



## Measuring the perceived pressure and stakeholders' response that may impact the status of the safety of the food chain in Belgium



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### ABSTRACT

At country level the safety of the food chain is influenced by local and global pressures, such as social, economical, environmental or political pressures. As a reaction on the perceived pressures and the status of the safety of the food chain, response is taken by food policy makers and by stakeholders in order to maintain or improve the safety level. The present paper describes the measurement of the perceived pressures and the resulting responses in Belgium. In order to collect this information a survey was performed in June 2010 among the various actors in the Belgian food chain. In total 38 completed surveys were obtained (response rate: 56%). The top 3 pressures that act on the food chain are in particular of economic (financial crisis/limitation of resources, price of raw materials), political (complexity of legislation) and social (media and perception of food safety) natures. International trade and globalization of the supply chain did not show up as a high ranked pressure, neither did technological development. In general, the generation of a specific response to the perceived pressures was shown to be difficult. The various types of responses could be summarized into five main strategies: i) communication and networking; ii) training; iii) participation in working groups and elaboration of research programs; iv) legislation, control and monitoring plans; v) no or limited response.

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### 1. Introduction

The food chain is a complex web of activities in which a large number of actors and/or stakeholders are involved at different levels. It is well recognized that the safeguarding of the food chain requires an integrated approach to ensure a level – as low as reasonably achievable – of exposure of the population to potential hazards. All aspects related to the feed and food supply chain, from suppliers to primary production until the final distribution to the consumer should be addressed.

*Abbreviations:* FASFC, Belgian Federal Agency for the Safety of the Food Chain; FSI, food safety indicator; HACCP, Hazard Analysis Critical Control Points; PEST, Political, Economic, Social, Technological; PESTLE, Political, Economic, Social, Technological, Legal, Environmental; PRP, prerequisite program; PSR, Pressure–State–Response; STEEP, Social, Technological, Economic, Ecological, Political.

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In order to get a better understanding of the dynamics of the safety of the food chain the Scientific Committee of the Belgian Federal Agency for the Safety of the Food Chain (FASFC) developed, on demand of the stakeholders of the food chain and the FASFC, the food safety barometer. This barometer was developed (Baert et al., 2011; Scientific Committee, 2010) based on the Pressure–State–Response (PSR) concept, which was used in 1980s by the OECD for the classification of environmental indicators. Within this concept, 'Pressure' stands for the pressures that are exerted by numerous general forces, processes or mechanisms operating within a society and that influence the environment. The pressures involve economic factors, sociological factors, technological factors, environmental factors and international requirements. These factors are often referred to as belonging to the so-called 'PEST' or 'PESTLE' (Political, Economic, Social, Technological, Legal, Environmental) or 'STEPP' (Social, Technological, Economic, Ecological, Political) framework, a denomination that is frequently used in management circles (Value Based Management, 2010). The 'State' is a measurement of the safety of the food chain at the end of a determined period (e.g. one year). The 'Response' refers to the preventive and corrective measures that are taken by the stakeholders to react to the pressures, as well as to

the current state of the safety of the food chain as measured by the concept of the barometer, in order to maintain or improve the state. This PSR concept is based on the principle of causal relationship, occurring when activities or incidents exert a 'Pressure' on the system, thereby causing a change in the 'State' of the system (OECD Framework for Environmental Indicators, 2010; Van Gerven, Block, Geens, Cornelis, & Vandecasteele, 2007). Society reacts to these changes and will ultimately have to take decisions ('Response') (OECD Framework for Environmental Indicators, 2010).

The Belgian food safety barometer compares the state of food safety to a previous year and provides a helicopter view of the food chain (Baert et al., 2011). It is a tool to communicate in an intelligible, comprehensible manner on food safety to consumers and other stakeholders in the food chain. Food safety was reflected in a composite agreed upon set of 30 indicators related to i) the compliance to action limits/criteria for selected chemical and microbial hazards, ii) the implementation of preventive and control measures to mitigate food safety throughout the food chain from farm to fork and iii) the reported number of food borne outbreaks and reported cases of some selected zoonotic agents (*Salmonella* sp. and *Listeria monocytogenes*). Since the impact of each indicator on food safety is perceived differently by various individuals, a weighing of the indicators was performed by consulting the various food policy makers and stakeholders in the food chain including scientists of various food science disciplines, the FASFC risk managers and representatives of the agro-food industry federations, consumer organizations and other competent authorities in the Belgian food chain (Baert et al., 2011).

The concept of a food safety barometer using a set of 30 food safety indicators should enable in due time to observe trends with regard to historical evolutions of the food safety state in Belgium. There are, however, multiple factors ('Pressures') which are more or less related to the feed and food production chain which may affect the food safety status of the food chain. (Food and Consumer Product Safety Authority, 2006). Such events, trends and other types of issues shaping the development of food safety and introducing future challenges to food safety are often referred to as 'drivers of change' (EFSA, 2011; Havelaar et al., 2010). Climate change and variability is only one of the multiple factors that is often cited that may have an impact on food safety hazards (Jacxsens et al., 2010; Miraglia et al., 2009; Tirado, Clarke, Jaykus, McQuatters-Gollop, & Frank, 2010). Other factors that may influence the status of food safety are for example technological innovation (e.g. mild processing techniques, Rajkovic, Smigic, & Devlieghere, 2010), trade (e.g. import from low cost countries, Florkowski, 2008; Klontz, Klontz, Mody, & Hoekstra, 2010) and consumption patterns (e.g. increasing sales of cooked chilled foods or ready-to-eat meals (Peck, 2006) and others as reviewed by Quedsted, Cook, Gorris, & Cole, 2010). As an example of changes in society with potential impact on food safety one can refer to the food industry which seeks to reduce salt content (an important growth inhibitory factor for *L. monocytogenes*) in response to recommendations of food and health organizations that aim at reducing the average salt intake per day in order to prevent hypertension-related diseases (Goulet, Hedberg, Le Monnier, & de Valk, 2008). This, along with the aging of the Western European population (and thus increase of the risk group for listeriosis) and the fact that more mildly processed foods with extended shelf-life under refrigeration are put on the market (at risk products for *L. monocytogenes*) may impact on the incidence of listeriosis (Taormina, 2010).

However, also food (or agricultural) policy or initiatives ('Responses') taken by risk managers (either in food industry or in competent authorities) may have an impact on the status of the food safety. An example of such a response is the elaboration of an EU Directive to put monitoring and control programs in place on *Salmonella* in broilers and layers (European Parliament & Council, 2003). Although no cause-and-effect relationship between a decline in human *S. Enteritidis* infections and one of the implemented measures, namely vaccination of laying

hens in Belgium, has been statistically proven, the study by Collard et al. (2008) indicated that increased vaccination status of flocks has most probably contributed to the decrease in contamination of eggs with *Salmonella* sp. and a subsequent decrease in human salmonellosis cases reported. As another example, the prevalence of *L. monocytogenes* in deli-salads and cooked meat products has been reported to decrease in the last decennium in Belgium. Whereas in 1997–1998, the prevalence for *L. monocytogenes* in deli-salads ( $n=874$ ) and cooked meat products ( $n=3405$ ) in Belgium amounted to 21.3% and 4.9% (Uyttendaele, De Troy, & Debevere, 1999); it decreased to respectively 6.7% ( $n=1187$ ) and 1.1% ( $n=639$ ) in the period 2005–2007 (Uyttendaele et al., 2009). This evolution was hypothesized to be influenced by the introduction of specific legislative criteria for *L. monocytogenes* by the EU (European Commission, 2005) and to reflect the subsequent increased awareness and attention of food business operators to implement an effective food safety management system based on PRPs (prerequisite programs) and HACCP (Hazard Analysis Critical Control Points) aimed at preventing *L. monocytogenes* contamination in the end product (Uyttendaele et al., 2009).

Besides the measurement of the state of the food safety using the food safety barometer, it is also important to collect information regarding the pressures and responses in order to better understand the dynamics within the food chain. The current manuscript describes the methodology and results of the survey organized to i) measure the (perceived) pressure and ii) to collect information with regard to response among the stakeholders involved in the safety of the food chain in Belgium.

## 2. Materials and methods

A survey was performed in 2010 among the food policy makers and various stakeholders of the Belgian food chain, namely the FASFC (risk managers of the FASFC and directors of the directorate-general Control Policy), the Advisory Committee of the FASFC (including representatives from the sector organizations, as well as from other competent authorities and consumer organizations) and, the Scientific Committee of the FASFC (risk assessors representing various disciplines in food chain related sciences including food microbiology, food chemistry, food technology, public health, epidemiology, animal health and plant health). The relation between the different participants of the survey is shown in Fig. 1. The composition of the Advisory Committee, Scientific Committee and FASFC management can be consulted at the FASFC website ([www.favv-afsc.fgov.be](http://www.favv-afsc.fgov.be)). The survey consisted of 2 parts. In part 1 the perceived pressures were addressed and in part 2 information concerning the response was collected. The survey was executed from May to June 2010.

As a first step in the organization of the survey a list of pressures encountered in the food chain was drawn up by the authors after review of international literature and following consultation of the Advisory Committee in February 2010. These pressures were subdivided into major generic categories (economical pressure, social pressure, technological pressure, environmental/climate pressure, and pressure from national/international authorities) (Table 1). Participants of the survey were invited to add new pressures to the list. The participants were asked to assign 20 points to the different pressures by taking into account the extent in which the pressure had affected the safety of the food chain in their organization/department/area of expertise in 2009. The points could only be allocated as full units. Several points could be assigned to one pressure and several pressures could receive points, however the total sum of all assigned points had to be equal to 20. The methodology to assign a number of points, frequently 20, to different factors to set priorities, is frequently used (e.g. Baert et al., 2011; Cardoen et al., 2009; Gore, 1987) and is often referred to as the Las Vegas Method or Trial Roulette. Moreover, it was asked to provide a concise comment on how the scored pressure was experienced.

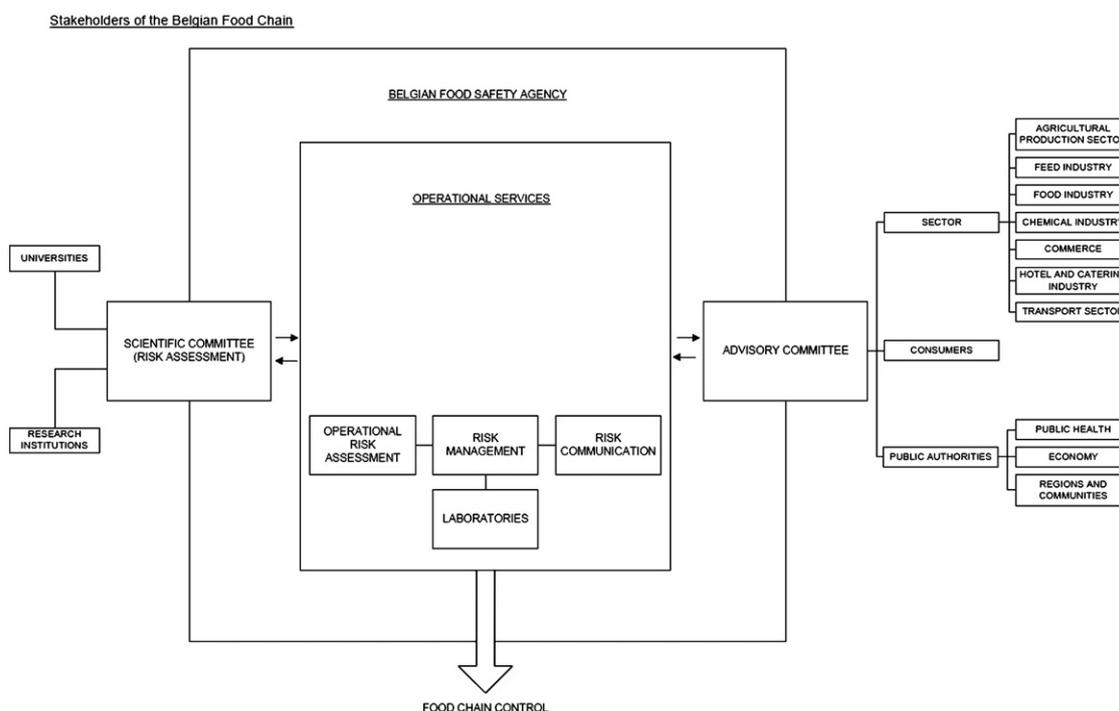


Fig. 1. Relation between the different participants of the survey.

In the response survey, the participants were asked to answer three open questions for each of the pressures from the list in Table 1 to which they had assigned 1 or more points. The questions were as follows:

- How did your organization/department or you as an expert react to the pressure?
- What was the objective of your organization/department or you as an expert in doing so?
- What is the deadline set by your organization/department or you as an expert for achieving any results?

If participants felt that it had been impossible to react on a scored response, it was asked to indicate this.

The survey was launched by mail after having explained, in face to face meetings, the concept of the barometer (Baert et al., 2011), the list of potential pressures (Table 1), and the Trial Roulette method to be used to analyze the survey. Also the open questions for collection of information on the responses were explained to the participants. Participants were asked to submit their input as individual experts (members of the Scientific Committee or the FASFC risk managers) or as representatives of a federation, organization, authority or department (members of the Advisory Committee and directors of the directorate-general Control Policy).

To process the answers, the pressures (including the pressures that were added by the participants) were subdivided into 15 categories (Table 2) and the mean number of assigned points per category was calculated. The answers that were received regarding the response were summarized in types of responses (Table 3).

### 3. Results

#### 3.1. Survey response rate

In total 38 completed surveys were obtained (response rate: 56%) of which 9, 18 and 11 were completed by respectively the FASFC (response rate: 69%), the Advisory Committee (response rate: 49%) and the Scientific Committee (response rate: 58%). Of the 18 surveys completed by the members of the Advisory Committee 13 were filled in

by representatives of the sector organizations (72%), 4 by representatives of the competent authorities (different from FASFC) (22%) and 1 by representatives of the consumer organizations (6%).

#### 3.2. Measurement of the perceived pressures

The list of various pressures was aggregated into 15 categories. Table 2 shows an overview of the obtained scores for every category. Besides a mean score for all participants, the mean number of assigned points was also calculated for the 3 groups that participated in the survey (FASFC, Advisory Committee and Scientific Committee). A distinction was made within the Advisory Committee for the answers received by the representatives of sector federations, consumer organizations and authorities.

Based on the results, a ranking was established according to the relative importance of the type of pressure perceived by the various stakeholders (Table 2). Financial and economic aspects were considered by all actors, except by the participants from the Scientific Committee, to be a dominant factor with potential impact on the actual status of food safety. Remarkable differences were observed between stakeholder groups indicating that the pressure on the food chain was differently perceived depending upon the affiliation of the actor. For example, complexity of legislation was perceived as a dominant pressure by sector federations, while pressure from international trade was ranked much lower (<1). Surprisingly international trade was considered as a more important pressure factor by FASFC than by the Advisory Committee, in which the agro-food sector federations are represented whose members are supposed to be more in the frontline of international trade pressure than a food chain control agency. However, the FASFC monitors the safety of imported foods and is in this respect confronted with the pressure on the food safety on a daily basis. Overall the complexity of the food chain (and its related legislation) seems to be a challenge for continuously assuring food safety. This may explain the ranking (total score of 0.6) of a pressure exerted by the food safety authorities which is perceived in particular by the industrial sector associations and also by the scientists. This pressure relates to the need to implement an (increasing) number of programmed controls and administration, as well as to the

**Table 1**  
Overview of the identified pressures.

1. Economical pressure factors
1.1 Increase trade within the European Union (import from EU member states)
1.2. Increase of international trade (import from non-EU member states)
1.3. Increased competition with the EU member states (impact on market price and/or export)
1.4. Price increase or limited supply of resources
1.5. Increase of integrations/aggregations in the food chain
1.6. Deterioration of the economic crisis, with an impact on investment opportunities
1.7. Decrease of the available budgets for (daily) management of food safety and food quality, leading to a greater tension between safety and profitability
1.8. Changes to the logistic chain (e.g. transport organization, chain length)
1.9. An increase of impact of demand (cfr. demand and supply)
2. Social pressure factors
2.1. Increased aging of the population (an increase of the immune-deficient population)
2.2. Increased mobility of persons, international travels, migration
2.3. Evolution of consumer behavior with regard to eating habits: growing demand for better sensory quality of food
2.4. Evolution of consumer behavior with regard to eating habits: growing demand for fresh or minimally treated (healthy) food
2.5. Evolution of consumer behavior with regard to eating habits: having meals outside the house (e.g. collectivities)
2.6. Evolution of consumer behavior with regard to eating habits: growing demand for variation, multicultural, culinary creations (e.g. original and exotic ingredients, cooking methods)
2.7. Evolution of consumer behavior with regard to eating habits: other
2.8. The occurrence of incidents that influence the consumer's perception on food safety
2.9. The occurrence of incidents that influence the perception on food safety of professional actors within the food chain
2.10. A growing stream of media reporting, having an impact on consumers perception on food safety
2.11. A growing stream of reporting in professional media, having an impact on the perception of the professional actors within the food chain
2.12. A lack of educated/trained personnel
2.13. Limited development status of 3rd world countries, having an impact on the quality of imported foodstuffs
2.14. Increased social diversity
2.15. Evolution of income inequality
3. Technological pressure factors
3.1. The development of new processing technologies or preservation techniques
3.2. The development of new insights/concepts/systematic for food safety management
3.3. The development of new/improved detection methods
3.4. The development of new/improved reporting systems/surveillance
4. Environmental/climate/physical environment related pressure factors
4.1. Increased attention to the well-being of animals
4.2. Increased attention to landscape management/environmental planning
4.3. Increased attention to the impact of (industrial) activities on the environment (water, air, soil)
4.4. Climate change: the introduction of new hazards, having an impact on food safety
4.5. Climate change: short supply of food/resources, having an impact on food security
4.6. Decreased availability of drinking water
4.7. The emergence of adaptation/resistance in biological agents (vectors or micro-organisms)
4.8. The emergence of adaptation/resistance in plants
4.9. Growing attention to newly arising health problems in humans (pandemics)
4.10. Growing attention to newly arising health problems in animals
4.11. Growing attention to newly arising health problems in plants
4.12. Growing political instability or disasters (national or international, e.g. war/conflicts)
5. Pressure from national/international authorities
5.1. Growing complexity of imposed management measures on an international or European level (legislation texts or regulations, ...)
5.2. Growing complexity of imposed management measures on a national/regional level, as required by the competent authorities
5.3. Growing complexity of imposed management measures (international/national level) between the actors in the food chain (specifications etc., ...)
5.4. Harmonizing (or a lack of it) of legal product requirements (criteria/action limits) on an international level
5.5. Harmonizing (or a lack of it) of food safety management systems recommended by the authorities for safeguarding the production process on an international level
5.6. Increase of the requirements as a result of controls/control programs executed by the authorities
5.7. Increased pressure with regard to administrative simplification
5.8. Increased pressure on the balance between food safety/economical profitability

need to develop and introduce new methods etc. in surveillance. In a similar way, and probably as a consequence of the aforementioned and in reaction to the complexity of the food chain (and its legislation), the demand for administrative simplification (pressure on the government) was also noted as a pressure and was in particular indicated by the competent authorities (total score of 0.3).

The FASFC considered (biological) adaptation, antibiotic resistance and emerging risks as well as media and perception of food safety by the general public as being important pressures (next to the dominant financial/economic issues). The Scientific Committee indicated the development of (new) analytical methods as being the most important pressure perceived with potential impact on the status of the safety of the food chain. This might relate to the fact that scientists are the most exposed actors in the development and optimization of detection methods and the elaboration of surveys (with these methods) leading to increased detection and/or potential identification of new (emerging) hazards. Only one consumer organization completed the questionnaire and indicated a high score for eating habits as having a potential impact on the safety of the food chain, but media & perception and environment & welfare were also perceived as important pressures. It was also noted that competent authorities (other than the FASFC) referred to eating habits as an important pressure.

Remarkably climate change, much debated lately in society and in scientific literature and with potential impact on food safety, received a low score from all stakeholders. This may be ascribed to the overall vaguely defined term of "climate change" and less tangible effect of it on food safety at present. Climate change is a driver with per definition a long-term impact.

### 3.3. Measurement of response

The measurement of response via open questions was perceived as a difficult exercise. The type of response received by the stakeholders was generic in nature, not specifically linked to the type of pressure and was in most cases restricted to the first question on the description, namely how the organization/department or the expert reacted to the perceived pressure. Further details on the objective or timeline of expected results to be achieved (the remaining two questions) were rarely filled out in the questionnaires. The spectrum of responses received for the various pressures was listed up as short phrases/keywords in Table 3. Overall, the various types of responses could be summarized into five main aspects: i) communication and networking; ii) training; iii) participation in working groups and elaboration of research programs; iv) legislation, control and monitoring plans; v) no or limited response.

Communication, consultation and dialogue with regard to the safety of the food chain are important ways of responding in particular by the FASFC and Advisory Committee to different types of pressures. This can take place within or among various competent authorities, within or among industrial federations and/or individual companies. It can take place at regional, national or European level. Networking and communication has also been identified as crucial issues for early detection of emerging risks which may have an impact on the current status of food safety (EFSA, 2011).

Training of collaborators, providing information and guidance to food business operators and investment in education programs was also taken up as a way to tackle the potential impact of pressures on the status of the food chain. Training and information may provide a broader context to comprehend and provide clarity on and insight into the perceived pressure (e.g. the complexity of the food chain). Training refers to capacity building whereas information may also sensitize the involved personnel, actors in the food chain or general public on potential emerging issues or expected challenges that can occur and create awareness and thus preparedness.

**Table 2**

Overview of obtained scores for the pressures divided in 15 categories for all respondents and the different groups of respondents.

Pressure (theme)	PESTLE <sup>a</sup>	Included pressures <sup>b</sup>	Mean score						
			Total <sup>c</sup>	SciCom <sup>d</sup>	FASFC <sup>e</sup>	Advisory Committee			
						Total	Authorities <sup>f</sup>	Sector	Consumer
Number of respondents			38	11	9	18	4	13	1
Financial-economic	Ec	Price increase of resources (1.4), economical crisis (1.6 & 1.12), decrease in budget (1.7), impact of demand (1.9), lack of economies of scale (1.13), income inequality (2.15), balanced food safety versus economical profitability (5.8), specifications (5.3)	3	1.8	3.6	3.9	5.3	3.8	0
Complexity legislation	P/L	International (5.1), national (5.2)	2.3	2	1.6	2.9	1	3.7	0
Media and perception	S	Incidents influencing consumer/professional actor (2.8–2.9), media attention concerning food safety consumer/professional actor (2.10–2.11)	2.3	1.5	2.7	2.6	1.8	2.8	3
Eating habits	S	Sensory quality (2.3), minimally treated (2.4), outside the house (2.5), culinary evolutions (2.6), other (2.7)	2.0	1.9	1.4	2.3	2.8	1.6	9
Adaptation/resistance/ emerging risks	T	Adaptation/resistance of biological agents (4.7) and plants (4.8), emerging risks in humans (4.9), animals (4.10) and plants (4.11)	1.9	1.5	3.1	1.5	0.5	1.8	2
International trade	Ec	Within EU (1.1) and non-EU (1.2) import, increased competition (1.3), imitation (1.10), off-shoring (1.11), limited stage of development of 3rd world countries (2.13)	1.3	2.0	1.6	0.8	1.3	0.7	0
Environment/welfare	Env	Animal well-being (4.1), landscape (4.2), environment (4.3), increased pressure on sustainable but intensive systems (2.17)	1.2	1.2	0.9	1.4	0.5	1.5	3
Methods of analysis	T	Methods of detection (3.3), surveillance (3.4), kits availability (3.5)	1.2	2.6	0.8	0.5	0.3	0.6	0
Harmonization (lack)	P/L	Product requirements (5.4), food safety management systems (5.5)	1.0	0.7	1.0	1.2	0.8	1.5	0
Society	S	Aging (2.1), mobility (2.2), personnel availability (2.12), diversity (2.14), disasters (4.12)	1.0	1.6	1.0	0.6	1.3	0.3	2.0
Climate	Env	Impact on safety (4.4), security (4.5) and drinking water availability (4.6)	0.7	1.2	0.6	0.6	1.3	0.3	1.0
Pressure from the government	P/L	Increasing pressure from government to introduce new methods (5.9), increase of requirements as result of controls by government (5.6), increasing administration and formalities (2.16), complaints about labeling (5.10)	0.6	1.0	0.1	0.6	0.3	0.8	0
Processing technology/ management evolutions	T	Processing technology (3.1)/management evolutions (3.2)	0.6	0.5	1.0	0.4	1.3	0.2	0
Logistics	Ec	Integration (1.5), logistics (1.8)	0.4	0.3	0.1	0.6	1.8	0.2	0
Pressure on the government	P/L	Pressure on administrative simplification (5.7), pressure on GMO management (4.13), influence on regulatory decisions (5.11)	0.3	0.2	0.7	0.2	0.3	0.2	0

<sup>a</sup> PESTLE: Political, Economical, Social, Technological, Legal, Environmental.<sup>b</sup> Numbers between brackets refer to the numbering in Table 1. Pressures (numbers) that are mentioned in Table 2 but not in Table 1 were pressures that were added by the participants as they were invited to add new pressures to the list.<sup>c</sup> Mean score calculated with the scores of the individual participants of the specific group.<sup>d</sup> SciCom: Scientific Committee.<sup>e</sup> FASFC: Federal Agency for the Safety of the Food Chain.<sup>f</sup> Authorities: Federal and Regional authorities except the FASFC (Federal Agency for the Safety of the Food Chain).

Active participation to (inter)national working groups is a response to deal with for example the lack of harmonization. Elaboration of scientific research programs has been noted also to play a role in the response, which was often addressed, in particular by the scientific experts, in relation to participation in expert groups and initiating and performing scientific research. But the response is also extended to other stakeholders by participation to advisory forums, taking interest in, dedicating resources or launching calls to set-up research programs. An important response mentioned in particular by the FASFC is the implementation or adaptation of legislation and the adaptation of control and monitoring programs to the current needs.

Finally, on several occasions the stakeholders reported that no or limited response was possible. This was in particular related to socio-economic aspects and environmental factors which are of a broad and complex nature. It reflects the difficulties expressed by the participants on the fact that they, as an organization or institute, may experience a particular pressure, but may not always be the appropriate stakeholder or actor in the food chain having the competence to act and generate a response.

#### 4. Discussion

The concept to measure and follow up the safety of the food chain in Belgium based on the 'Pressure–State–Response' model was described

by Baert et al. (2011). By comparing the years 2007, 2008 and 2009, it was concluded that the status of the global food safety in Belgium was high. The status of food safety is expected to change continuously, impacted by the other two aspects in the OECD Pressure–State–Response model. The methodology and results of the survey for the measurement of pressure and response impact on the status of the safety of the food chain in Belgium are presented in this manuscript. The PSR framework is originally linked to environmental policy and relates pressures on the environment as a result of human activities, with changes in the state (condition) of the environment (land, air, water, etc.). Society then responds to these changes by instituting environmental and economic programs and policies, in order to reduce or mitigate the pressures or repair the natural resource (OECD, 1993). To the best of our knowledge, the PSR concept has not been previously applied to measure or explore the dynamics of food safety.

The approach taken in the present study using the PSR model provides a solid framework to structure the complex interaction between drivers of food safety, the actual status of food safety as it is and the reactions, response, in turn impacting on food safety. The collection of information on the pressures via a pre-defined list of pressures and the Trial Roulette method for prioritization of pressures as perceived by the participants of the survey also introduced a quantitative aspect in the gathering of knowledge and enabled ranking of the events or factors impacting on the development of food safety.

However, as the present study focused on the national level and was directed to a restricted number of participants, in particular to representatives of the sector organizations, the competent authorities and

experts of the scientific committee of the Belgian Food Safety Agency, the study sample was quite small and further statistical analysis was not performed. The approach taken in the present study using the

**Table 3**

Summary of the received answers regarding the response of stakeholders to react to the pressure on the food chain.

Pressure (theme)	PESTLE <sup>a</sup>	Type of response (codewords)
Financial-economic (incl. relations between operators)	Ec	<ul style="list-style-type: none"> <li>• <i>Communication</i> about issues with authorities/sectors/enterprises</li> <li>• <i>To attempt to achieve crisis supporting measures through consultation</i></li> <li>• <i>To inform and to sensitize</i> about added value, alternative benefits (commercial opportunities), why specific legislation was introduced so that utility is recognized</li> <li>• <i>To give some flexibility to reduce costs for operators</i></li> <li>• <i>Limited/no response</i> (1.9, 1.13, 2.15)<sup>b</sup></li> <li>• <i>To give scientific advice</i> to obtain more uniform quality demands (5.3)</li> </ul>
Complexity legislation	P/L	<ul style="list-style-type: none"> <li>• <i>Participation in working groups</i> (e.g. EFSA<sup>c</sup>, SciCom<sup>d</sup> of the FASFC<sup>e</sup>)</li> <li>• <i>Consultation with authorities</i> (national and European)</li> <li>• <i>To lobby</i></li> <li>• <i>To adapt legislation</i></li> <li>• <i>To inform and to sensitize</i> (to create clarity)</li> </ul>
Media and perception	S	<ul style="list-style-type: none"> <li>• <i>To answer questions</i> (of consumers, parliamentary questions)</li> <li>• <i>To communicate</i> (to inform and to sensitize) with consumers and operators (incl. opinions of the SciCom of the FASFC) via e.g. the media</li> <li>• <i>To develop and to implement an IMS<sup>f</sup></i></li> </ul>
Eating habits	S	<ul style="list-style-type: none"> <li>• <i>To inform operators</i> (incl. training), consumers, inspectors and auditors</li> <li>• <i>Research</i></li> <li>• <i>To adjust the control program</i></li> </ul>
Adaptation/resistance/emerging risks	T	<ul style="list-style-type: none"> <li>• <i>Research</i></li> <li>• <i>To inform oneself</i> (incl. opinions SciCom)</li> <li>• <i>To inform and to sensitize</i> sectors and consumers (incl. opinions SciCom)</li> <li>• <i>To adapt the control program</i> (increased antibiotic resistance analyses)</li> <li>• <i>To introduce/adapt legislation</i></li> <li>• <i>To follow up research and new developments</i></li> </ul>
International trade	Ec	<ul style="list-style-type: none"> <li>• <i>To take into account this pressure in the control programs and controls</i></li> <li>• <i>Research</i> (incl. development of methods)</li> <li>• <i>To guide and to inform operators</i></li> <li>• <i>Limited/no response</i> for 1.3, 1.11, 2.13</li> <li>• <i>Consultation with competent authorities</i> (1.10)</li> <li>• <i>To provide training</i> for students of 3rd world countries (2.13)</li> </ul>
Environment/welfare	Env	<ul style="list-style-type: none"> <li>• <i>To bring more balance in public debate through communication</i></li> <li>• <i>Research</i> (e.g. influence of animal welfare measures on food safety, influence of animal and plant production on environment)</li> <li>• <i>To comply with legislation</i> concerning animal welfare (incl. in research)</li> <li>• <i>Communication</i> with those involved, to put in proper context</li> <li>• <i>Increasing attention</i> for various sustainability criteria</li> <li>• <i>To adapt the control program</i></li> </ul>
Methods of analysis	T	<ul style="list-style-type: none"> <li>• <i>Research</i> on the development of new methods</li> <li>• <i>To communicate</i> about new methods with authorities and sectors</li> <li>• <i>Dialogue</i> with labs about accuracy</li> <li>• <i>Dialogue</i> with authorities about issues of lower detection techniques</li> <li>• <i>Development of monitoring systems</i> for certain hazards</li> <li>• <i>To put pressure on suppliers</i> to deliver adequate test kits</li> </ul>
Harmonization (lack)	P/L	<ul style="list-style-type: none"> <li>• <i>Participation in working groups</i> (e.g. EFSA, SciCom of the FASFC)</li> <li>• <i>Consultation</i> between different actors</li> <li>• <i>To follow international consultations</i> and to attempt to influence</li> <li>• <i>To give advice</i> to authorities and sectors abroad</li> <li>• <i>To tailor the Belgian approach</i> to international evolution</li> </ul>
Society	S	<ul style="list-style-type: none"> <li>• <i>To inform</i> medical staff, operators and consumers</li> <li>• <i>Attention for issues</i> in opinions SciCom</li> <li>• <i>To provide training</i> (2.12)</li> <li>• <i>To bring students into contact with the field</i> (2.12)</li> <li>• <i>No response was possible</i> (4.12)</li> </ul>
Climate	Env	<ul style="list-style-type: none"> <li>• <i>Research</i></li> <li>• <i>To inform oneself</i></li> <li>• <i>To adapt the control program</i></li> <li>• <i>To take measures</i> to reduce water use (dialogue, research)</li> </ul>
Pressure from the government	P/L	<ul style="list-style-type: none"> <li>• <i>Limited response</i> (2.16, 5.10)</li> <li>• <i>Consultation</i> (e.g. via AdvCom<sup>g</sup> of the FASFC)</li> <li>• <i>Training of personnel</i></li> <li>• <i>Consultation with FASFC</i> (5.9)</li> </ul>
Processing technology/management evolutions	T	<ul style="list-style-type: none"> <li>• <i>Research</i></li> <li>• <i>To inform oneself and others</i> (int.a. through starting up of own initiative dossiers, to organize congress)</li> </ul>
Logistics	Ec	<ul style="list-style-type: none"> <li>• <i>To inform operators</i></li> <li>• <i>To adapt legislation</i> to take this pressure into account</li> <li>• <i>Projects that bring short chain to attention</i></li> <li>• <i>Limited response</i> (1.8)</li> </ul>
Pressure on the government	P/L	<ul style="list-style-type: none"> <li>• <i>To follow GMO policy</i></li> <li>• <i>Consultation</i> (e.g. ia AdvCom of the FASFC)</li> <li>• <i>Administrative simplification project was started</i></li> <li>• <i>No response</i> (5.11)</li> </ul>

Trial Roulette method is however an interesting alternative to current procedures on information gathering on “drivers on food safety” and their impact on e.g. emerging risks which currently often rely on open sessions or working groups designed to capture the opinions of experts in a qualitative manner and resulting in a consensus report reflecting the various opinions expressed (EFSA, 2011; Havelaar et al., 2010; Noteborn, Ooms, & de Prado, 2005).

Another aspect in which the present study differs is the inclusion of a wide variety of stakeholders' organizations and food policy makers which may look at the pressures on the food supply chain from a different perspective than the scientific experts. Often discussion groups on drivers of food safety and emerging risks are composed of experts from academia, agricultural or food research institutes or collaborators from risk assessment units of food safety and public health agencies, and although these experts come from a wide variety of food science disciplines there might be a bias in these types of experts to the information that is circulating or the concerns in this predominantly scientific oriented community. As such the present study was different in both including scientific experts and representatives of the food industry and risk managers of the food supply chain. This is to some extent to be noted in the results obtained.

The top 3 pressures that are experienced or perceived by the participants of the survey (at the period of consultation) to act on the food chain are in particular of economic (financial crisis/limitation of resources, price of raw materials), political (complexity of legislation) and social (media and perception of food safety) natures. Also the pressure with the 4th highest score was of social nature, namely eating habits. Only on the 5th place there is a pressure of technical nature relating to emerging risks due to adaptation or increased resistance of biological hazards. From the ranking it is clear that the economic-financial climate drivers have an important impact on the pressures perceived by food policy makers and stakeholders. It is recommended to repeat the measurement of the pressure on a regular basis (e.g. five-yearly) to monitor timeliness and effect of prior (socio-economic) events on pressures experienced or perceived by the stakeholders.

International trade and globalization of the supply chain did not show up as a high ranked pressure in the present study although these are overall acknowledged to have an impact on the status of the safety of the food chain. In general it is accepted that globalization increases the vulnerability of the food supply chain by the introduction and (increased) exposure to established and (re-) emerging food safety issues. “Global change” in all its aspects makes it a challenge to safeguard the quality and safety of the food chain. While consumers benefit from the fresh product variety which is available throughout the year, the complexity of the global chain requires more international collaboration and harmonization of management efforts as well as multidisciplinary research approach to safeguard an acceptable level of food safety. Also companies that operate in a more vulnerable, ambiguous and uncertain situation require a more advanced level of food safety management system to be able to realize and ensure safety requirements (Luning et al., 2009). The measurement of response relates to what we are doing or what can be done about these factors that come from a wide range of spheres and that might impact on the safety of the food chain. It refers to actions adopted by stakeholders in response to the concerns. On some occasions these responses will themselves become pressures e.g. the

complexity of legislation and in turn the pressure perceived by the competent authorities on the simplification of legislation.

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 FASFC, 2005). The reported responses can all be situated to some extent within the 3 sub-domains of risk analysis, namely risk assessment (i.e. participation to working groups and elaboration of research programs), risk management (i.e. legislation, control and monitoring plans) and risk communication (i.e. communication and networking supported by training and capacity building).

All these responses refer to a set of measures that are taken by the stakeholders to react to the pressures, as well as to the current measured state of the safety of the food chain in order to maintain or improve the state. However, it was not elaborated in the ‘Responses’ received during the survey which particular objective or timeline the ‘Response’ was aiming at. Overall, the feedback of the survey participants to the “Response” open questions showed it was difficult to provoke dedicated answers or to acquire detailed response actions. In future surveys it would be recommendable that the above mentioned topics identified as types of response in the present survey are more elaborated in detail and to be taken up in a list of pre-defined responses (as was the case for the pressures) to achieve more quantitative information and potential for ranking of the “Response” aspect in the PSR model.

The rather vague and generic response obtained in the survey which is not directly related to the pressures perceived, may also be contributed to the fact that the participants of the survey were situated at the meso level and macro level of the food chain (GTZ, 2010). The meso level includes all chain-specific actors providing regular support services or representing the common interest of the actual operators or actors. They are represented in the present study by the industrial sector federations, the consumer organizations (both in the FASFC Advisory Committee) and the scientific experts (in the FASFC Scientific Committee). The macro level refers to the public agencies and institutions constituting the business enabling environment. Typically, the macro level of a value chain is made up of national, regional and local governments, the judicial system and major providers of public utilities (e.g. roads and water supply). Thus these refer to the competent authorities (both FASFC and others represented in the Advisory Committee). The reported responses are typical activities of the actors at the meso and macro levels and not of the operators in the food supply chain. However, it would be interesting to include in the survey also the micro level, the actual food business operators in the food chain i.e. individual food processing companies or suppliers to the food chain, which may lead to a different and more defined outcome of relationship between pressure and response.

In conclusion, the level of food safety is dynamic and in order to maintain a high status of the safety of the food chain, continuous efforts are demanded to monitor a variety of factors that act on the food chain (socio-economic changes, politics, technology, environmental issues) and that might impact food safety and lead to emerging issues and need response. The pressure perceived by the stakeholders differs according to the type of stakeholder but was in this survey dominated by the economic-financial climate. The generation of a response to the perceived pressure was shown to be difficult. It is in general summarized as communication, networking, expert panels, research, training, legislation, monitoring and surveillance.

Note to Table 3:

<sup>a</sup> PESTLE: Political, Economical, Social, Technological, Legal, Environmental.

<sup>b</sup> Numbers between brackets refer to the numbering in Table 1.

<sup>c</sup> EFSA: European Food Safety Authority.

<sup>d</sup> SciCom: Scientific Committee.

<sup>e</sup> FASFC: Federal Agency for the Safety of the Food Chain. fIMS: Incident Management System. gAdvCom: Advisory Committee.

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