature.

3.1.2.1. In regard to the structure of the organization to be created

- Regrouping of all control services into one 'parastatal A'
- Operational support by a scientific and advisory committee
- As for the structure, distinction must be made of the following:
    - control
    - advice
    - research and information processing
    - information supply
    - internal auditing service

- Establishing accredited facilities for analysis and research

3.1.2.2. Competence related

- The authority to control the entire food chain, under the responsibility of the Minister of Public Health
- A strict separation of normative and control functions
- Preservation of homogenous competences regarding food chain monitoring (in view of the regionalization of things)
- Extending the competences onto the entire animal and plant health field

3.1.2.3. Staff/personnel related

- Guarding against/prohibiting any inconsistencies regarding job 'cumulation' and/or conflict of interests
- Hiring of senior officials in a mandate system with a duty to achieve a given result
- No political appointments or promotions, but solid competence guarantees
- Maximum efficiency in human resource utilization
- Drawing up of a deontological code for all staff

3.1.2.4. Operation and goal related

The basic goal is to ensure a permanent, high-quality supply of foodstuffs in general, thereby implementing the following basic principles:

- Transparency
- Subsidiarity and co-operation
- Concertation
- Scientific support
- Self-checking
- Pro-activity
- Reactivity
- Implementation of the precautionary principle
- Quality
- Independence

3.1.2.5. Regarding risk analyses

- A pro-active approach, while observing the precautionary principle
- An independent risk evaluation, also taking the precautionary principle into account, is essential for an adequate risk management
- Any risk evaluation must be scientifically substantiated

3.1.2.6. Regarding self-checking

- The entrusting of certain research projects to accredited private or public institutions
- All operators within the food chain must be made accountable via improved self-checking and implementation of the GMP and the HACCP
- Product safety primarily belongs to the responsibility of the producers
- The producers should provide the authorities with any information that is required for ensuring safety monitoring
- The obligation to report should be extended to all sectors involved, as well as to all findings that are related to food safety.
- Traceability and reliable registers throughout the entire food chain must be imposed

3.1.2.7. Regarding controls

- Supervision on self-checking
- Independent controls, based on objective criteria
- Focusing on hazardous practices and products
- Economical and fiscal analysis of fraud mechanisms
- Functional co-operation with other departments, as well as with third parties
- Elaboration of control procedures, and ensuring that they are being implemented
- Overall implementation of quality procedures, based on an integrated quality monitoring

3.1.2.8. Regarding laboratories

- Accredited laboratories
- Adequate analysis capacity for conducting routine analyses
- Co-operation with external analysis and reference laboratories

3.1.2.9. Regarding funding

- A separate budget, being a guarantee for independence
- In creating this institution, budgetary neutrality must be observed
- Financial autonomy for the control missions
- Funding is done through contributions in function of the risks that are connected to the products concerned, as well as the nature of the activities and the size or scope of these activities
- Maximum efficiency with regard to the utilization of financial resources
- Introduction of an analytic accountancy system

3.1.2.10. Regarding communication

- A transparent communication policy towards the public and the operators, ensured by an independent information service
- A transparent communication towards scientists
- A high quality internal communication
- The creation of a secure intranet
- The creation of a clearly 'visible' communication service
- Protocols concerning:
    - the exchange of information with all relevant national and international authorities
    - the exchange of information with the producers, the latter being considered as full partners
    - the exchange of information towards consumers, whereby the latter are involved in the risk management process
- Risk communication forms part of the risk analysis

3.1.2.11. Regarding crisis management

- High quality external communication with other services or departments (national and European):
    - Analysis and auditing of communication flows
    - 24/24 availability
    - Improved implementation of communication technologies
    - Guaranteed follow-up of invoices
    - Avoiding the use of letters sent by regular mail in crisis situations
- An efficient warning and follow-up system, allowing early detection of problems
- Efficient crisis management is considered a basic principle

3.1.2.12. Regarding the international context

- International co-operation with agencies sharing the same objectives
- Adequate support for the national experts who are supposed to defend the Belgian standpoints in the European Commission
- A single negotiating partner, serving as a basis for building up confidence abroad

In short:

At the time the FASFC was created, the expectations regarding the organization of the food chain control system have been clearly defined. This control system was meant to cover the entire food chain, from the point of view of protecting public health, as well as implementing basic principles, such as transparency, co-operation, consultation, scientific support, self-checking, pro-activity and reactivity, implementation of risk analysis and of the precautionary principle, as well as the quality, integrity and independence of services offered.

As far as the set goals for food safety or food chain safety are concerned, much has yet to be clarified: the descriptions or specifications don't go any further than a mere "guarantee for a permanent high quality of our food".

3.1.3. Step 3: The selection of a scientifically substantiated concept: the "Pressure-State-Response" concept and its implementation on the food chain

The recommendations for the barometer of the safety of the food chain are based on the 'Pressure-State-Response' (PSR) concept as a starting point for establishing the research model. The PSR concept was used in the 1980's by the OECD for the classification of environmental indicators into three different categories: Pressure (P), Status (S), and Response (R) (OECD framework for environmental indicators; Van Gerven et al., 2007). The PSR concept is based on the principle of causal relationship, occurring when human activities exert a 'pressure' on the system, thereby causing a change in the status (or 'state') of said system. Society must react to these changes and will ultimately have to take decisions ('response').

'Pressure' is exerted by numerous general forces, processes or mechanisms operating within human society (e.g.: globalisation, demographic changes, new technologies, climate change, economy crisis, new consumption patterns, etc …). These processes have an impact on the food chain and may possibly modify its status (= 'safety').
The pressure on the food chain involves economic factors, sociological factors, technological factors, environmental factors and international requirements.
In defining/analyzing the whole of these external factors that have an impact on the food chain, these are often referred to as belonging to the so-called 'PEST' or PESTLE (Political, Economic, Social, Technological, Legal, Environmental) framework, a denomination that is frequently used in management circles. The pressure on the food chain can not be measured in a direct way. It is being proposed to determine the pressure on the food chain via an inquiry among the stakeholders of the food chain (see 3.3.1.).

The 'State' or 'status' is a criterion for the safety of the food chain at the moment of measuring. As mentioned before in the section entitled 'Scope of Implementation', we opted for determining the 'State' of the food chain mainly at the level of exposure. This means that

this ‘status’ basically relates to the presence of hazards within the food chain and the existence of preventive systems for limiting the presence of such hazards, and only to lesser degree to the possible impact of these hazards on public health and on animal and plant health. Information about the status is systematically being collected via the core activities of the FASFC. The status is measured in a quantitative way, by using a ‘battery’ of indicators which, taken as a whole, constitute the actual “barometer”.

‘Response’ or ‘reaction’ refers to the policy-level and social decisions or choices that have to be made in order to react to the pressure on the food chain, as well as to the overall safety status of the latter. ‘Response’ indicators refer to individual or collective actions or reactions, aimed at mitigating, correcting or preventing any negative consequences in case changes occur within the food chain. Actions may of a technical/technological nature, or of a more policy-oriented or social nature. Policy-level actions typically involve the elaboration of rules and legislation. Social actions rather relate to initiatives taken within society itself, such as: quality labels, consumption of biologically grown products, etc … It follows that ‘Response’ actions are situated at the various levels within the food chain, namely the operator and/or sector levels, the consumer (organization) level, and the competent authorities (FAVV, Federal Public Health Service, Safety of the Food Chain and of the Environment, regional authorities), scientific advisory bodies and institutions, and so on. The reaction or ‘response’ relates to the preventive and corrective measures that are taken by the respective stakeholders within the food chain, in order to maintain or improve its safety. ‘Response’ actions basically belong to the field of risk assessment, risk management and risk communication.

3.2. Workshop: How does the proposed model correlate with the opinions or judgments of the various stakeholders within the food chain?

On November 27, 2009, a workshop was organized for various stakeholders within the food chain (FASFC, Scientific Committee of the FASFC, Advisory Committee of the FASFC, Federal Public Health Service, Safety of the Food Chain and of the Environment, Superior Health Council, industrial sectors, enterprises, universities, scientific institutions, cabinet, ….).

This workshop was aimed at determining to which extent the food safety status (as defined within the scope of expectations of society as a whole) can be measured by means of indicators. At the workshop, the Pressure-State-Response model was presented and several examples of indicators were discussed.

The workshop resulted in a number of recommendations (the sections or paragraphs where these recommendations are being discussed in this present document are indicated in italics), such as:

- There is need for an adequate definition of ‘food safety’ and ‘food chain’. *(see 1.3. definitions)*
- There is need for an adequate description of the scope of the barometer. *(see 1.2. scope of implementation and 1.3. definitions)*
- Distinction must be made between measuring food safety and measuring public health. *(see 1.2. scope of implementation)*
- It is important that the chain concept be involved in measuring the food safety status, instead of limiting oneself to measuring the exposure at the ‘end point’. *(see 3.3.2. status measurement)*
- Clarity must be provided with regard to the real goals of this barometer: is it merely an informative instrument, or rather a policy-oriented instrument? *(see 2. introduction)*
- Indicators should be representative and easy to determine. *(see 3.3.2. status measurement)*
- ‘Pressure’ factors must also be measured. *(see 3.3.1. pressure measurement)*
- The actual barometer for the safety of the food chain should consist of ‘Status’-related indicators. Indicators for the ‘Pressure’ and ‘Response’ are not suited for inclusion in the barometer. The barometer should consist of 3 partial aspects, namely a food safety barometer, an animal health barometer and a plant health barometer. *(see 3.3.2. status measurement)*

A summary of the remarks that were made during the workshop's brainstorming session can be found in Annex 1.

3.3. Developing/realization of a measurement system for Pressure - State - Response

A measuring system is needed, both for determining the pressure and for determining the response. As the 3 components of the PSR-model each stand for a different aspect of the safety of the food chain, it is not possible to elaborate one single measuring system for all three components. As a consequence, specific measuring systems were established for pressure, status and response. As set out before in this present advise, the discussions during the workshop led to the conclusion that **the final barometer should only consist of 'Status', and that 'Pressure' and 'Response' must be used to give a further interpretation to 'Status' within a broader social and policy-related context.** The final barometer consists of 3 partial aspects, namely food safety, animal health and plant health, and will be measured using a 'battery' of indicators. The 'Pressure' and 'Response' will be charted by means of an inquiry among the stakeholders. Figure 1 illustrates the implementation of the PSR-model on the safety of the food chain.

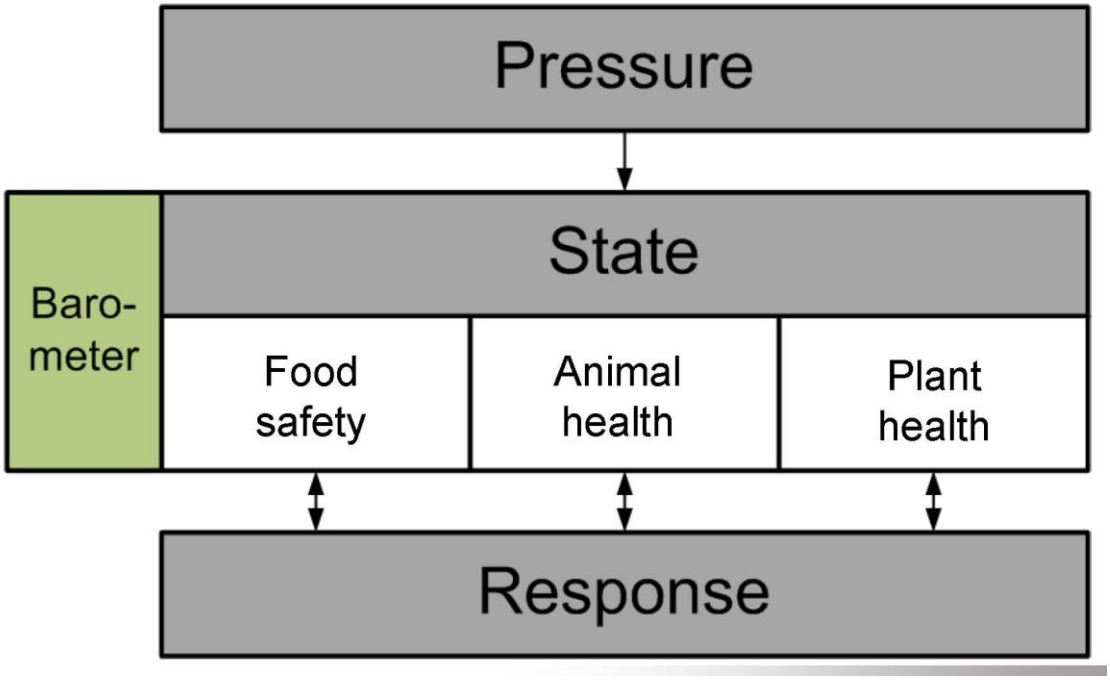


Figure 1: Implementation of the Pressure-State-Response model on food chain safety

3.3.1 'PRESSURE' MEASUREMENT

For pressure measurement, it was chosen to draw up a priority list of the pressures perceived, based on expert opinions and guided by the Las Vegas method (Gore, 1987), and also by periodically setting up an inquiry among the stakeholders within the food chain in Belgium. To this end, it is proposed, to present a list of identified pressures providing the possibility to further complete said list, in case their organization or institution might have experienced a type of pressure that was not yet included in the list. The participants will be asked to conduct some kid of appraisal or weighing by allotting 20 virtual 'tokens' to respective pressure factors, while taking into account the degree in which any given pressure factor has affected the food chain in a specific year. A single 'token' can be assigned to

several pressure factors, and several tokens may also be assigned to one single pressure factor. However, the total sum for each pressure factor must always be equal to 20. On the basis of the results thus obtained, a ranking will be established according to the relative importance of the pressure factors for any specific year. This ranking will then allow to provide more clarity with regard to the possible evolutions of the food chain safety status.

It is proposed to periodically conduct this type of inquiry among the stakeholders and experts of the food chain, namely the FASFC (e.g. the Board of Directors and the General Directorate for Control Policy), the Advisory Committee (including representatives from the sector organizations, as well as from other authorities – including the Federal Public Health Service, Safety of the Food Chain and of the Environment – and consumer organizations) and the Scientific Committee.

A list containing potential pressures can be found in Annex 2. This list was drawn up after due consultation of international literature and following due deliberation with the Advisory Committee on February 24, 2010.

3.3.2. STATUS MEASUREMENT

As explained before, the food chain safety can be split up into 3 partial aspects, namely food safety, animal health and plant health. As the specific status of each of these three partial aspects may be of a very divergent nature, and in view of their importance to the respective stakeholders, it was opted to separately measure each of these 3 partial aspects.

Numerous controls and inspections are being conducted by the FASFC, in order to monitor the safety of the food chain. If all the results of these controls and inspections would be incorporated into this measuring instrument, this would only lead to an unworkable instrument, and would pass beyond the objectives of using 'indicators'. Furthermore, an overview of most of these measurement data is publicly available in the annual reports of the FASFC or other authorities, institutions or organizations.

In pursuance of the health index[2], it is opted for 3 'batteries' of indicators that are representative for the state of food safety, for animal health and for plant health. An indicator provides information about a partial aspect of the status. The indicators are basically descriptive in nature, and are not intended for checking any data against any set goals. Their real goal is to achieve a trend analysis of the overall situation on the longer term, both at the level of the individual indicators as at the level of the barometer itself (across all indicators).

It follows that the exact composition of the battery of indicators is of major importance. This battery must also be representative for each of the 3 partial aspects of the safety of the food chain. Hence it is also clear that this battery of indicators can not by itself encompass any and all aspects or features of food safety, animal health and/or plant health. It is self-evident that each indicator will have its own limitations. Because a balanced set of indicators has been opted for, which also needs to be representative for the entire chain, it is being proposed **not** to proceed to a **weighing or appraisal** of said indicators for the time being. The composition of the indicator batteries may be modified from time to time, whenever it would appear that some indicators are not any longer representative, or whenever other indicators appear to better reflect the actual situation as a result of new developments.

The concept of using a battery of indicators inherently implies that choices must be made as to the definitions of these indicators. A number of criteria have been established for the selection of carefully considered indicators:

- **Measurability**: The actual goal of status measurement is to find out whether overall food safety, animal health or plant health have improved, deteriorated or remained the same. That is why indicators were selected that are measurable on a quantitative

2 http://economie.fgov.be/nl/statistieken/cijfers/economie/consumptieprijzen/gezondheidsindex/wat_is_gezondheidsindex/index.jsp

data basis and also are capable of rendering evolutionary trends over certain periods of time.

- **Independence**: It is recommended that the indicators should not overlap with each another.

- **Reliability**: The indicators must not be sensitive to any bias (deviations).

- **Availability**: The information required for the indicator must at all times be easily available in existing reports, documents or databanks. Only results that were collected in the context of the control program will be used for product control purposes.

- **Being representative for food safety, animal health or plant health.**

- **Being representative for the food chain**: The whole of the indicators must be representative for the entire chain (for example, for food safety, not only the sectors concerned must be addressed, but also the importation process).

- **Unambiguity of the formulation**: Is there, or is there not, an unambiguous relationship between an increase or decrease of the indicator on the one hand, and an improvement of the overall food safety and/or animal and plant health status during production on the other hand?

- **Durability**: The indicators have already been measured over a long period of time, and it is expected that they will be further followed up during many years to come.

Case study: Food Safety Barometer

For purposes of illustrating the set principles, the status of the food safety has been further elaborated, as a case study. Based on the abovementioned criteria, a battery consisting of 30 different indicators has been composed (table 1). This battery of indicators includes:

- the entire food chain, including suppliers, primary production, processing, distribution, storage and transport by third parties, as well as services and wage work
- both the Belgian production chain and the intra-Community trade and import from third countries;
- vegetable and animal production;
- product control (biological and chemical hazards)
- process control (inspections/audits)
- a preventive approach (self-checking/mandatory notification/traceability);
- human health condition (in case of a direct link with food safety, and, as such, limited to biological hazards)

Table 1 gives an overview of the 30 indicators of food safety. For each indicator, a detailed technical data sheet was drawn up, which can be found in Annex 3.

Table 1: Overview of the food safety indicators

Name	Definition
FSI1: Mandatory notification with regard to food safety	The number of notifications received by the FASFC for each year. This indicator does not relate to the notifications concerning animal diseases, plant diseases or harmful organisms, as long as they do not have an impact on food safety.
FSI2: Self-checking systems in the supply sector for primary production	The percentage of performed key activities using a validated self-checking system in the supply sector for primary production, on an annual basis.
FSI3: Self-checking systems in the primary production sector	The percentage of performed key activities using a validated self-checking system in the primary production sector, on an annual basis.

FSI4: Self-checking systems in the transformation sector	The percentage of performed key activities using a validated self-checking system in the transformation sector, on an annual basis.
FSI5: Self-checking systems in the community kitchen sector	The percentage of performed key activities using a validated self-checking system in the community kitchen sector, on an annual basis.
FSI6: Monitoring of self-checking throughout the food chain	The percentage of inspections with regard to self-checking that turned out to be OK or 'OK, subject to remarks'. These inspections are done in primary vegetable production intended for human consumption, as well as in slaughterhouses, processing, dairy farms, egg packaging plants, hotels & restaurants, community kitchens and wholesale and retail. This indicator does not include the phytosanitary inspections, because they are irrelevant to food safety.
FSI7: Inspections of infrastructure, installations and hygiene in the sectors of distribution, hotels & restaurants and community kitchens	The percentage of inspections with regard to infrastructure, installations, and hygiene in the hotel & restaurant sector, in community kitchens and in wholesale and retail businesses that turned out to be OK or 'OK, subject to remarks'.
FSI8: Inspections regarding the traceability within the food chain	The percentage of inspections regarding traceability that turned out to be OK or 'OK, subject to remarks'. These inspections are conducted at the level of the suppliers to primary production (fertilizers, soil conditioners, growing substrates, purification sludge and animal fodders), as well as at the level of primary vegetable production intended for human consumption and animal primary production (cattle farms, pig farms, farms having sheep, goat and deer-like animals, layer hen farms, poultry farms, hatcheries), slaughterhouses, traders and collecting centers (for the identification and registration of animals), transport (identification and registration of animals), processing, and, finally, wholesale and retail.
FSI9: Residues from pesticides/herbicides in vegetables and fruit of Belgian origin	The percentage of samples of vegetables and fruit of Belgian origin that is tested for residues from pestidices/herbicides and that were conform.
FSI10: Acrylamide	The percentage of samples that is tested for acrylamide and that were conform.
FSI11: Lead and cadmium in vegetables and fruit	The percentage of samples of vegetables and fruit that is tested for the presence of lead and cadmium and that were conform.
FSI12: Aflatoxin en deoxynivalenol	The percentage of samples of foodstuffs in distribution that is tested for aflatoxin B_1, B_2, G_1 and G_2 and deoxynivalenol (DON) and that were conform.
FSI13: Substances with an anabolic action, unauthorized substances and veterinary drugs for cattle and pigs	The percentage of samples/animals that is tested for substances with an anabolic action and for the presence of unauthorized substances (Group A: stilbene, and its derivates, salts and esters; antithyreogenic substances; steroids; resorcylic adic lactones (including zeranol); β-agonists; substances that listed in Annex IV of the Regulation (EEC) n° 2377/90) and veterinary drugs (group B1 (antibacterial substances, including sulfonamides and quinolones) and group B2 (anthelminthica; coccidiostatica, including nitro-imidazoles; carbamates and pyrethroids; tranquillizers; non-steroidal anti-inflammatory pharmaceuticals; other substances with a pharmacological action) that are taken in cattle and pigs, within the scope of the control program and that were conform.

FSI14: Sulfite in minced meat	The percentage of samples of minced meat that is tested for sulfite in the distribution sector and that were conform.
FSI15: Dioxins and dioxin-like PCBs in dairy products and eggs	The percentage of samples of dairy products and eggs that is tested for dioxins and dioxin-like PCBs and that were conform.
FSI16: Mercury in mollusks, crustaceans and fish	The percentage of samples of mollusks, crustaceans and fish that is tested for the presence of mercury and that turned out to be conform.
FSI17: Residues from pesticides/herbicides in vegetables and fruit originating from other EU-countries and third countries	The percentage of samples of vegetables and fruit originating from other EU-countries and third countries that is tested for the presence of herbicides/pesticides and that were conform.
FSI18: Forbidden colorants	The percentage of samples that is tested for forbidden colorants and that were conform.
FSI19: Chemical and microbiological hazards in imported animal products intended for human consumption	The percentage of samples of animal products intended for human consumption that was taken in border inspection stations and that is tested within the context of the control plan and that were conform.
FSI20: Dioxins and dioxin-like PCBs in feed	The percentage of samples of feed (raw materials, mixed fodders, premixtures and additives) that is tested for dioxins and dioxin-like PCBs and that were conform.
FSI21: Contact materials	The percentage of samples of contact materials per year that were conform.
FSI22: *Salmonella* sp. in meat pigs	The number of meat pig farms that were labelled as a risk farm for *Salmonella* sp., per year. This indicator includes both the newly labelled risk farms within a given year and the farms of which the risk status is being extended for another year.
FSI23: *Salmonella* sp. in layer hens	The percentage of negative layer hen flocks (breeding and production) for *Salmonella* sp., per year.
FSI24: *Salmonella* sp. in poultry and pigs	The percentage of samples, taken on poultry and pigs at the level of slaughterhouses and meat cutting plants, that were tested for *Salmonella* sp. and that were conform. Accordingly, this indicator relates to the analysis of carcasses and cut meat of fowl and pigs, collected in slaughterhouses and meat cutting plants.
FSI25: *E. coli* in carcasses and cut meat	The percentage of samples taken in slaughterhouses and meat cutting plants that was tested for *E. coli* and that were conform. Accordingly, this indicator includes samples of carcasses from layer hens and broilers, as well as cut pork and beef meat.
FSI26: *E. coli* in foodstuffs	The percentage of samples of foodstuffs taken in farmstead dairy producers, in the processing sector (with the exception of slaughterhouses and meat cutting plants) and in the distribution sector that was tested for *E. coli* and that were conform.
FSI27: *Listeria monocytogenes* in foodstuffs	The percentage of samples of foodstuffs taken in local producers of dairy farm products, in the processing sector and in the distribution sector that was tested for *Listeria monocytogenes* and that were conform.
FSI28: Foodborne outbreak	The number of reported individuals affected by a collective food toxin infection (CFTI), per year and per 100.000 inhabitants.
FSI29: Salmonellosis in humans	The number of reported cases of human salmonellosis (the number of humane *Salmonella* strains received by the National Reference Centre for *Salmonella* and *Shigella*), per year and per 100.000 inhabitants.
FI30: Listeriosis in humans	The number of reported cases of listeriosis per year and per

100.000 inhabitants.

For the purpose of verifying whether or not the whole set of indicators is representative for the entire chain, a Food Safety Indicator Matrix has been established (Annex 4). This matrix shows the relationship of the different Food Safety Indicators to the respective segments of the food chain. A summary of this is also presented in table 2.

Table 2: Overview of the number of Food Safety Indicators that are related to the different segments of the food chain.

Food chain segment	Number of Food Safety Indicators
Suppliers	7
Primary vegetable production	10
Primary animal production	14
Processing	15
Distribution	12
Consumer	3
Import	8
Storage and transport by third parties	7
Services and wage work	2

The indicators measure and reflect the different aspects of the food safety situation and are based on preventive measures, control actions and on public health. These preventive measures for safeguarding food safety include the setting up and implementation of food safety management systems (namely self-checking, based on good working practices and HACCP (Hazard Analysis Critical Control Points), and on mandatory notification). Control actions involve product control and inspection. And finally, a number of indicators render the impact of food safety (biological hazards only) on public health, thereby showing a clear connection to contaminated foodstuffs.

Each indicator has its own possibilities and limitations, as explained in the technical data sheets in Annex 3. In this respect, it is important to take into account the context within which the indicators were defined. The identified “food safety indicators” must constitute the basis of a food safety barometer. As far as this case study is concerned, the goal is to introduce a systematic operating procedure based on this “barometer”, in order to enable monitoring of the status of the food safety, as defined from the viewpoint of society’s expectations, in a way that is accessible to a broader public.

In this context, the interpretation of certain groups of indicators needs to be further explained in a generic way, as follows:

For example, for Food Safety Indicator 1 (mandatory notification), it is obvious that an increase of the number of reports may possibly be due to the fact that incidents have occurred (national or abroad), or may possibly be the result of a higher degree of alertness (whether or not stimulated by campaigns), leading to a greater vigilance with regard to hazards and risks. However, as mandatory notification is an inherent part of the preventive approach, and is also essential for preventing hazardous foodstuffs from entering the market, an increase of the number of reported cases anyhow indicates that there is a substantial degree of vigilance with regard to the safeguarding of food safety.

As for the presence of a validated self-checking system (Food Safety Indicators 2 to 5), it needs to be mentioned that the operators may freely choose whether or not they want to have their self-checking system validated. One must however note that, in case a key activity doesn’t have a validated self-checking system, this does not mean that the self-checking system is absent or malfunctioning. The point is that an independently validated self-checking system gives a surplus value and adds to the confidence as to the foundations and functioning of such system. An increase of the percentage of key activities with a validated self-checking system thus indirectly leads to a higher confidence level with regard to adequate preventive actions taken in order to ensure overall food safety. Furthermore, recent

literature indicates that a well functioning self-checking system is generally reflected in a better performance of food safety. (Noble et al., 2009; Sampers et al. 2010).

As for the results of product inspections (Food Safety Indicators 6 to 8) and controls od products (analyses) (Food Safety Indicators 9 up to 27), one must take into account any changes that may be made to the evaluation system from time to time (e.g. new checklists, different action limits or tolerance levels). This may result in year-to-year differences with regard to the detection of non-conformities. It is however recommended that, in case of significant changes to the evaluation system, both the sector and the authorities make strong efforts to sensitize, inform and assist the concerned operators. One must also take into account the fact that some inspections or controls may have been aimed at high-risk production sites, products or countries of origin as a result of which some degree of bias may be involved. On the other hand, in defining the indicators related to product control, it is opted, to the extent possible, to only include the results of the proposed control program, with the exclusion of analysis results from samples that were taken following complaints or incidents.

The indicators relating to samplings and analyses within the context of the control program (Food Safety Indicators 9 to 27) were defined on the basis of the percentage of established conformities (exceeding the norm or action limit) of the concerned hazard, while this does not necessarily represent a direct and significant risk to public health. In order to assess the impact on public health, a risk assessment should be conducted, taking into account the amount of exposure experienced by consumers (in the consumption phase) to the chemical or microbiological hazards, as well as the relative importance of the non-conform product within the consumer diet. These types of risk-assessments don't fall under the scope of implementation of the "barometer", but are being conducted for specific case studies and are the subject of specific dossiers of the Scientific Committee. Within the framework of the "barometer", the presence of non-conform samples, as established in the control programs for certain indicators, must accordingly be understood as an indication that good working practices were insufficiently implemented, as a result of which the predefined action limits or standards have not been met (resulting in a possible negative impact on food safety). Accordingly, an increase of the indicator, namely an increase of the percentage of conform samples, will above all reflect a better mastering of good working practices and preventive action, which also indirectly (or in some cases also directly) is an indication of the fact that the overall food safety situation has improved.

Results and presentation

As indicated in the technical data sheets (annex 3), data were gathered for the Food Safety Indicators for the years 2007 and 2008. Table 3 gives an overview of the Food Safety Indicators for which date were available in 2008 and 2007.

Table 3: Overview of the results for 2007 and 2008 of the respective Food Safety Indicators (the number of samples or inspections is shown between brackets) and significance level (* = $p < 0,05$, ** = $p < 0,01$, *** $p < 0,001$) when comparing between years.

	Results for 2007	Results for 2008	Percentual change[3]	Significance level
FSI1	357	390	9,24%	
FSI2	43,57% (1065)[1]	53,33% (1065)	22,41%	
FSI3	6,25% (84303)	11,73% (92399)	87,78%	***
FSI4	0,61% (16754)	1,76% (17888)	185,53%[4]	
FSI5	0,01% (20972)	0,11% (21635)	643,17%[4]	
FSI6	73,10% (5693)	62,16% (7068)	-14,97%	***
FSI7	77,77% (14910)	56,01% (12492)	-27,98%	***
FSI8	93,87% (11856)	94,70% (13713)	0,88%	**
FSI9	94,20% (889)	96,30% (538)	2,23%	
FSI10	91,57% (178)	89,01% (182)	-2,80%	
FSI11	100,00% (374)	100,00% (397)	0,00%	

FSI12	99,33% (297)	99,72% (406)	0,39%	
FSI13	99,81% (10945)	99,86% (11624)	0,05%	
FSI14	94,00% (480)	91,10% (936)	-3,09%	
FSI15	99,51% (838)	99,15% (470)	-0,36%	
FSI16	100,00% (153)	100,00% (212)	0,00%	
FSI17	91,20% (770)	92,30% (862)	1,21%	
FSI18	100,00% (228)	100,00% (246)	0,00%	
FSI19	99,30% (1248)	99,00% (1586)	-0,30%	
FSI20	99,20% (1441)	100,00% (1264)	0,81%	*
FSI21	95,72% (397)	95,83% (719)	0,11%	
FSI22	96,15% (6978)	93,50% (6658)	-2,75%	***
FSI23	94,66% (487)	91,83% (942)	-3,00%	
FSI24	86,62% (1248)	89,75% (1256)	3,62%	*
FSI25	93,88% (1066)	95,04% (1164)	1,24%	
FSI26	95,51% (732)	97,80% (1095)	2,40%	**
FSI27	98,16% (1872)	98,20% (5055)	0,04%	
FSI28	8,17[2]	9,37	-14,57%[5]	**
FSI29	39,92[2]	36,97	7,37%[5]	***
FSI30	0,59[2]	0,60	-1,72%[5]	
Globally			2,44%[6]	

[1]As the database of the operators and their activities was only completed in the course of 2007, there is a certain degree of uncertainty as to the number of key activities performed in the animal feed sector for the year 2007. As a consequence, the number of key activities performed in 2008 was used as a basis for the calculation of the indicator for 2007.
[2]Average value for the years 2005, 2006 and 2007
[3]Percentual change = (result 2008 – result 2007) / result 2007 x 100%
[4]As the percentage of performed key activities with a validated self-checking system for the year is below 1%, the impact on food safety is only very limited. Therefore, this indicator has been neutralized in the barometer.
[5]The sign of this indicator was changed, because a decrease of this indicator actually shows an improvement of food safety.
[6]Average value for the 28 indicators (Indicator FSI4 and FSI5 were neutralized. See[4])

Most of the Food Safety Indicators are expressed as a percentage of conform samples or as a percentage of inspections that turned out to be OK or 'OK, subject to remarks'. For these indicators, the percentual change for the year 2008 has been calculated, as compared to the year 2007.
However, the Food Safety Indicators 28, 29 and 30 are expressed in a different way (namely the number of reported cases of salmonellosis per 100.000 inhabitants, …), for which an alternative processing was required. This is because, for these indicators, the data for 2005, 2006 and 2007 were used as a reference for the calculation of an average value for these years, to which the results for 2008 were subsequently compared. This way it can be avoided that, for these low-count indicators, a incidental rise or drop in a large population might entail excessive deviations of the barometer.

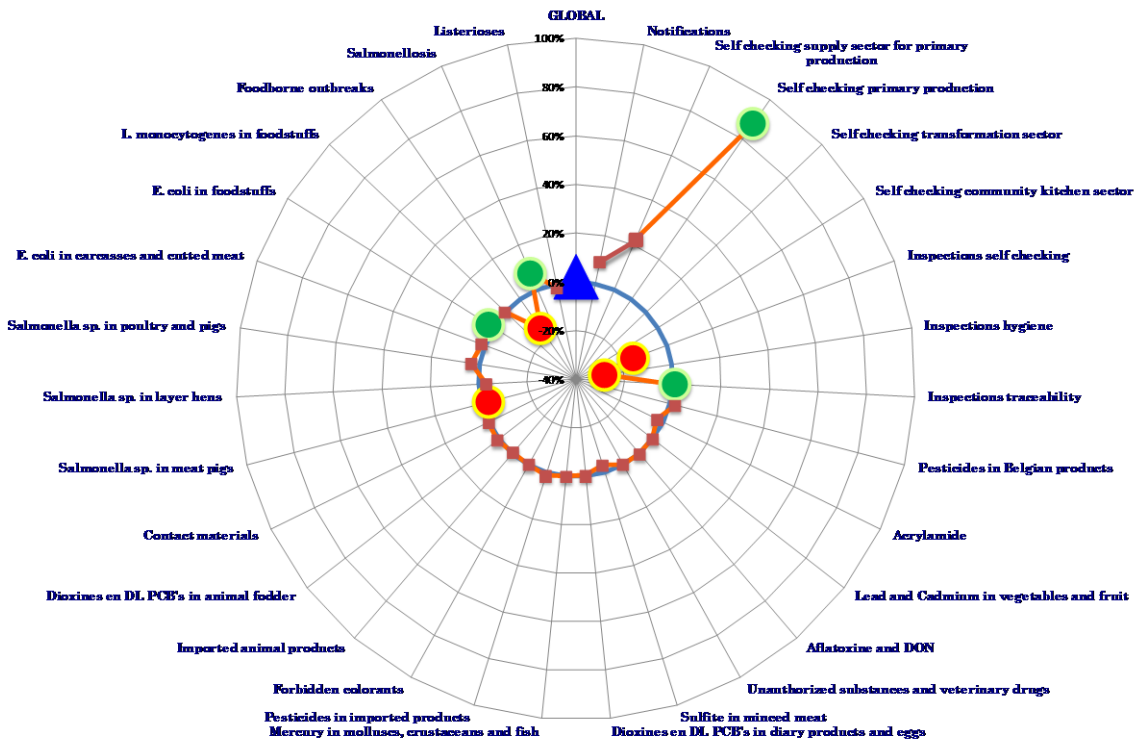
From the results it is clear that, in the first place, a significant number of indicators score very high results in regard to conformity (> 95 %), **which means that food safety in Belgium is to be situated at a very high level.**

Next, using a Poisson regression, it was checked whether the observed changes were to be considered as incidental or statistically significant (comparison of 2008 versus 2007). Given the large number of indicators (30) that are being tested, a significance level of 0,01 was used in order to detect any significant changes in a more certain way. **This analysis shows that the overall food safety situation has not significantly changed in 2008, when compared to 2007.** As for Food Safety Indicator 2 (self-checking systems in the sector of suppliers to primary production) and Food Safety Indicator 3 (self-checking systems in the primary production sector), a significant increase ($p<0,001$) was found of the percentage of performed key activities with a validated self-checking system. For Food Safety Indicator 6 (Monitoring of

self-checking) ($p<0,001$) and Food Safety Indicator 7 (Inspections of infrastructure, installations and hygiene) ($p<0,001$) a significant decrease was observed in the percentage of 'favourable' inspections (incl. 'favourable, subject to remarks'). This is to an important extent due to the implementation of a new, more stringent evaluation method. As for Food Safety Indicator 8 (Inspections on traceability) a significant increase ($p=0,006$) of the percentage of 'favourable' (incl. 'favourable, subject to remarks') was observed. The percentage of meat pig farms without risk status for Salmonella sp. (FSI22) showed a significant decrease ($p<0,001$) in 2008, when compared to 2007. As for FSI26 (*E. coli* in foodstuffs), a significant increase ($p=0,007$) of the percentage of conform samples has been noticed (97,80% in 2008, compared to 95,51% in 2007). The number of persons affected by a CFTI per 100.000 inhabitants (FSI28) was significantly greater ($p=0,004$) in 2008 when compared to the average value for 2005, 2006 and 2007. On the other hand, salmonellosis in humans (FSI29) showed a significant decrease ($p=0,001$) in 2008, when compared to the average value for 2005, 2006 and 2007. Figure 2 gives a visual representation of the results obtained.

As for the proposed processing of results, **no weighting of indicators has been included,** as a result of which each indicator will have a similar impact on the barometer. As mentioned before, when viewed from a society's standpoint, the definition of "food safety" is not as unambiguous as it seems: the impact of various indicators on the overall food safety may be perceived in a different way by different individuals or stakeholders. It is possible that one and the same change, when applied to several indicators, may result in quite different impacts on food safety and public health. For example, one will see that the impact on food safety of an increase by 20% of FSI29 (salmonellosis) will be greater than the impact of a decrease by 20% of FSI1 (mandatory notification). As was mentioned before, the primary goal of the barometer is to conduct a measuring and trend analysis regarding the "Food Safety" Status, on the basis of indicators that are directly or indirectly related to monitoring and ensuring of food safety throughout the entire food chain, rather than conducting a comprehensive 'all-in' risk-based measurement of food safety or of its impact on public health. In order to get a proper insight into the degree of importance attached to certain indicators by the various stakeholders and/or experts, it is proposed to proceed to a weighting of the indicators in the future, based on expert opinion and guided by the Las Vegas method (Gore, 1987) with the purpose to determine the relative importance of the indicators as a measure of food safety.

A


GLOBAL
Notifications
Self checking supply sector for primary production
Self checking primary production
Self checking transformation sector
Self checking community kitchen sector
Inspections self checking
Inspections hygiene
Inspections traceability
Pesticides in Belgian products
Acrylamide
Lead and Cadmium in vegetables and fruit
Aflatoxine and DON
Unauthorized substances and veterinary drugs
Sulfite in minced meat
Dioxines en DL PCB's in diary products and eggs
Mercury in molluses, crustaceans and fish
Pesticides in imported products
Forbidden colorants
Imported animal products
Dioxines en DL PCB's in animal fodder
Contact materials
Salmonella sp. in meat pigs
Salmonella sp. in layer hens
Salmonella sp. in poultry and pigs
E. coli in carcasses and cutted meat
E. coli in foodstuffs
L. monocytogenes in foodstuffs
Foodborne outbreaks
Salmonellosis
Listerioses
100%
80%
60%
40%
20%
0%
-20%
-40%

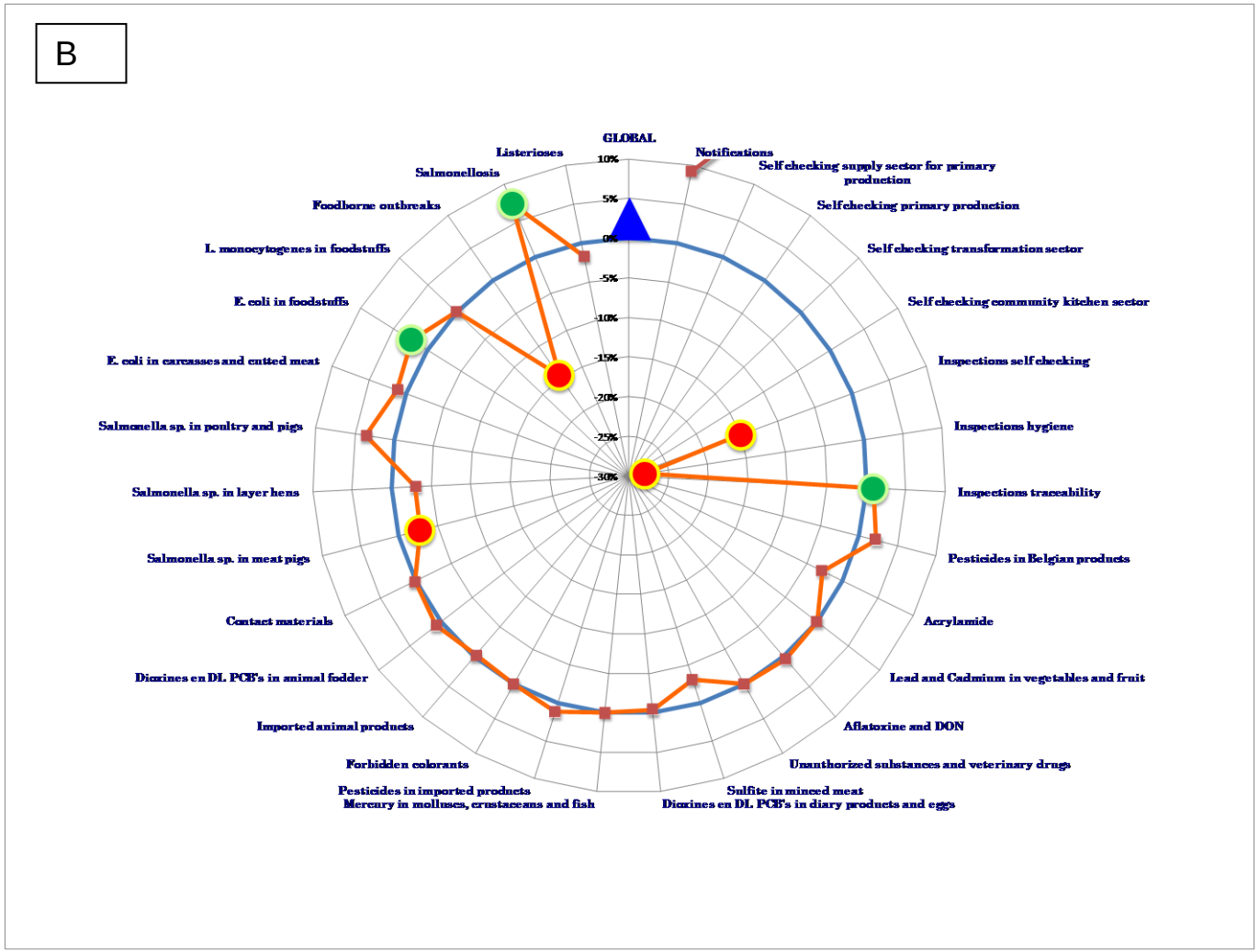


Figure 2: Visual representation of the food safety barometer (A: complete representation (scale: - 40% up to + 100 %; B: detail (scale: -30 % up to + 10%)) (▲: global food safety; ●: significant improvement of the food safety indicator; ●: significant deterioration of the food safety indicator; blue line: 0% change)

3.3.3 MEASURING THE 'RESPONSE'

Measuring of "Response" (or reaction) is done through self assessment and is aimed at charting the Response of various stakeholders within the food chain. 'Response' refers to individual or collective actions or reactions aimed at mitigating or preventing any negative consequences in case of any perceived or expected changes within the food chain (cfr. "Pressures").

As a rule, "Response" is based on risk analysis. On basis of risk assessment results (quantitative or qualitative), the stakeholders within the food chain need to set up a risk management system that includes adequate communication towards the groups or persons involved (Scientific Committee and Scientific Secretariat of the FASFC, 2005).

Various stakeholders within the food chain each bear their own responsibility for safeguarding the safety of the food chain, within the scope of their own competences and authority. (Käferstein, 2003; Scientific Committee and Scientific Secretariat of the FAVV, 2005). Possible actions are situated within the 3 sub-domains of risk analysis, namely risk assessment, risk management and risk communication, as follows.

Risk assessment

Risk assessment as a scientifically based process, consisting of four steps: identification of the hazards, characterization of the hazards, exposure assessment and risk characterization. Risk assessments may be conducted at several levels. This includes the drawing up of a mere risk profile, or the realization of an ad interim, limited or complete risk assessment, (FAO/WHO, 2002; Scientific Committee and Scientific Secretariat of the FASFC, 2005*)* depending on the amount of information, knowledge, time and resources available for the realization of such risk assessments. Furthermore, the outcome of these risk assessments will be of a different nature. For complete risk assessments, most often a numerical value is assigned to the risk and its corresponding uncertainty. In the case of ad interim or limited risk assessments, a ranking list will be drawn up of the risks or the risks will be split up into descriptive categories, based on data that constitute an inadequate basis for numerical risk assessment. This is however subject to the prior opinion of experts and to the identification of related uncertainties.

Risk assessments can be conducted on initiative of scientific institutions. However, most often they are however being conducted within the context of specific requests or calls from competent authorities or, in some cases, from sector organizations or groups of enterprises, whereby the outcome of such risk assessment serves as a basis for risk assessment (deciding on certain preventive measures, defining standards or norms, etc.). The qualitative or, preferably, quantitative information resulting from the risk assessment may also be used for hazard analysis, which forms part of the HACCP-study that is conducted at the level of the stakeholders within the food chain (Gorris, 2005).

Risk assessment can be done using in-house expertise or by gaining advice from independent experts or advisory bodies. Besides conducting, outsourcing or supporting (collective) research projects on risk assessment on their own initiative, stakeholders may also choose to passively await and follow-up the outcomes of research studies with regard to risk assessment around specific issues, by gathering information from publications or by attending study days, workshops, training programs, information sessions, etc …

Risk management

The competent authorities are responsible for **establishing standards and norms** and for the **development of required legislation or guidelines** (with the latter also on the initiative of sector organizations or operators) relating to safeguarding and control of the food chain safety, as a kind of 'benchmark' for individual businesses within the food chain.

The development of well-substantiated **control programs** and **surveillance procedures** for products, processes and human disease cases, undertaken by both the competent authorities and the sector organizations or individual operators, is of crucial importance for monitoring the safety of the food chain and will also create new opportunities for trend analysis and early detection of (newly) arising problems. Furthermore, this will lead to a greater knowledge about the spreading (and impact) of certain hazards within the food chain. Finally, this also represents an opportunity for gathering information that is essential for conducting risk assessment.

The availability of a wide range of up-to-date and performant **analysis methods in laboratories** (in-house or service labs, as well as government laboratories or scientific institutions) will enable the operators and the competent authorities to adequately substantiate or validate the respective food safety management systems or to verify the proper functioning of the latter, on the basis of analysis results. This is also allows identification of newly occurring hazards and a swift and flexible reaction whenever incidents would occur within the food chain.

Risk management is to be situated on different levels of decisiveness and certainty/surety: either directly, in basis of existing and available information; or on the mid-long term, whenever there seems to be a need for an additional gathering of knowledge; or perhaps also on the long term, due to a lack of adequate knowledge, as a result of which additional knowledge needs to be generated for the purpose of creating further insights.

Risk communication

Each and every stakeholder is responsible for providing training and information with regard to possible risks within the food chain. However, the type of information provided, as well as the channels used and the target group, will differ according to the type of the type of stakeholder within the food chain.

The competent authorities, together with the sector organizations, mainly concentrate on the explanation and clarification of the regulations and their goals towards the operators, but should also take care of adequate support and assistance towards these operators regarding the implementation of the legal requirements and in view of creating an awareness about the fact that policy related measures does result in a safeguarding against the identified hazards

The competent authorities, together with the individual operators and consumer organizations, also address the end consumers in order to make them aware of their role in safeguarding food chain safety and to inform them of any possible hazards in the food chain, thereby clearly explaining to them that a zero-tolerance for some hazards is simply very hard to achieve.

The establishing and maintaining of international relations by the different stakeholders can create opportunities for information exchange and may enable them to exert some influence on the food safety policy on an international level.

Just as is the case for risk assessment, risk communication can also be conducted on different levels, depending on the methods/channels used for getting in touch with the target group and on the efforts required by said target group to acquire the information concerned. For example, risk communication can be done via a website, whether or not containing targeted information, but one may also create opportunities to get in touch with the target group by participating to public events, such as trade fairs or by setting up specific information campaigns through various media channels, or by creating a contact point. Finally, steps can be taken to organize information or consultation sessions to which the target groups will be especially invited.

In order to chart the response, an inquiry will be held among the respective stakeholders (as set forth in paragraph 3.3.1. measuring of ‘Pressure’), that is being linked to a “Pressure” related inquiry. The goal of this inquiry is to find out how the stakeholders have reacted to the pressure factors on the food chain in the course of a given year. To this end, the participants

to the inquiry will be asked to answer the following questions for each pressure factor to which one or more 'tokens' were assigned:

- How did your institution/organization react to the pressure?
- What were the objectives of your institution/organization in doing so?
- What is the deadline set by your institution/organization for achieving any results?

It must be noted that it is not possible to give an immediate answer for all types of pressure. This is because some society-related and environmental factors are of a broad and complex nature, which definitely require an answer on the long term. It is also possible that institutions or organizations experiencing some kind of pressure may not always be the ideal stakeholders for taking further action.

Conclusion

In this dossier, an instrument is being proposed for measuring and monitoring the safety of the food chain. The Pressure-State-Response (PSR) model was used as a basis for this instrument. The 'Status' or 'condition' represents the actual barometer and is divided into three partial aspects, namely food safety, animal health and plant health. 'Pressure' and 'Response' must be understood as an additional clarification of the actual barometer, and will allow to further interpret and understand the barometer 'an sich'.

For measuring the 'Pressure', it is recommenced to proceed to a prioritisation of the perceived pressures, based on expert opinion and guided by the Las Vegas method, through an inquiry among the different stakeholders within the food chain in Belgium.

For measuring the 'State' or condition, it is opted to make use of a battery of indicators of which the composition may vary from time to time. For these indicators, quantitative data must be available, so as to ensure an adequate monitoring over time. This set of indicators has been elaborated under the form of a case study for the food safety barometer. In total, 30 food safety indicators (FSI) have been identified. Based on the comparison between the years 2007 and 2008, it was found that no significant change with regard to food safety took place in 2008, compared to 2007.

In a next stage, a similar set of indicators will need to be composed for the barometer of animal health as well as for the barometer of plant health.

As for 'Response' measuring, it is proposed to set up an inquiry among the different stakeholders, linked to the inquiry regarding the 'Pressure'. In this inquiry, it is proposed to examine, based on 3 questions how stakeholders of the food chain have reacted on perceived pressure factors.

With regard to the food safety 'Status', the Scientific Committee has been confronted with the difficulty regarding the composition of a representative set of indicators without including all of the potential risks that might occur. Let it therefore be clear that each indicator has its own possibilities and limitations, and that the whole set of indicators is representative for food safety in general, but does not encompass each and every aspect of food safety.

In the process of developing this barometer, one of the major 'bottlenecks' appeared to be the tracing of historical numerical data in the desired form. That is why it is recommended to try and maintain a consequent reporting method for the future, in order to enable a more adequate follow-up of the barometer.

The food safety indicators included in the barometer mutually differ in their direct relationship to the measuring of the actual safety within the food chain. Consequently, a further refinement of the barometer might consist of a weighting of the indicators in function of their direct relationship to food safety as perceived by various stakeholders of the food chain.

In many cases, food safety indicators are a measure of exposure. A surplus value might be added to it by conducting a risk evaluation for the purpose of assessing the impact of non-conformities on public health.

The Scientific Committee recommends to proceed to an evaluation of the formulated proposal for measuring the 'Pressure' and 'Response' following its first application. Furthermore, a regular evaluation of the set of indicators will be required, in order to check whether new indicators must be included or existing indicators need to be deleted.

Finally, the Scientific Committee came to the conclusion that the policy goals regarding food chain safety are not quantitatively defined, neither in national documents, nor in European documents. If more measurable goals would be available for specific points of interest, a further objective assessment with regard to the improvement of the safety of the food chain would be simplified.

For the Scientific Committee,
The President,

Prof. Dr. Ir. André Huyghebaert

Brussels, November 19, 2010

Annexes

Annex 1: Workshop of November 27, 2009 on the indicators for the barometer for the safety of the food chain. Overview of remarks.
Annex 2: Listing of potential pressures on the food chain
Annex 3: Technical data sheets of the indicators for the food safety status
Annex 4: Matrix of food safety indicators per sector
Annex 5: Overview of key activities

References

Carruthers, H., 2009. Using PEST analysis to improve business performance. In Practice 31, 37-39.

Coosemans, P., 2009. Performantie indicatoren op basis van historische verwachtingen ten aanzien van het FAVV. Literatuurlijst:

1. De brug naar de eenentwintigste eeuw – regeerakkoord – 7 juli 1999.
2. Regeringsverklaring – 14 juli 1999.
3. Federaal Agentschap voor de Veiligheid van de Voedselketen – persbericht Minister M. Aelvoet – 3 augustus 1999.
4. Advies aan de commissie voor de volksgezondheid, het leefmilieu en de maatschappelijke hernieuwing – Verslag van de commissie voor het bedrijfsleven, het wetenschapsbeleid, het onderwijs, de nationale wetenschappelijke en culturele instellingen, de middenstand en de landbouw – 30 november en 2 december 1999.
5. Tussentijdse aanbevelingen namens de parlementaire onderzoekscommissie belast met een onderzoek naar Belgische vlees-, zuivel- en eierproductie en naar de politieke verantwoordelijkheden in het licht van de zogenaamde dioxinecrisis – 9 december 1999.
6. Wet van 4 februari 2000 houdende oprichting van het FAVV en de memorie van toelichting bij deze wet.
7. Parlementair onderzoek naar Belgische vlees-, zuivel- en eierproductie en naar de politieke verantwoordelijkheden in het licht van de zogenaamde dioxinecrisis – 3 maart 2000.
8. Principebeslissingen betreffende het FAVV – Ministerraad 20 juli 2000.
9. Business plan – Luc Beernaert 31 oktober 2000, goedgekeurd door de Ministerraad op 22 november 2000.
10. Koninklijk besluit van 16 november 2001 houdende het toevertrouwen van bijkomende opdrachten aan het Federaal Agentschap voor de Veiligheid van de Voedselketen

FAO/WHO, 2002. Principles and guidelines for incorporating microbiological risk assessment in the development of food safety standards, guidelines and related texts. Report of a Joint FAO/WHO Consultation, Kiel Germany 18-22 maart 2002, 47p. Available on https://apps.who.int/fsf/Micro/Report_Kiel2002.pdf

Federaal Agentschap voor de Veiligheid van de Voedselketen, 2004. Activiteitenverslag 2004, 248p.

Federaal Agentschap voor de Veiligheid van de Voedselketen, 2005. Activiteitenverslag 2005, 191p.

Federaal Agentschap voor de Veiligheid van de Voedselketen, 2006. Activiteitenverslag 2006, 182p.

Federaal Agentschap voor de Veiligheid van de Voedselketen, 2007. Activiteitenverslag 2007, 224p.

Federaal Agentschap voor de Veiligheid van de Voedselketen, 2008. Activiteitenverslag 2008, 279p.

Gore, S.M., 1987. Biostatistics and the Medical Research Council. MRC News 35, 19–20.

Gorris, L.G.M., 2005. Food safety objective: an integral part of food chain management. Food Control 16, 801-809.

Houins, G., 2009. Businessplan voor het voedselagentschap 2009-2011, 88p.

Käferstein, F. K., 2003. Actions to reverse the upward curve of foodborne illness. Food Control 14, 101-109.

Kreijl, C.F., Knaap, A.G.A.C., Busch, M.C.M., Havelaar, A.H., Kramers, P.G.N., Kromhout, D., van Leeuwen, F.X.R., van Leent-Loenen, H.M.J.A., Ocke, M.C., Verkley, H. (eds), 2004. Ons eten gemeten. Gezonde voeding en veilig voedsel in Nederland. RIVM Rapport 270555007, 365p. Available on www.rivm.nl/bibliotheek/rapporten/270555007.pdf

Luning, P.A., Bango, L., Kussaga, J., Rovira, J., Marcelis, W.J., 2008. Comprehensive analysis and differentiated assessment of food safety control systems: a diagnostic instrument. Trends in Food Science & Technology 19, 522-534.

Luning, P.A., Marcelis, W.J., 2009. A food quality management research methodology. Integrating technological and managerial theories. Trends in Food Science & Technology 20, 35-44.

OECD framework for environmental indicators. Using the pressure-state-response model to develop indicators of sustainability, 11p.

Noble, S, Griffiths, M., Thompson, S., Maclaurin, T., 2009. Frequency and Type of Food Safety Infractions in Food Establishments with and without Certified Food Handlers. Food Protection Trends, 29, 840–848.

PEST Analysis. Value based management. Available on http://www.valuebasedmanagement.net/methods_PEST_analysis.html

Sampers, I., Jacxsens, L., Luning, P., Marcelis, W., Dumoulin, A., Uyttendaele, M., 2010. Relation between *Campylobacter* contamination and performance of Food Safety Management Systems in the poultry meats industries. Journal of Food Protection. In Press.

Staatssecretaris van armoedebestrijding, FOD Maatschappelijke Integratie, FOD Sociale Zekerheid en de FOD Economie, 2010. De interfederale armoedebarometer. Available on: http://www.mi-is.be/armoede_100323-1350/pages_nl/startMenu.html

Task Force Duurzame Ontwikkeling, 2009. 'Indicatoren, doelstellingen en visies van duurzame ontwikkeling' – Federaal rapport inzake duurzame ontwikkeling. 232p. Available on: http://www.plan.be/admin/uploaded/200910261232550.rapport_2009_nl.pdf

Van Gerven, T., Block, C., Geens , J., Cornelis, G., Vandecasteele, C., 2007. Environmental response indicators for the industrial and energy sector in Flanders. Journal of Cleaner Production 15, 886-894.

Verordening (EG) nr. 178/2002 van het Europees Parlement en de Raad van 28 januari 2002 tot vaststelling van de algemene beginselen en voorschriften van de levensmiddelenwetgeving, tot oprichting van een Europese Autoriteit voor voedselveiligheid en tot vaststelling van de procedures voor voedselveiligheidsaangelegenheden.

Wet van 4 februari 2000 houdende de oprichting van het FAVV.

Wetenschappelijk Comité en Wetenschappelijk Secretariaat van het FAVV, 2005. Terminologie inzake gevaren- en risicoanalyse volgens de codex alimentarius, 46p.

WHO, 2010. Global strategy: overall goal. Available on :
http://www.who.int/dietphysicalactivity/goals/en/index.html

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Incompatibility

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Legal framework of this advice

The Law of February 4, 2000, on the establishment of the “Federaal Agentschap voor de Veiligheid van de Voedselketen, and more in particular article 8 of said Law;

The Royal Decree of May 19, 2000, on the structure and operating procedures of the Scientific Committee, as established within the Federal Agency for Food Chain Safety;

The Internal Rules as mentioned in Article 3 of the Royal Decree of May 19, 2000, on the composition and operating procedures of the Scientific Committee established within the Federal Agency for Food Chain Safety, as approved by the Minister on March 27, 2006.

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